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Biomechanical Analysis of Ballroom Dancing

Meredith Diane Wells

Georgia State University

ACCEPTANCE

This dissertation, BIOMECHANICAL ANALYSIS OF BALLROOM DANCING, by MEREDITH WELLS, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education & Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

Feng Yang, PhD
Committee Chair

Jianhua Wu, PhD
Committee Member

Madeleine Hackney, PhD
Committee Member

Chris Ingalls, PhD
Committee Member

Pey-Shan Wen, PhD
Committee Member

Date

Leslie Brandon, PhD
Chairperson, Department of Kinesiology

Paul A. Alberto, PhD
Dean, College of Education &
Human Development

AUTHOR'S STATEMENT

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Meredith D. Wells

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Meredith Diane Wells
Department of Kinesiology
College of Education & Human Development
Georgia State University

The director of this dissertation is:

Dr. Feng Yang
Department of Kinesiology
College of Education & Human Development
Georgia State University
Atlanta, GA 30303

CURRICULUM VITAE

Meredith Wells

ADDRESS: 2788 DeFoors Ferry Rd NW
Atlanta, GA 30318

EDUCATION:

Ph.D.	2022	Georgia State University Kinesiology
Master's Degree	2017	Ball State University Kinesiology
Bachelor's Degree	2015	Ithaca College Exercise Science

PROFESSIONAL EXPERIENCE:

2017-present	Instructure - Biomechanics Georgia State University
2017-present	Research Fellow - Biomechanics Georgia State University
2018-2021	Assistant Swim Coach Spartans Aquatic Club
2016-2017	Unit Administrator Ball Memorial Hospital
2015-2017	Research Assistant - Biomechanics Ball State University

PRESENTATIONS AND PUBLICATIONS:

Wells, M. D., Simpkins, C., Yang, F. (2022, August). *External loading during the rock step in three levels of ballroom dancers.*
North American Conference on Biomechanics, Ottawa, Canada.

Wells M. D., Yang, F. (2021, August). *Frontal plane kinematics of the triple step in swing dancers*.

Virtual 45th Meeting of the American Society of Biomechanics.

Wells M.D., Yang, F. (2021, July). *Sagittal plane kinematics of partnered and individual triple steps in swing dancing.*
XXVIII Congress of the International Society of Biomechanics, virtual.

Simpkins C., Ahn J., Wells M.D., Yang F. (2021, July). *Dynamic gait stability during anteriorly loaded treadmill walking.*
XXVIII Congress of the International Society of Biomechanics, virtual.

Wells M. D., Yang, F. (2020, August). *A biomechanical analysis of the triple step in recreational swing dancers.*
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Wells M. D., Geil M., Safaeepour Z., Yang F. (2019, July). *Quantification of vaulting in healthy adults walking with an immobilized knee.*
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Wells M. D., Wang H. (2018, August). *Effect of grade on joint mechanics during downhill running in female distance runners.*
43rd Annual Meeting of the American Society of Biomechanics, Rochester, MN.

Wells M. D., Dickin D., Popp J., Wang H. (2017, August). *Effect of grade on the biomechanics of downhill running in female distance runners.*
42nd Annual Meeting of the American Society of Biomechanics, Boulder, CO.

Wells M. D., Yang F. (2021). Ballroom dance as a form of rehabilitation: A systematic review.
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BIOMECHANICAL ANALYSIS OF BALLROOM DANCING

by

MEREDITH WELLS

Under the Direction of Dr. Feng Yang

ABSTRACT

Ballroom dance has become increasingly more popular in competition, recreation, and rehabilitation settings. However, little is known about its movement pattern from the biomechanical perspective. This knowledge gap could impede the development of approaches for improving dance performance and the successful implementation of ballroom dance into rehabilitation programs. It is also unknown whether the biomechanics of ballroom dance differ between genders given gender-related anatomical differences. The overall goal of this study was to gain a better understanding of the movement patterns associated with ballroom dance movements. Two specific aims were explored in this project: 1) to quantify the kinetics, kinematics and muscle activity for five rhythm ballroom dance elements in professional ballroom dancers compared to recreational and inexperienced ballroom dancers, and 2) to compare the ballroom dance biomechanics between men and women within the three levels of participants. A total of 56 healthy individuals aged 18 to 42 were recruited for this study. Participants performed five rhythm ballroom dance elements – forward/backward step, side step, rock step, triple step, and a spot turn –

both with and without a partner, followed by maximal voluntary isometric contractions at the ankle, knee, and hip. Lower extremity kinetics, kinematics, and muscle activity were collected using a nine-camera VICON motion capture system, two embedded AMTI force plates, and 10 Delsys Trigno wireless EMG sensors. Results from the primary variables illustrated greater external forces and decreased joint power in the inexperienced dance level compared to the more experienced levels, as well as greater joint power for males compared to females. This study expands our understanding of the biomechanical characteristics associated with ballroom dance, and provides a reference for developing approaches to improve dance performance, and improve mobility among various populations.

INDEX WORDS: Ballroom Dance, Partner Dance, Rhythm Dance, Biomechanics

BIOMECHANICAL ANALYSIS OF BALLROOM DANCING

by

MEREDITH WELLS

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LIST OF ACRONYMS

IDSF	International DanceSport Federation
WDSF	World DanceSport Federation
ACSM	American College of Sports Medicine
CDC	Center for Disease Control
AHA	American Health Association
BMI	Body Mass Index
fMRI	Functional Magnetic Resonance Imaging
PD	Parkinson’s Disease
MS	Multiple Sclerosis
MCI	Mild Cognitive Impairment
ROM	Range of Motion
NEW	Inexperienced Dancers
REC	Recreational Dancers
PRO	Professional Dancers
GRF	Ground Reaction Force
EMG	Electromyography
MVIC	Maximum Voluntary Isometric Contraction
TA	Tibialis Anterior
MG	Medial Gastrocnemius
VL	Vastus Lateralis
BF	Biceps Femoris
GM	Gluteus Medius

BSR	Backward Step with Right
BSRP	Backward Step with Right with Partner
FSL	Forward Step with Left
FSLP	Forward Step with Left with Partner
RSBR	Rock Step Back with Right
RSBRP	Rock Step Back with Right with Partner
RSFL	Rock Step Forward with Left
RSFLP	Rock Step Forward with Left with Partner
SSL	Side Step to Left
SSLP	Side Step to Left with Partner
SSR	Side Step to Right
SSRP	Side Step to Right with Partner
ST	Spot Turn
STP	Spot Turn with Partner
TSL	Triple Step Left
TSLP	Triple Step Left with Partner
TSR	Triple Step Right
TSRP	Triple Step Right with Partner
TD	Touchdown
LO	Liftoff
BW	Body Weight

1 THE PROBLEM

1.1 Introduction

Ballroom dance is characterized by fast and dynamic movements performed in pairs, with technical and artistic aspects. Ballroom dance can be practiced by individuals in almost all age groups, from children to seniors ('About DanceSport' 2010). It is swiftly gaining popularity throughout the United States (US) and across the globe. One of the driving forces of such popularity is the competitive version of ballroom dance, DanceSport, which is recognized by both the US Olympic Committee and the International Olympic Committee ('About DanceSport' 2010). The successes of television shows such as “So You Think You Can Dance,” “Strictly Come Dancing,” and “Dancing with the Stars” have also reinforced and strengthened the appeal of DanceSport and has contributed to millions more participating worldwide ('About DanceSport' 2010). This growth is also reflected by the increasing registrations for social and competitive dance memberships across all ages (Lankford et al., 2014).

Another factor that inspires ballroom dance is the physical, mental, and medical benefits of practicing ballroom dance. DanceSport is an activity that combines athleticism and art and allows the participants to develop physical fitness and mental well-being (Lankford et al. 2014). Dance has been widely recognized as a holistic workout, and an improved cardiorespiratory function is an important component of health and physical fitness. Studies have shown that competitive ballroom dancers maintain high aerobic capacities and peak heart rates during competitions, which can strengthen the cardiovascular system (Blanksby and Reidy 1988; Liiv et al. 2013; Liiv et al. 2014). Additionally, the peak heartrate of competitive ballroom dancers during a dance simulation has been found to be similar to that during a maximal test (Liiv et al. 2013; Liiv et al. 2014). Furthermore, there is growing evidence that shows females maintain a higher peak heartrate during ballroom dance, as evidenced by research analyzing dance simulations and static holds, likely due to the difference in the dance frame. Female ballroom dancers have also displayed a lower VO_2Max than male dancers (Vaczi et al. 2016).

Recreational ballroom dance has been classified as a moderate to vigorous form of activity based on the American College of Sports Medicine (ACSM) guidelines (Lankford et al. 2014). Participating in regular recreational ballroom dance has also demonstrated improved resting heartrates and improved cardiac responses to exercise (Gomes da Cruz et al. 2017). In addition, a classroom ballroom dance intervention demonstrated the ability to help children meet the daily moderate to vigorous physical activity recommendations (Huang et al. 2012), as well as to improve muscle architecture in older adult females (Cepeda et al. 2015). Considering the physiological benefits and social characteristics, ballroom dance may be attractive for cardiovascular, as well as general health, improvements in individuals that struggle to adhere to standard exercise programs (Gomes da Cruz et al. 2017).

It is more likely that individuals will continue an exercise program if they perceive some benefit from it. A 2016 study found that participants felt that partnered dance improved their physical fitness and body coordination, helped with focusing for an extended period of time, and improved their memory and ability to learn new things (Lakes et al. 2016). Multiple studies have also reported that partnered dance increased self-confidence in their participants (Lakes et al. 2016; Maraz et al. 2015). Additionally, a previous study indicated that ballroom dance could improve cognitive functioning (Merom, Grunseit, et al. 2016). When typical exercise modalities are less effective in motivating regular exercise, ballroom dance, by its fun, social, and motivating characteristics, could be a form of physical activity with the potential for high compliance among participants. Plus, it may be a promising alternative strategy for combatting sedentary lifestyles (Gomes da Cruz et al. 2017; Lankford et al. 2014).

Due to the physiological benefits and the reported enjoyment, ballroom dance has begun to be used as a tool for improving balance in older adults, as well as in populations of individuals with chronic diseases and disorders. DanceSport movements, such as forward, backward, and sideways stepping, spinning, tip-toeing, heel rising, and turning could all influence muscle strength and movement coordination, and therefore, gait and balance, thereby minimizing the risk of falling (Sohn, Park, and Kim 2018). Several studies documented various ballroom dance-induced health benefits, such as improved postural control (Gomes da Silva Borges et al. 2012; Gomes da Silva Borges et al. 2018; Gomes da Silva Borges et al. 2014; Sohn, Park, and Kim 2018), gait speed (Merom, Mathieu, et al. 2016), and balance (Gomes da Silva Borges et al. 2012; Gomes da Silva Borges et al. 2018; Gomes da Silva Borges et al. 2014). Furthermore, ballroom dance has been related to improved balance, cognition, and/or quality of life among different clinical populations (Wells and Yang 2021a) such as: Parkinson's disease (Allen et al. 2017; Hackney and Earhart 2010; Hulbert et al. 2017; Kunkel, Fitton, et al. 2017; Kunkel, Robison, et al. 2017), multiple sclerosis (Mandelbaum et al. 2016; Ng et al. 2019), spinal cord injury (Masters, Kiratli, and Hong 2013), stroke (Hackney et al. 2012), dementia (Lazarou et al. 2017), and cancer (Pisu et al. 2017; Schmidt et al. 2018).

Despite the growing interest in ballroom dance, little information is available regarding its biomechanics. Compared to ballet or modern dance, which are less popular than DanceSport, the amount of peer-reviewed research about ballroom dance is disproportionally lower (McCabe et al. 2013). There is only one known study that has analyzed the forces and joint loading associated with a ballroom related dance (Wells and Yang 2021b). Yet, it remains largely unknown how the movements involved in ballroom dance load the body segments and joints. This is not a trivial issue, as mounting evidence suggests that ballroom dance injuries, particularly ankle and foot injuries, are prevalent (Domene, Stanley, and Skamagki 2018; Premelc et al. 2019; Wanke, Haenel, and Groneberg 2020). In addition, due to the inherent differences in movements between ballroom dances and other dance forms which have been extensively studied (such as ballet), ballroom dancers may be susceptible to injuries that are not common in other forms of dance (Tsien and Trepman 2001; Tsung and Mulford 1998). Thus, it is crucial to understand the biomechanics behind ballroom dance. Additionally, reported injuries in ballroom dance have indicated that females are at a greater risk of sustaining an injury than males (Domene, Stanley, and Skamagki 2018; Premelc et al. 2019; Tsien and Trepman 2001; Tsung and Mulford 1998; Wanke, Haenel, and Groneberg 2020). Thus, it is meaningful to examine if the biomechanical movement pattern differs between genders since males and females are anatomically different and thus may experience different forces acting on the body.

From the perspective of improving performance or designing an effective ballroom dance training program, it is of interest to examine whether and to what extent the biomechanics of ballroom dance differs among dancers with different degrees of dance experience. For example, if significant or systematic differences are found between groups with dissimilar experience, the biomechanical information from the professional level could be used as a reference to design effective training strategies to facilitate the learning process for those with less experience.

1.2 Research Questions

This project aimed to answer two specific questions.

1) What biomechanical measurements such as forces, loading rate, joint powers, joint moments, joint angles, and muscle activity are present in the key rhythm ballroom dance elements, and how do they change amongst experience levels?

2) Are the biomechanics different between male and female ballroom dancers?

Correspondingly, the hypotheses tested in this study included:

1) The professional dancers' movements would differ from their non-professional counterparts. Specifically, professional ballroom dancers would exhibit lower forces, less joint loading, greater joint angles, and decreased muscle activity during dance performance relative to age- and gender-matched non-professional levels. This was based on the knowledge that professional ballroom dancers generally keep their feet close to the floor and step more precisely.

2) Male dancers will demonstrate different movement patterns compared to female dancers. Such differences could result from the between-gender anatomical differences (Horton and Hall 1989) and the fact that females are generally observed to display flashier movements during rhythm dances.

1.3 Purpose

The primary purpose of this study was to quantify the biomechanics and muscle activity for five common rhythm ballroom dance elements in professional ballroom dancers compared to non-professional dancers, including both recreational and inexperienced ballroom dancers. The secondary purpose of this study was to compare the biomechanics between males and females within each experience level to evaluate any gender-associated differences in movement patterns.

1.4 Significance of the Study

This study helps fill the knowledge gap regarding the movement patterns associated with ballroom dance. The knowledge derived from this study can help the research community gain a comprehensive understanding of the movement patterns in rhythm ballroom dances to improve the performance among individuals. The biomechanics of ballroom dance collected in this study can also help dance educators to identify the possible root causes of faults that arise in particular movements, and achieve the optimal use of their dancers' abilities. Rhythm ballroom dance steps were chosen because the high energy of rhythm/Latin dances led us to believe that there would be a greater potential for injury associated with rhythm dances compared to standard/smooth dances. Additionally, there is less research available regarding the biomechanics of rhythm dances compared to smooth dances.

In addition, it may provide insight into the mechanism of ballroom dance as an intervention to improve body balance and reduce fall risk from the biomechanical perspective. Dance is a complex sensorimotor rhythmic activity integrating multiple physical, cognitive, and social elements (Gomes da Silva Borges et al. 2012; Gomes da Silva Borges et al. 2014). It is critical that, prior to recommending this activity to different populations, we understand the joint loading associated with ballroom dance. Studies on other dance forms indicate that dance movements require high joint moments (Wild, Grealish, and Hopper 2017), which represent stimulation on the body and may aid in strengthening muscles. Our results may support ballroom dance as an intervention to reduce the risk of falling. This study helps deepen our scientific understanding of the biomechanics of ballroom dancers. Therefore, this study is significant because the learned information may improve dance performance and provide health benefits to healthy and clinical populations (Wells and Yang 2021a).

1.5 Assumptions and Limitations

Limitations for this study were related to participants' age and their dance experience, the footwear, the dance environment, the elements chosen and muscles selected, and the significance level identified.

The USA Dance Rulebook has defined multiple age brackets for competition ranging from pre-teen (9th grade and younger) to senior V (75 years and older). Thus, the selected age range (18 – 45) may compromise the generalizability of the findings. Yet, it was predicted that most currently competitive professional ballroom dancers likely fall between the ages of 18 and 45, which will give us the most representative picture of the ideal biomechanics for rhythm dance elements. As the first attempt to characterize the biomechanics of ballroom dance, there are no guidelines for selecting the dance experience of professional dancers in terms of years of dance practice. This may cause variability in their experience and lead to confounding effects. However, professional dancers currently competing are likely near similar ability levels, despite potential differences in years of experience.

Participants were provided identical athletic socks to standardize the footwear and eliminate the possibility of differences due to non-uniform footwear. However, most female ballroom dancers practice and perform in dance heels, which may alter the biomechanics slightly.

This study was conducted in a controlled laboratory setting and participants performed the five dance elements discretely. This may reduce generalizability of the findings to real-life dance situations. However, each dance element was preceded by a leading dance step to mimic the momentum that occurs in the livelier dances, to reduce the effects of the discrete elements.

The movements chosen for this study are the key elements that make up almost all rhythm dances, but they do not exhaust all ballroom dance movements. Consequently, the results from this study may not be representative of all rhythm dance movements, but it will provide a good understanding of the biomechanics of a few of the key rhythm ballroom dance elements. It will also lay the groundwork for future studies to analyze other movements.

As the initial effort to examine the biomechanical features of ballroom dance, we have no reference for which muscles are the most active in ballroom dance. We chose to analyze five muscles based on the nature of the movements of interest in this study (i.e., Tibialis Anterior, Medial Gastrocnemius, Vastus Lateralis, Biceps Femoris, and Gluteus Medius) bilaterally as a starting point for future studies.

In addition, the shear GRF in the anterior-posterior and medial-lateral directions were not analyzed. Balance was also not directly measured in this study. These variables were excluded in an effort to reduce the number of outcome variables examined during this project.

Finally, the significance level cut-off identified for this study was $\alpha < 0.05$, which may not have been sufficient for detecting the differences among groups and between genders. Thus, future studies should be conducted with greater sample sizes, and the effect size should be calculated to provide more comprehensive information for the interpretation of the results.

1.6 Overview of the Study

Ballroom dance is growing in popularity internationally. The increased popularity is due to various factors such as the competition and entertainment aspects and the increasing appearance on stage and television, the physical and cognitive benefits, and the fun and social aspects. However, little information is available regarding the biomechanics behind the ballroom dance elements. This has limited the ability of researchers and dance instructors to design training protocols that may improve performance while also minimizing the risk of injury. In addition, ballroom dance may serve as an ideal exercise solution for individuals who struggle to adhere to or have conditions that prevent them from participating in a traditional exercise program. The additional knowledge regarding the kinetics, kinematics, and muscle activity of ballroom dance elements gained from this study will aid in improving performance and enhancing the quality of life in different populations.

2 REVIEW OF THE LITERATURE

2.1 DanceSport

DanceSport is the competitive form of ballroom dance with monetary winnings and world rankings (McCabe et al. 2013). The International DanceSport Federation (IDSF) was founded in Germany in 1957 ('About DanceSport' 2010). In 1997, the IDSF was officially recognized by the International Olympic Committee as the representative body for DanceSport, and DanceSport became eligible to be included in the Olympic Program. In 2008, IDSF entered into a formal agreement with the International Paralympic Committee to develop Wheelchair DanceSport. Three years later, the International DanceSport Federation changed the name of the organization to the World DanceSport Federation – or WDSF ('About DanceSport' 2010).

2.1.1 DanceSport Styles

DanceSport includes many different styles, such as Acrobatic rock n' roll, Disco, Hip Hop, Latin, Rhythm, Salsa, Smooth, Standard, Stage dance, and Wheelchair. Among the various disciplines are American Smooth and American Rhythm, and International Latin and International Modern/Standard. However, American Smooth and American Rhythm are only performed in the United States (US). American Smooth dances are the Waltz, Foxtrot, Tango, and Viennese Waltz, and Standard dances include the Waltz, slow Foxtrot, Tango, Viennese Waltz, and the Quickstep. These dances are generally more formal and versatile, making them harder to master than the Rhythm or Latin dances. American Rhythm includes the Cha-Cha, Rumba, Swing, Bolero, and Mambo, while International Latin consists of the Cha-Cha, Rumba, Samba, Paso Doble, and the Jive. Though similar, International Latin and Rhythm have differing styling and dance figures. The heritage of these dances in Latin American, Hispanic, and American cultures gives them each a distinct trait, but they coincide in the expressiveness, intensity, and energy they exhibit ('About DanceSport' 2010).

2.1.2 DanceSport Competition Categories

DanceSport is open to individuals of all ages, making it a truly timeless event. Competition categories include Juvenile I for children under nine years old and younger, Juvenile II for children under 11 years old, Junior I for children under age 13, Junior II for adolescents under age 15, and youth for adolescents under age 18, as well as Adult for individuals 19 years or older, Senior I for individuals 35 years and older, Senior II for individuals 45 years and older, and Senior III for individuals 55 years and older ('About DanceSport' 2010). Along with age categories, there are many different DanceSport competition classifications such as Professional, Rising Star Professional, Pro/Am, Amateur, Championship, Novice, Adult, Youth, etc. The ten-dance competition includes all of the dances from Standard and International Latin. The nine-dance competition contains all of the dances from the American Smooth and American Rhythm (McCabe et al. 2013).

2.1.3 The Performing Athlete

Sport has been defined by the European Sports Charter as “all forms of physical activity which, through casual or organized participation, aid at improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels.” Adhering to the wording, WDSF defines DanceSport as “the activity that combines sport and dance, and that allows the participants to improve physical fitness and mental well-being, to form social relationships and to obtain results in competition at all levels…” ('About DanceSport' 2010). Though ballroom dancers are ranked based on artistic performance and technique, the physiological and psychological demands are great (Koutedakis and Jamurtas 2004). Because of this, competitive dancers are often referred to as performing athletes (Koutedakis and Jamurtas 2004).

Dance has been widely recognized as a holistic workout. Dance is capable of combating obesity in adolescents just as well as it can reduce solitude among the elderly ('About DanceSport' 2010). Research by McNitt-Gray has shown that couples performing the Jive reach foot speeds up to 24 km/hour and can spin at a rate of 180 revolutions per minute, and muscular exertion and breathing rates of top dancers performing Latin and Standard dance routines can equal those of elite 800-meter runners (McNitt-Gray, as cited by WDSF). Dance competitions and tournaments, extending over several rounds of multiple dances each, require high energy expenditure at both aerobic and anaerobic levels with minimal recovery. However, dancers are challenged to look elegant and graceful at all times, so physical exertion often goes unnoticed. Dance is one of the most complete cardiovascular and aerobic workouts, and is mentally engaging and physically demanding. As such, dance produces excellent results in individuals of all ages, from children to older adults ('About DanceSport' 2010).

DanceSport is an activity that combines athleticism and art and allows the participants to develop physical fitness and mental well-being (Lankford et al. 2014). Dancers must be experts in aesthetics and technique, psychologically prepared to handle the stress, injury-free, and physically fit (Koutedakis and Jamurtas 2004). Physical fitness can be defined as an individual's ability to meet the physical demands of a specific task (Koutedakis and Jamurtas 2004).

2.2 Exercise Physiology and Health Effects of Dance

Improved cardiorespiratory function is recognized as an important component of health and physical fitness. The ACSM, the Center for Disease Control and Prevention (CDC), and the American Heart Association (AHA) have published recommendations for aerobic activity necessary for the prevention and management of chronic diseases (Garber et al. 2011). Studies have shown that regular physical activity aids in cardiovascular function and overall health and well-being (Gomes da Cruz et al. 2017). Sports are typically researched as forms of physical activity for practical application of the activity recommendations (Lankford et al. 2014). However, despite health benefits from engaging in regular physical activity and exercise, there is a high rate of inactivity in the population (Gomes da Cruz et al. 2017). When typical exercise modalities are insufficient at motivating regular exercise, ballroom dance, by its fun, social and motivating characteristics, appears to be a form of physical activity with the potential for high compliance among participants and may be an alternative strategy for combatting sedentary lifestyles (Gomes da Cruz et al. 2017; Lankford et al. 2014).

Recreational ballroom dance can be done with little training and is frequently enjoyed in the company of several participants, which may help to explain the increased popularity in recent years (Lankford et al. 2014). However, controlling the exercise intensity during dance can be a challenge as instructors aim to teach motor patterns rather than focusing on the physical fitness of the participants (Gomes da Cruz et al. 2017). Yet, it can be argued that the physical demands placed on dancers during choreography make physical fitness as important as skill development (Redding and Wyon 2003). Therefore, it is important to understand the physiological effects that result from ballroom dance.

2.2.1 Exercise Physiology and Competitive Ballroom Dancing

Several studies have analyzed the cardiovascular effects of ballroom dance in competitive DanceSport athletes. Blanksby and Reidy (1988) sought to determine the energy requirements for both competitive Modern and Latin American ballroom dance from telemetered heart rate while dancing simulated competitive sequences and relating it back to VO_2. Ten ballroom dance couples participated in their study. Couples danced either Modern or Latin American dance sequences with 15 to 20 second breaks between dances in order to simulate a real-life competition scenario. Couples then changed costumes and rested for another thirty minutes before dancing the second sequence of dances. Males in this study displayed a mean heart rate of 170 beats per minute for Modern and 168 beats per minute for Latin American putting them at 86 percent and 85 percent of their max heart rate, respectively, while females displayed a mean heart rate of 179 for Modern and 177 for Latin American, which was 89 percent and 91 percent of their max heart rate respectively. Therefore, competitive ballroom dance would be considered a vigorous activity requiring the cardiovascular system to work in its peak zone (Blanksby and Reidy 1988). A slightly higher VO_2 was observed during the Latin American dance sequence, which could be due to the greater variation in movement patterns that occurs in Latin dances compared to Modern dances. Additionally, females required lower absolute values of oxygen than males, which can be explained by females having a lower VO_2 max compared to males (Blanksby and Reidy 1988).

A 2014 study aimed to determine international level DanceSport dancers' aerobic capacity during an incremental test and during a competition simulation as it relates to gender, dance style, and international rank (Liiv et al. 2014). The study included 30 couples, all of which were ranked in the top six percent of DanceSport athletes in the world. Of the couples, 12 danced Standard, seven danced Latin American, and 11 competed in Ten Dance. Participants' maximum oxygen consumption and aerobic power were measured during a VO_2 max test on a treadmill until exhaustion. A week later, dancers performed a competition simulation in costume while heartrate and lactic acid were measured. Standard and Latin American disciplines performed three rounds of five dances while Ten Dance couples danced two rounds of 10 dances. Participants also had their body composition measured via a DXA scan.

The male dancers had greater VO_2 max results, faster treadmill speeds, and greater post treadmill lactic acid than the females. Latin American dancers displayed higher average heartrates than the Standard dancers in each of the three rounds compared to the same gender. Standard dancers generally performed below the aerobic threshold intensity, while the intensity of Latin American and Ten Dance performers was above the aerobic threshold. During the entire dance simulation, the average heartrate compared to heartrate at aerobic threshold was higher in female Latin dancers than female Standard or Ten Dance performers. Additionally, when compared in the same dance and same round, there were no significant differences between male and female heartrate in all ten dances. Latin American dances were observed to be physiologically more intense than Standard and Ten Dance, as illustrated by the higher heart rate values. This may be due to the Latin American dance style being more energetic compared to Standard dances. Additionally, the VO_2 max values of the DanceSport athletes were found to be greater than what has been previously seen in ballet, modern dance, flamenco, and folk dancers (Liiv et al. 2014).

As we have seen from the previously discussed studies, ballroom dancers maintain a high aerobic capacity and peak heart rate during competition simulations (Liiv et al. 2013; Liiv et al. 2014). It is important to note that in Standard dances the male and female frequently dance in a closed position, so partners mirror each other's steps. The idea is that the path and travel distance during the dance steps are the same for both the male and the female, otherwise, the hold position becomes disrupted, which compromises the artistic appearance. If this is the case, the absolute step rate, length, and speed, all of which affect the exercise intensity, should be the same. However, male ballroom dancers have been seen to have higher cardiorespiratory capacities than females (Liiv et al. 2013; Liiv et al. 2014). This would suggest that the conditioning status of the female partner would be the limiting factor in the overall dance performance in ballroom dance (Vaczi et al. 2016). A particular feature that differentiates the technique in Standard ballroom dances is that the male will maintain an upright head and upper body position, while females will have significant lateral flexion and hyperextension of both the neck and trunk, which increases the aesthetic appeal of the dance. This technique requires isometric contractions in the upper body muscles, which may increase the energy demand placed on the female partner (Vaczi et al. 2016).

Therefore, Vaczi and colleagues (2016) analyzed the physiological responses of 10 amateur DanceSport competitors during a maximal test, a simulated competition, and while maintaining a stationary hold over three different sessions (Vaczi et al. 2016). Maximum cardiorespiratory capacity was determined using a graded treadmill test. The simulation consisted of one round of five Standard dances, performed in costume and competition shoes, lasting two minutes with 15 seconds rest between each dance, with the dances being performed in the following order: Waltz, Tango, Viennese Waltz, slow Foxtrot, and Quickstep. Heartrate was measured during the simulation, and lactate levels were measured immediately following. In the final session, couples were asked to stand in a stationary closed position with the hold they would maintain for the Waltz with the same timing and rest sequence as the dance simulation.

Results showed that the males' peak heartrate was lower than the females' during each of the three scenarios. In addition, when genders were combined, the peak heartrate during the dance simulation was similar to the peak heartrate during the max test, but the peak heartrate during the static hold was significantly lower. Peak heartrate during the static hold was also significantly greater for females than males, and the VO_2 max was significantly greater for males than females, but gender did not appear to affect the lactate responses in any of the conditions.

Lastly, the ratio of heart rate during the dance simulation and the static hold compared to the max test was significantly smaller for males than for females. These results provide evidence that the difference in hold position may be responsible for the greater relative intensity for the female partner due to increased activation of the core and upper body muscles (Vaczi et al. 2016).

2.2.2 Exercise Physiology and Recreational Ballroom Dancing

In addition to competitive DanceSport athletes, it is important to understand how ballroom dance affects the body when performed recreationally. Accordingly, one study sought to determine the energy requirements of several forms of recreational ballroom dance using a portable metabolic system (Lankford et al. 2014). This study included 24 recreational ballroom dancers – 12 males and 12 females, with an average of 51 months and 61 months of experience, respectively. Participants performed the Waltz, Foxtrot, Swing, Cha-Cha, and Swing (again) for four minutes each with a two-minute rest period between each dance. This study revealed that the energy expenditure of the lead dancer (male) was significantly related to the energy expenditure of the following dancer (female). The Waltz and the Foxtrot had an average energy expenditure of 5.3 METS, classifying them as moderate-intensity based on ACSM guidelines (ACSM). The Cha-Cha had an energy expenditure of 6.4 METS, and Swing had an energy expenditure of 7.1 METS, classifying them as vigorous-intensity. Results of this study indicate that recreational ballroom dance may be used to meet the aerobic intensity component of activity guidelines set out by ACSM, the CDC, and the AHA (Lankford et al. 2014). Although the duration of ballroom dance is dependent upon the length of songs, modifications may be made to meet ACSM guidelines. Therefore, recreational ballroom dance may lead to cardiorespiratory adaptions for improving aerobic fitness due to its higher intensity, which may further yield improved fitness levels and reduced risk for disease (Lankford et al. 2014). In addition, because lead energy expenditure was significantly correlated with follow energy expenditure, partnering with a more active or experienced individual may increase the exercise intensity, thereby providing increased health benefits (Lankford et al. 2014).

Another study assessed the physiological effects of ballroom dance by analyzing resting heartrate, and heart rate recovery (Gomes da Cruz et al. 2017). Participants included 25 males using ballroom dance as their primary form of exercise three to five times per week for the past six months and 25 males that were sedentary or insufficiently active for the past six months. Participants completed a submaximal exercise test on a treadmill where initial heartrate was collected following the warm-up, and again during each minute of the five-minute recovery once the participants reached 85 percent of their predicted max heartrate. Results showed that participants in the dance group had a lower baseline heartrate, a lower heartrate immediately prior to starting the treadmill test, and were able to continue the test for a longer period of time compared to the sedentary group. Both groups achieved the same maximum heart rate, but the dance group showed a quicker heartrate recovery, illustrating that practicing ballroom dance regularly is associated with positive changes in resting heartrate and improved cardiac responses to exercise. Additionally, the ballroom dance group did not practice dancing at a controlled intensity, which shows that even when intensity is not controlled, there are beneficial physiological changes that occur from ballroom dancing regularly. Additionally, the greater tolerance to submaximal activity demonstrated by the ballroom dance group is an indicator of greater overall cardiorespiratory fitness. This is an indication that ballroom dance may be an acceptable alternative to typical exercise modalities, and may help reduce cardiovascular risk (Gomes da Cruz et al. 2017). Understanding physiological adaptations in both recreational and competitive ballroom dancers provides insight for those interested in dancing for fun, as well as those with a competitive side.

In addition to the positive health effects that ballroom dance can have for recreational and competitive young adult dancers, ballroom dance can also benefit young and elderly individuals alike. Healthy People 2010, a national health promotion and disease prevention initiative, identified a minimum of 30 minutes of moderate physical activity for five or more days each week and 20 minutes of vigorous activity for at least two days a week as the goal for children and adolescents in order to promote cardiorespiratory fitness (Health and Human 2000). A New York City elementary school classroom-based ballroom dance program sought to determine if students taking part in ballroom dance classes could achieve these recommendations for physical activity. Participants were fourth- and fifth-grade students that participated in a ballroom dance program conducted over a 10-week period, and taught by professional ballroom dance instructors. The intervention focused on Rumba, Swing, Tango, Waltz, and Foxtrot. Additionally, the curriculum utilized was a standard curriculum aimed to nurture respect, teamwork, confidence, and joy. Results from the study found that 14 percent of the children improved their BMI, and none moved to a category of greater risk. Additionally, based on collected heartrate data, students that participated were able to achieve physical activity recommendations. These results support the idea that ballroom dance classes can be sufficient in providing the necessary moderate to vigorous physical activity that children need each day (Huang et al. 2012).

Another ballroom dance intervention also saw improvements in muscle architecture in older adult females (Cepeda et al. 2015). Aging is associated with decreased muscle mass and diminished strength due to decreased physical activity. Therefore, this intervention sought to determine the effects of a ballroom dance program on muscle architecture parameters of the lower extremity in older women (Cepeda et al. 2015). The intervention consisted of three moderate-intensity dance sessions each week for eight weeks in which four rhythm dances were taught by a professional instructor. Dependent variables included a six-minute walk test, Tinetti test, timed up-and-go test, dual-task timed up-and-go test, and cross-sectional area of the Vastus Lateralis, Tibialis Anterior, Biceps Femoris, and Medial Gastrocnemius muscles. Following the eight weeks, it was observed that there was an increase in thickness of all four muscles, increased pennation angle of the Vastus Lateralis, Biceps Femoris, and Medial Gastrocnemius, and increased fascicle length of all four muscles. Additionally, the dance group improved in all of the functional tests. These results indicate that ballroom dance training aids in muscular changes that may in turn improve functional movements in older adults.

Considering the physiological benefits and social characteristics, ballroom dance may be attractive for cardiovascular, as well as general, health improvements in individuals, particularly those that struggle to adhere to standard exercise programs (Gomes da Cruz et al. 2017).

2.3 Motives for Dancing and Psychological Effects

Dancing can provide a strenuous yet enjoyable form of exercise that improves fitness and also encourages an active lifestyle (Lu, Wang, and Zhou 2018; Maraz et al. 2015). This is particularly true in populations that may have difficulty participating in traditional forms of exercise, such as those with chronic health problems (Wells and Yang 2021a). Dancing is also linked to music and requires the physical closeness of a partner, which is different from most other exercise activities (Maraz et al. 2015). Beyond a good workout, dance involves emotion, social interaction, sensory stimulation, motor coordination, and music, and as such has been deemed more enjoyable and thus more sustainable over longer periods of time (Lakes et al. 2016). It is clear that ballroom dancing has benefits on physiology and overall health, however, it is also important to understand the psychological effects.

2.3.1 Cognitive Benefits of Ballroom Dancing

Changes in brain activity of ballroom dancers have been reported (Lu, Wang, and Zhou 2018). Functional magnetic resonance imaging (fMRI) was used to examine the resting-state functional activity in professional ballroom dancers compared to novice individuals with no dance experience. It was reported that the ballroom dancers had increased brain activity in areas associated with perception and movement control, and audiovisual processing and memory (Lu, Wang, and Zhou 2018). There was also increased activity in the primary motor cortex, which is responsible for motor performance, action memory, motor skill learning, and motor control, in the professional ballroom dancers compared to the control participants (Lu, Wang, and Zhou 2018). These findings indicate that ballroom dance, a relatively new and unique form of physical activity, is related to the cortical plasticity of the sensorimotor system (Lu, Wang, and Zhou 2018).

Simple motor skills, such as running, are predictable and involve less goal-directed movement. However, complex motor skills, like ballroom dance steps, incorporate high levels of coordinated body movements that require learning and practice, which may have a greater impact on cognitive processes (Merom, Grunseit, et al. 2016). For this reason, a group of researchers sought to find out how cognitive abilities changed in two groups of older adults after either a walking or a ballroom dancing intervention (Merom, Grunseit, et al. 2016). The dance group participated in one hour-long, bi-weekly dance classes for eight months learning a variety of dances, including the Foxtrot, Waltz, Salsa, and Rumba. The walking group walked the same number of hours per week for eight months. Physical and cognitive assessments were conducted before and after the eight-month intervention. Following the intervention period, the dance group was seen to improve in visuospatial learning, visuospatial delayed recall and executive function response inhibition supporting the idea that ballroom dance may help to improve cognitive skills in older adults.

2.3.2 Motivation for Ballroom Dancing

It is more likely that individuals will continue an exercise program if they perceive some kind of benefit from it. Thus, dance-based interventions may lead to a low attrition rate or a high adherence rate. So, an investigation into dancers' perceptions of the physical, cognitive, affective, and social benefits of different forms of partnered dance in a population of healthy adults was conducted via a survey (Lakes et al. 2016). Results indicated that the preferred forms of dance were swing dance and ballroom dance, and the preferred partner for most were friends and significant others. Most of the participants reported feeling that dance improved their physical fitness, body coordination, and helped with focusing for an extended period of time, as well as improving memory and the ability to learn new things. Results were also associated with a reduced risk for dementia. This ties into the improved cognitive functions reported by other studies (Merom, Grunseit, et al. 2016; Lu, Wang, and Zhou 2018). Additionally, most participants agreed that partnered dance improved their comfort in making eye contact, physical contact with others, social interpersonal skills, self-confidence, and helped decrease nervousness in social situations. However, results did indicate that dancing over a longer period of time was associated with greater perceived social benefits. The primary motivation for dancing was to have fun. Lifelong participation in physical activity is vital for sustained physical and mental health, and results from this study illustrate that dancing is an enjoyable activity that individuals are willing to continue (Lakes et al. 2016).

Another study sought to discover the motivation behind social-recreational dancers participation in ballroom dance, and to determine the differences in motivation between gender and level of dance activity through an online 51-item Dance Motivation Inventory (Maraz et al. 2015). The strongest motivator overall was mood enhancement, followed by self-confidence. Women were more likely to dance for fitness, mood enhancement, self-confidence, and escapism than men, who were primarily motivated by intimacy. This study observed social and physical contact to be as important as improving skills when it came to the frequency of dancing. The authors concluded that dancing is a popular form of exercise and can lead to decreased anxiety, increased self-esteem, and improved psychological well-being (Maraz et al. 2015).

Both Lakes and colleagues (2016) and Maraz et al. (2015) found that partnered dancing increased self-confidence in their participants. Similarly, ballroom dance may improve body image. Ballroom dance is a sensorimotor activity that integrates skills including rhythm, synchrony, balance, coordination, and spatial sense (Fonseca et al. 2014; Lu, Wang, and Zhou 2018). Ballroom dance steps are sequences of predetermined movements that vary in rhythm and characteristics and are performed in pairs. Moving with a partner to a musical rhythm, combined with the fluidity of dancing, also requires being aware of one's own body, the body of your partner, and the ballroom space. Thus, the goal of this study was to analyze the influence of dancing on the body size perception of ballroom dancers (Fonseca et al. 2014). Thirty participants were split into two groups – a beginner ballroom group and a control group. The ballroom group participated in 12 classes, each lasting 90 minutes, taught by two instructors. Body image was measured using the Image Marking Procedure, which evaluates the sense of touch at particular points on the body while the participants are blindfolded. In the control group, a pre-post comparison showed a 22 percent decrease in the number of individuals with appropriate body size perception, while the ballroom dance group showed a 40 percent increase in appropriate body size perception. Therefore, ballroom dance may have positive effects on body perception, which could be due to the attention and awareness that is required when learning new dance steps (Fonseca et al. 2014).

2.3.3 Competitive Ballroom Dancing and Stress

The mood has been regarded as one of the most significant psychological functions (Zajenkowski, Jankowski, and Kolata 2015). Researchers aimed to determine mood changes in recreational and competitive dancers doing basic training, and competitive dancers participating in a competition using the UWIST Mood Adjective Check List (Zajenkowski, Jankowski, and Kolata 2015). This study used a model that assessed tense arousal (tension and nervousness vs. relaxation and calm), energetic arousal (vigor and energy vs. fatigue and tiredness), and hedonic tone (pleasantness vs. unpleasantness). Results showed that recreational dancers, competitive dancers during training and competitive dancers during competition did not differ in hedonic tone before dancing, but recreational dancers after dancing increased hedonic tone, while the hedonic tone in competitive dancers competing decreased, and it was unchanged in competitive dancers training. Tense arousal was higher in all groups before dancing compared to after dancing, but tense arousal was higher in competing dancers than in training competitors and recreational dancers. Before dancing energetic arousal was higher in competitive dancers preparing to compete than in recreational dancers, while after dancing recreational dancers showed higher energetic arousal than competing dancers.

Higher hedonic tone scores reflect optimism and happiness, while lower scores reflect sadness and depression. The increase in hedonic tone after dancing in the recreational group is consistent with the notion that recreational dancing improves the sense of well-being and decreases depression. Hedonic tone decreased significantly following a competition which suggests that hedonic tone is an identifier in stressful experiences, indicating that social evaluation and competition may increase stress levels. Tense arousal decreased in all groups, which suggests that ballroom dance still places physical demands on participants, as tension is shown to decrease following vigorous and intense exercise. Interestingly, the changes in energetic arousal in the group of recreational and competing dancers were in opposite directions. Recreational dancers reported an increase in energy following dancing, while competing dancers reported a decrease in energy. Changes in energy are consistent with the notion that moderate physical activity improves energy, while vigorous activity is usually associated with more fatigue. Researchers concluded that mood changes differ depending on the situation and that generally, recreational dance produces the most positive changes in mood (Zajenkowski, Jankowski, and Kolata 2015).

Regular physical activity and exercise help to reduce stress and its negative consequences (Strahler and Luft 2019). However, the positive effects of regular physical activity, including ballroom dance, may not apply to all intensities of physical activity. Competitive sports lead to heightened stress, exhaustion, and injury (Strahler and Luft 2019). Competitive ballroom dance is not only physically demanding but social-evaluative as well, which places increased psychological demands on the individual (Berndt et al. 2012; Strahler and Luft 2019). Acutely, stress invokes the body's fight or flight response, leading to physiological responses such as increased heart rate, shallow breathing, and tightened muscles. This means that under prolonged stress, the body is constantly activated, which leads to exhaustion (Strahler and Luft 2019). Additionally, stress has been linked to serious disease (Strahler and Luft 2019).

Strahler and Luft (2018) aimed to identify the stress response in competitive elite sports using a professional ballroom dancer monitored over an eight-month period. The subject was a 25-year-old international-level female ballroom dancer who provided information on mood, stress, and fatigue. The dancer's chronic stress level was moderately higher than the average individual, while their health-related quality of life was within the average range, and physical activity scores were considered high. This case study illustrated that psychological stress is related to a reduced sense of well-being and a deterioration in mood. Additionally, ballroom dance competitions were a major biological stressor. Interestingly, there did not appear to be any adjustment to competition, indicating that competitive ballroom dancers experience chronic stress, resulting in wear and tear on the body and exhaustion. However, the athlete did show a great ability to recover from stress when the stressor was removed (Strahler and Luft 2019).

Competitive ballroom dancers have self-reported a higher susceptibility to the common cold and other diseases (Berndt et al. 2012). Therefore, the stress response in athletes was studied with the goal of discovering potential mechanisms that may lead to higher disease susceptibility in healthy, young athletes. This study included a group of experienced ballroom dancers and a group of regularly active controls that provided blood and saliva samples to assess stress and inflammatory parameters. Researchers revealed that competitive ballroom dancers illustrated evidence of hypoactivity in their stress systems and peripheral inflammation, as well as self-reported physical ailments. These results indicate that competitive ballroom dance is a chronic stressor that has the potential to lead to negative outcomes.

Another group of researchers conducted five different studies all assessing cortisol levels in competitive ballroom dancers (Rohleder et al. 2007). The first study analyzed the effects of a real-life ballroom dance competition on the stress response. The second study looked at whether the stress response was due to the physical strain of competition. Study three looked at whether or not the stress response to competition habituated over time. The fourth study analyzed differences in stress response based on the focus of the dancers. Lastly, the fifth study examined a real-life competition compared to a laboratory setting. Following these studies, it was determined that ballroom dance competition is a stressor that elicits a strong psychophysiological threat response, as illustrated by cortisol levels. It was further shown that this stress response is not based on the physical strain of dancing. This stress response also does not habituate across competitions, but is dependent on how focused the individual is, and there is a much greater stress response in real-life than when in a laboratory setting (Rohleder et al. 2007). The lack of habituation shown in this study is consistent with the results found by Stahler and Luft in their 2019 study. The chronic stress of competition may lead to negative health outcomes. However, it is unknown whether there is a direct link between this stress and future disease (Berndt et al. 2012).

2.4 Ballroom Dance and Balance in Older Adults

Developments in medical and science fields have been accompanied by a growth in the elderly population who are at an increased risk of falling (Merom et al. 2013; Sohn, Park, and Kim 2018). Falls are a leading cause of premature death, bone fracture, head injury, and admittance to long-term care facilities (Sohn, Park, and Kim 2018). However, research on specific fall prevention exercises has been minimal (Merom, Mathieu, et al. 2016). Dance is a complex sensorimotor rhythmic activity that integrates many physical, cognitive, and social elements, which may help to alleviate fall risk factors (Merom, Mathieu, et al. 2016). DanceSport movements, such as forward, backward, and sideways stepping, spinning, tip-toeing, heel rising, and turning, could all influence muscle strength and, therefore, gait and balance, thereby minimizing the risk of falling (Sohn, Park, and Kim 2018). For this reason, several studies have aimed to determine if ballroom dance may help improve overall balance and help reduce fall risk in older adults (Sohn, Park, and Kim 2018).

One research group (Sohn, Park, and Kim 2018) analyzed 15 older adults enrolled in a 15-week DanceSport program. Classes lasted for 50 minutes three times each week. Participants were taught the Rumba, Cha-Cha, and the Jive. Following the program, significant improvements in both standing and walking balance were seen, suggesting that DanceSport training may help older adults improve their neuromuscular response to control lower extremity muscles, leading to enhanced postural stability (Sohn, Park, and Kim 2018).

Another study examined the effects of either a ballroom dance or a folk dance intervention on the physical activity and fall risk in older adults compared to a control group (Merom, Mathieu, et al. 2016). For this study, dance classes were one hour long, twice a week, for a total of 80 hours over 12 months, while the control group was instructed to continue their normal activities. The results from this study reported that participants in the control group increased their time spent in planned exercise by 18 minutes, and increased incidental physical activity by 113 minutes, whereas participants in the dance groups increased planned exercise by 110 minutes and increased incidental physical activity by 142 minutes. Although non-significant, ballroom dance participants with high attendance showed the lowest incidence of falls over the 12 months. Ballroom dancers also improved gait speed by approximately 0.07 m/s from pre- to post-intervention, while the other two groups did not show significant changes in gait speed.

Gomes de Silva Borges and colleagues conducted three studies analyzing the effects of a ballroom dance intervention with older adults (Gomes da Silva Borges et al. 2012; Gomes da Silva Borges et al. 2018; Gomes da Silva Borges et al. 2014). The first study analyzed the effect of a ballroom dance program on functional autonomy and postural balance of elderly individuals (Gomes da Silva Borges et al. 2012). The experimental group participated in a ballroom dance program that was 50 minutes three times each week and lasted for eight months. Dances taught included the Foxtrot, Waltz, Rumba, Swing, Samba and Bolero. The control group was instructed to continue their regular activities. Functional autonomy was assessed using the GDLAM index, which consists of 5 tests – 10m walk, standing from a seated position, standing from a prone position, standing from a chair and walking around, and putting on and removing a shirt. Results illustrated a significant improvement by the dance group in all of the tests, while the control group did not improve in any of the tests. Plus, the experimental group performed significantly better compared to the control group.

The later study analyzed the effects of ballroom dance in a group of older adults suffering from dementia (Gomes da Silva Borges et al. 2018). The experimental group learned the same dances for the same frequency but only for 12 weeks, while the control group continued their normal activities. Cognition was assessed using a mini-mental state exam, functional autonomy was assessed using the GDLAM index, and balance was assessed using stabilometric and postural platforms. The ballroom dance group showed improvement in all assessments from pre-test to post-test, and performed significantly better than the control group at post-test.

The third study examined the effects of a ballroom dance program on postural balance and the incidence of falls in elderly individuals (Gomes da Silva Borges et al. 2014). The same experimental and control group procedures were again applied for 12 weeks. Results revealed a significant improvement in balance in the dance group, but not the control group. In addition, the dance group experienced a reduction in falls from pre- to post-test, which did not occur in the control group. These three studies demonstrate the positive effects of ballroom dance on multiple factors related to fall risks, such as increased functional autonomy and ability to perform activities of daily living, which promotes the prescription of ballroom dance to improve balance and motor performance. Results also support the use of ballroom dance in helping to prevent and control dementia in elderly individuals (Gomes da Silva Borges et al. 2012; Gomes da Silva Borges et al. 2018; Gomes da Silva Borges et al. 2014).

Another study compared Tai Chi Chuan to ballroom dance with regard to postural balance, gait, and postural transfer in elderly adults using a NeuroCom Balance Master force platform system (Rahal et al. 2015). Participants included individuals that had practiced either ballroom dance or Tai Chi Chuan at least three times per week for a minimum of one year. Results revealed that the Tai Chi group performed better in most tests with a lower sway velocity in the static assessments on the NeuroCom, and a lower sway velocity in the unilateral stance test with eyes open. However, the dance group demonstrated a lower sway velocity with eyes closed, a faster walking speed, and a shorter transfer time in the sit-to-stand test. Results illustrate the benefits of both protocols on improved static and dynamic balance by enhancing postural adjustments (Rahal et al. 2015).

2.5 Use of Ballroom Dance in Rehabilitation

Ballroom dance has been shown to have a positive impact on the cardiovascular system, and to serve as a moderate to vigorous form of activity (Blanksby and Reidy 1988; Gomes da Cruz et al. 2017; Huang et al. 2012; Lankford et al. 2014; Liiv et al. 2013), in addition to enhancing mood and being enjoyable for those that participate in it (Lakes et al. 2016; Maraz et al. 2015; Merom, Mathieu, et al. 2016; Merom, Grunseit, et al. 2016; Zajenkowski, Jankowski, and Kolata 2015). Therefore, ballroom dance is an excellent option for those either uninterested or unable to participate in traditional forms of exercise. For these reasons, ballroom dance has begun to be used as a form of rehabilitation for individuals with physical and mental illnesses (Wells and Yang 2021a).

Ballroom dance has several advantages over other forms of dance. Ballroom dance requires partnership – each movement is successful only if both partners cooperate. Furthermore, ballroom dance has a variety of relatively different dance styles that span a broad range of movements and music styles, making it possible for the vast majority of participants to find a dance they enjoy. In addition, movements vary in intensity and tempo of the music, so they can be adapted to more active or more frail individuals (Pisu et al. 2017).

2.5.1 Parkinson's Disease

Parkinson's disease (PD) is a progressive neurological condition causing deterioration of spinal posture, mobility, and stability, ultimately leading to dependency and falls and a decreased quality of life (Ashburn et al. 2014; Kunkel, Robison, et al. 2017; Kunkel, Fitton, et al. 2017). People with PD tend to experience slow movements, rigidity, resting tremors, and abnormal postural reflexes. Gait is characterized by a shuffling walk with increased flexion of the hips and thoracic spine and reduced movement at the ankle. Restricted rotational movements of the head and trunk also contribute to instability (Ashburn et al. 2014). Balance and strength training, along with rhythmic cueing, are the key strategies to improving function in PD patients. Ballroom dance comprises many of these strategies, as the music provides rhythmic cueing and the stepping and turning challenge balance, making it a fitting activity for people with PD.

A 2010 study with PD patients posed the question of whether partnered dancing may decrease balance gains because the PD patient might rely on their partner for balance (Hackney and Earhart 2010). Authors compared the effects of partnered and non-partnered dance on balance and mobility in 39 individuals with PD. Participants were randomly assigned to either partnered or non-partnered Tango, and attended two one-hour classes per week for 10 weeks. Balance and gait were assessed prior to, immediately after, and one month after the intervention concluded.

Participants in both groups showed improvements in balance, comfortable and fast-paced walking velocity, and walking cadence. Though both groups improved equally, the participants in the partnered dance group reported greater enjoyment and interest in continuing classes.

A second study analyzed whether an adapted Tango dance program would produce changes in neuromuscular control of gait and balance (Allen et al. 2017). Six participants diagnosed with idiopathic PD were involved in fifteen 1.5 hour adapted tango lessons over three weeks. Researchers examined muscular activity data from the leg and trunk during overground walking and postural perturbations to assess whether changes in motor modules were associated with motor improvements in gait and balance. Results indicated no increases in the number of motor modules recruited during either walking or balance. However, it was noted that motor modules were more consistently recruited and distinctly organized immediately after rehabilitation, which suggests greater generalizability of the motor modules across tasks. This study illustrates that motor module distinctness, consistency, and generalizability are more sensitive to improvements in gait and balance than the number of motor modules recruited.

Another team of researchers conducted a study in three parts to determine the potential for using ballroom dance as an intervention for patients with PD. The first phase consisted of a randomized controlled trial that sought to determine the feasibility of a partnered ballroom dance protocol with PD patients (Kunkel, Fitton, et al. 2017). Fifty-one individuals with PD were randomized into either a dance group or a control group. The dance group was partnered with healthy, age-matched individuals, and participated in two one-hour dance classes a week for 10 weeks. Dances learned included the Foxtrot, Waltz, Tango, Rumba, Cha-Cha, and Rock-n-Roll. Limited differences were seen in balance due to the small sample size; however, the six-minute walk test did show small improvements in the dance group. Participants in the dance group also reported enjoying the dance classes. Therefore, the authors concluded that using ballroom dance as an intervention for patients with PD is feasible.

An additional benefit of partnered ballroom dance is that a partner provides both physical and cognitive challenges, as movements must be synchronized. A partner may also instill greater confidence in movement because they are in contact and can be supported by another person (Kunkel, Robison, et al. 2017; Ng et al. 2019). Also, most partnered dance classes are conducted as group classes, thus promoting personal and social relationships, which are important for individuals with PD (Kunkel, Robison, et al. 2017). Therefore, having a partner may ensure greater safety, as well as greater enjoyment which may increase exercise adherence (Kunkel, Robison, et al. 2017). Thus, the second part of the previous study was to determine the experience of PD patients and their dance partners through interviews to identify factors that may affect the enjoyment of partnered ballroom dance classes (Kunkel, Robison, et al. 2017). Of the participants in the original experimental group, seven men and seven women, along with their partners, were recruited to partake in a qualitative study. The partners were a mix of spouses, friends, and volunteers. The results indicated that those who were partnered with a spouse gained the greatest enjoyment from the experience. Those partnered with experienced dancers, or if they were able to build a good rapport with their partners, also reported feeling a sense of achievement and enjoyment from the dance classes. However, determining who would do the leading was a challenge for some couples, particularly if the person with Parkinson's was male. Therefore, authors concluded that the experience participants had in the dance classes was greatly influenced by the relationship and compatibility they felt with their partner.

The third part of the study analyzed the effects of ballroom dance on whole-body coordination when turning around in PD patients (Hulbert et al. 2017). The study included 25 people with PD randomly allocated to either the dance or control group. The dance group followed the same protocol as the feasibility study. Whole-body coordination during turning was assessed using 12 on-the-spot turns before and after the intervention. The position of the body was recorded using motion analysis, eye movement was detected using a helmet with a one-camera system, and the center of pressure was measured using a force plate. The 12 turns were split up with three predicted turns each to the preferred and non-preferred side, and three unpredicted turns each to the right and left, all at a self-selected pace. Results indicated that the control participants had a longer delay between the first segment to move and the feet, as well as between the pelvis and the feet, suggesting that segments were more separated over time. In contrast, the dance group showed less of a change in segmental delay over time, with a small reduction in delay across all segments. This indicates that those who participated in the dance intervention were more able to coordinate their axial and perpendicular segments and were better at turning their whole body together compared to the control group. Results from these three data sets demonstrate that partnered ballroom dance may be a beneficial form of rehabilitation and physical activity for individuals with PD (Hulbert et al. 2017; Kunkel, Robison, et al. 2017; Kunkel, Fitton, et al. 2017).

2.5.2 Multiple Sclerosis

Multiple Sclerosis (MS) is a chronic, progressive disease of the central nervous system that impairs mobility and postural control (Mandelbaum et al. 2016). Symptoms typically manifest as fatigue, and gait and balance issues, as well as depression and cognitive impairments (Mandelbaum et al. 2016; Ng et al. 2019). The trouble with gait and balance makes participation in physical activity challenging, contributing to a more sedentary lifestyle which then contributes to a higher risk of morbidity and all-cause mortality, such as obesity and heart disease

(Mandelbaum et al. 2016). Sufficient physical activity is one of the non-pharmacological interventions that can reduce the symptoms of MS and improve quality of life. Exercise has been shown to be well-tolerated in people with MS. However, the benefits of physical activity are only effective if exercise is maintained (Mandelbaum et al. 2016). Ballroom dance may be an effective way to promote exercise adherence because it is more fun (Lakes et al. 2016; Mandelbaum et al. 2016; Zajenkowski, Jankowski, and Kolata 2015).

Ballroom dance provides unique movement experiences for participants as step patterns must be remembered and initiated in multiple directions (Ng et al. 2019). Therefore, two pilot studies aimed to determine the feasibility of using ballroom dance as an intervention for individuals with MS (Mandelbaum et al. 2016; Ng et al. 2019). The first study analyzed the effects of Salsa dance on physical activity, gait, balance, and self-efficacy (Mandelbaum et al. 2016). Ten individuals with MS participated in two one-hour dance classes each week for four weeks with assessments at baseline, immediately following the intervention, and at three- and six-month follow-ups. Assessments included a variety of tests aimed at assessing walking gait and speed, balance, self-efficacy, confidence, and motivation. Results showed increased engagement in physical activity during the intervention period, and improvements in gait and balance immediately after and at the three-month follow-up compared to baseline as demonstrated by the improved timed up-and-go test, dynamic gait index, and MS Walking Scale-12. Moreover, the protocol was well tolerated, and participants completed the dance classes with no reported difficulty. The authors concluded that the Salsa dance protocol was well-tolerated, safe, and successful at promoting physical activity in independent individuals with MS. During post-intervention interviews, it was discovered that several participants joined a gym, lost weight, and requested that the intervention continue past four weeks. Thus, this study suggests that dance may be a promising form of physical activity for MS patients.

The second study evaluated the exercise intensity and feasibility of a ballroom dance protocol, as well as the effects of ballroom dance on the physical and psychological function in people with MS (Ng et al. 2019). A total of 13 participants with MS were placed into either a dance or control group. The dance group completed two one-hour dance sessions each week for at least six of the eight weeks offered. Dances taught included the Rumba, Foxtrot, Waltz, and Push-Pull. All participants with MS danced with individuals without MS. After the steps were taught, participants were encouraged to use whatever steps they wanted, which provided the opportunity to initiate steps in all directions, learn and recall motor patterns, and process multiple sensory stimuli. The average heart rate while dancing was around 60% of age-predicted max heart rate, and the average rate of perceived exertion was between 11 and 12 for all dances. Following the intervention, the dance group showed an improved health-related quality of life and cognition, and trends toward improved fatigue, depression, and balance measures, but no changes in self-efficacy, while the control group illustrated no significant changes. These results suggest that recreational ballroom dance could be suggested as an exercise program to meet activity guidelines for individuals with MS. Participants enjoyed the dance classes, moving with the music, and interacting with the instructor and other participants, which likely contributed to the improved quality of life. These two pilot studies indicate that recreational partnered social ballroom dance can provide sufficient exercise in a fun and social setting for MS patients.

2.5.3 Spinal Cord Injury

Many spinal cord injury patients are confined to wheelchairs due to the inability to walk, which poses difficulties in participating in physical activity. A group of researchers examined the physical benefits of a mixed ability social ballroom dance class for seven spinal cord injury paraplegic and eight tetraplegic wheelchair users (Masters, Kiratli, and Hong 2013). Participants participated in four hours of social dance classes each week for six weeks, where they learned Salsa, Tango, and Rumba dances. Following the dance protocol, there were significant increases in upper extremity and trunk range of motion (ROM) and upper body strength, and improved six-minute distance and coordination, along with decreases in weight, resting pain, and reaction time. Improvements in pain perception, weight loss, active ROM, and coordination illustrate that social ballroom dance may be a fun, safe, and social form of exercise with numerous benefits for this group of individuals.

2.5.4 Stroke

Balance and mobility challenges stemming from chronic stroke contribute to issues performing activities of daily living, and significantly impact health-related quality of life (Hackney et al. 2012). Because of this, exercise interventions that improve mobility, balance, and quality of life are essential for individuals suffering from chronic stroke. Adapted Tango involves frequent starting and stopping, multiple speeds, variations in rhythm, and spontaneous changes in direction. The partner may also provide some balance assistance for those in need (Hackney et al. 2012). Therefore, a case study was done to describe the effect of an adapted Tango program on movement functions, including balance, mobility, gait, endurance, dual-task ability, and quality of life in a 73-year-old male with hemiplegia and visual impairment 13 years post-stroke (Hackney et al. 2012). The participant partook in twenty 1.5-hour adapted Tango lessons over the course of 12 weeks. Following the intervention, the participant improved in the chair stand, Berg Balance Scale, timed up-and-go, and six-minute walk test. Self-reported physical and mental health and visual quality of life changed little, while balance confidence decreased. However, the participant indicated that he enjoyed the classes, would continue if given the opportunity, and was more physically active. He also felt that he improved in walking, coordination, strength, endurance, and mood. This case study provides promising results and illustrates that ballroom dance may provide some benefits to patients with chronic stroke.

2.4.5 Dementia

Mild Cognitive Impairment (MCI) is a syndrome defined by greater than expected cognitive decline based on an individual's age and education level, yet does not significantly interfere with activities of daily living (Lazarou et al. 2017). However, more than half the individuals with MCI progress to dementia within five years (Lazarou et al. 2017). Aerobic exercise is a possible solution for improving cognitive function in elderly individuals (Lazarou et al. 2017). Dance is a combination of aerobic, strength, coordination, cognition, and social interaction, and can be performed in numerous locations where it is safe, making it more likely to be adopted and sustained by older adults and may actually be a more effective modality for improving cognitive function than other aerobic activities (Lazarou et al. 2017).

A study with patients experiencing MCI aimed to evaluate the impact of ballroom dance class instruction on cognition and mood (Lazarou et al. 2017). Participants were randomly assigned to either the dance or control group. The focus was on balance, postural control, dance and rhythm recognition, movement initiation and termination, turning, and moving with close proximity to another individual. Lessons were held twice per week for 10 months. The dance group learned the Tango, Waltz, Viennese Waltz, Foxtrot, Rumba, Cha-Cha, Swing, Salsa, Merengue, Hustle, and a traditional Greek dance. Cognitive assessments were performed by a collection of neuropsychological tests designed to examine attention, working memory, executive functioning, and language. The dance group showed improvements in almost all parameters following the 10-month period, while the control group showed a decline in performance. Results illustrate that dance may be an ideal option for preventing age-related degradations, particularly in people with limited social opportunities and declining cognitive performance.

2.4.6 Cancer

Cancer survivors have an increased risk for progressive disease, additional cancers, functional decline, and other diseases such as cardiovascular disease. Additionally, cancer patients tend to suffer from physical and psychological distress, sleep disturbances and fatigue, and reduced quality of life. Being active reduces these risks and improves physical functioning, fatigue, psychological and social well-being, and overall quality of life (Schmidt et al. 2018). Therefore, ballroom dance programs for couples dealing with cancer may be an effective intervention for survivors as well as their partners (Pisu et al. 2017) as ballroom dance has the potential to favorably influence couples' relationships by requiring verbal and non-verbal communication, and by promoting physical touch and shared experiences and interaction (Kunkel, Robison, et al. 2017; Pisu et al. 2017). Additionally, dance interventions have shown positive physical, psychological, functional, and social outcomes that improve quality of life in other populations (Ashburn et al. 2014; Hackney et al. 2012; Hackney and Earhart 2010; Kunkel, Robison, et al. 2017; Kunkel, Fitton, et al. 2017; Lazarou et al. 2017; Mandelbaum et al. 2016; Ng et al. 2019).

Thus, a pilot study utilizing a ballroom dance program was conducted to determine the potential improvement in quality of life in cancer survivors and their partners (Pisu et al. 2017). Thirty-one couples were randomized into either the intervention or control group. The intervention included ten 45-minute private lessons and two group lessons over the course of 12 weeks, where couples learned the Foxtrot, Waltz, Cha-Cha, and East Coast Swing. It was requested that participants practice on their own five times each week as well to increase weekly activity minutes. Assessment tools analyzed physical activity, functional capacity, quality of life, and couples' trust, happiness, and perceived self-disclosure as it related to sharing thoughts and feelings with their partner. Following the intervention, the dance group exhibited significant improvements in physical activity, functional capacity, the mental component of quality of life, vitality, social function, and mental health. There were no significant improvements seen in the partners of the cancer survivors in either group, except for an increase in dyadic agreement and happiness in the ballroom dance partners. At the end of the dance program, cancer survivors reported appreciating the opportunity to ease into physical activity, and both survivors and their partners enjoyed spending time together, working toward a common goal, and laughing together. This shows that ballroom dance may have the potential to provide light physical activity and to improve quality of life in cancer survivors (Pisu et al. 2017).

A second pilot study aimed to assess the feasibility of ballroom dance for cancer patients and their partners (Schmidt et al. 2018). Participation was open to all adults with any kind of cancer. Dance classes were 90 minutes long and were offered once a week for eight months. Participants were asked to rate their well-being on a visual analog scale each week in order to monitor the impact of the classes on the participants. Findings showed that for the majority of the patients, well-being remained stable or increased during class and then returned to baseline over the following six days. Patients with a low well-being rating in the three days before class experienced notable improvements during class. All but one healthy partner reported well-being as increasing during the class. These findings illustrate the feasibility of ballroom dance classes as a new and different type of physical activity for cancer patients and their partners (Pisu et al. 2017).

2.4.7 Diabetes

A healthy diet and lifestyle, including regular physical activity, are essential for preventing and treating Type 2 Diabetes (Mangeri et al. 2014). However, behavior changes are the result of personal motivation to live a healthy life, and intrinsic motivation to exercise is the strongest predictor of long-term results. Dance may help aging individuals to enjoy physical activity because it stimulates positive emotions, promotes social interaction, and fosters relationships with other people (Mangeri et al. 2014).

Mangeri (2014) and colleagues conducted a six-month study aimed at determining the metabolic and clinical effects of dancing in individuals with Type 2 Diabetes and/or obesity. Participants were enrolled in either a dance program or a self-selected physical activity program based on their personal preferences. The dance program consisted of two 2-hour dance lessons each week. Participants were welcome to dance with their own partners or with other individuals in the class. The self-selected physical activity group was allowed to choose their preferred activity, such as walking, cycling, swimming, weight lifting, etc. Both programs illustrated significantly lower body weight and waist circumference at three months and maintained results at six months. In the dance group, activity-related energy expenditure was 13.5 METS/hour per week in the first three months and 14.1 in the second three months. While the self-selected program resulted in greater energy expenditure, it was also more variable in the first three months and decreased in the second three months. This study highlights the benefits of a dance program as an effective form of physical activity for improving metabolic control, and successfully motivating individuals with Type 2 Diabetes/obesity to exercise.

2.6 Injury Risk

Ballroom dance is often perceived as being gentle and controlled and therefore suitable for all individuals because there is no perceived strain (Tsien and Trepman 2001). In fact, dance medicine often overlooks the ballroom discipline altogether and instead refers to injuries in ballet, modern, jazz, folk, and ethnic (Tsien and Trepman 2001). However, there is a risk for injury in all physical activities (Domene, Stanley, and Skamagki 2018). Ballroom dance movements must be executed with precision, endurance, and power while maintaining the beauty of the dances, and, like ballet, DanceSport athletes must spend hours every week practicing (Tsien and Trepman 2001). DanceSport athletes experience increased heart rates and oxygen uptake during competition due to the high aerobic and anaerobic requirements of the sport (Blanksby and Reidy 1988; Lankford et al. 2014). In order for dancers to meet the physiological demands of competition, they must also train at high intensities (Premelc et al. 2019). Discrepancies in fitness level and competition demands have been suggested to be associated with an increased likelihood of injury (Premelc et al. 2019). Although ballroom dance has been seen to be beneficial in rehabilitation settings, it is also important to be aware of any injury risk that may be associated with it as well.

Most injuries in DanceSport have been self-reported, such as the study by Premelc and colleagues (2019) on the differences in injuries based on age-class and gender in DanceSport athletes. Nearly 100 participants from 21 different countries at an international competition participated. Of these dancers, 68 percent reported injuries in the previous twelve months, and a total of 96 injuries were recorded. Females were found to sustain a ten percent higher injury rate per 1000 hours of training, and six percent more injuries per dancer than males. There was no difference in injury incidence by age-class, and no interaction between gender and age class for incidence of injury. Most injuries were classified as traumatic, with females sustaining more traumatic injuries (74%) than males (46%). There were no significant differences by age-class or gender in overuse injuries. The increase in traumatic injuries compared to overuse injuries may be due to the quick movements that must be made when rotating and starting and stopping resulting from the stability and balance that is required when performing multidirectional movements (Premelc et al. 2019). The most common injuries reported were strains of the neck (22%), lower back (18%), and knee (16%). Dancers reported most injuries occurring during training (73%) or competition (26%), with most perceived causes of the injuries being overtraining (25%) and insufficient warm-up (17%). The greater number of injuries reported by females may be due to the more extreme back bending, and quick head turns they make compared to males (Premelc et al. 2019). Additionally, the spine is out of its natural alignment during hyperextension, which may explain the greater number of neck and back injuries reported.

Recreational Salsa dance is a popular social and physical activity for both men and women (Domene, Stanley, and Skamagki 2018). A survey of 450 nonprofessional Salsa dancers sought to determine the extent of injuries, the odds of sustaining an injury, and the injury incidence rate in recreational Salsa dancers (Domene, Stanley, and Skamagki 2018). Results revealed that the likelihood of sustaining an injury was twice as great for women versus men. There was a three percent greater chance of injury for every increased year in age, a seven percent greater risk of injury for every one-unit increase in body mass index (BMI), and a seven percent lower risk of injury for every one year of Salsa dance experience. There was a greater proportion of females that sustained at least one injury in the previous year compared to males. Of the 83 injuries reported in women, 34% of them required medical attention compared to 17% of the 23 injuries reported in men. Most of the injuries reported by women were muscle or tendon strains and located in the foot and ankle, while most of the injuries by men were joint or ligament related and either related to or located in the knee.

Latin formation dance, another form of DanceSport, also places high physical demands on the participants (Wanke, Haenel, and Groneberg 2020). Wanke and colleagues (2020) analyzed the pain and injuries of 72 Latin formation dancers. Fifty-nine of the dancers reported having pain either while dancing or during the 24 hours after dancing in the previous three months. Female dancers reported more affected regions of the body than male dancers. The most common injury site reported by all dancers was the lower back, while females also reported the right shoulder and males also reported the right knee as being frequently affected. Females also reported the toes and ankles as being a frequent region for pain, which may be due to the shoes worn when dancing. Females tended to report their pain as being higher on the 1-10 pain scale than men. All but three of the dancers stated that they trained with the pain with the reason being a passion for dancing and unwillingness to let down their teammates. This study illustrates the high relevance of pain and injury risk in Latin formation dancers (Wanke, Haenel, and Groneberg 2020).

Professional ballroom dancers are often compared to elite athletes as their training requires specific physical abilities and advanced techniques, a schedule that can lead to physical exhaustion all while striving for artistic excellence (Cardoso et al. 2020). Therefore, a group of researchers assessed the prevalence, characteristics, and factors associated with ballroom dance injuries in professional dancers (Cardoso et al. 2020). Results illustrated a high incidence of injury in this population with 64% reporting an injury during their professional career. The lower extremity was most frequently injured in women, and the knee was the most common injury site for men. Being overweight, and participating in other dance forms in order to complement ballroom training were identified as factors associated with injury. Understanding the factors associated with injury in ballroom dance will aid in the prevention and rehabilitation of injuries.

In addition to surveys of dancers, two different case reports of injuries shine a light on some of the injuries that are unique to ballroom dance. The first case report involved a 52-year-old woman with cervical radiculopathy. Cervical radiculopathy is a pathologic process involving the spinal nerve root (Tsung and Mulford 1998). This was the first case in which cervical radiculopathy was reported in a ballroom dancer. However, ballroom dance involves neck movements such as cervical extension and lateral bending, and lateral rotation, which narrows the space of the cervical spine root and may cause damage to the nerve roots (Tsung and Mulford 1998).

The second case report examined knee internal rotation (Tsien and Trepman 2001). The individual was a 29-year-old female, amateur competitive ballroom dancer with no prior history of orthopedic injury. She was pivoting to the right with knee internal rotation and her right foot planted on the floor while practicing a syncopated spin with her partner when she experienced intense pain in the right posterolateral knee causing her to drop to the floor. The mechanism of injury and location of pain was consistent with a popliteus tendon strain. Forced internal rotation can cause impingement of the lateral meniscus between the lateral femoral condyle and the tibial plateau. An internal rotation mechanism of injury is rare in dancing because of the emphasis that ballet and modern dance place on external rotation or parallel dance positions. It is generally suggested that dancers have fewer knee injuries than athletes in contact sports because the dancer's foot on the floor rotates, dissipating the twisting strains on the knee. However, in ballroom dance, movement of the body may occur when the foot is still planted firmly on the floor, and the partner leads the couple into a different position, resulting in strain on the knee (Tsien and

Trepman 2001). Although most dance injuries are reported in ballet, modern, and aerobics, the risk for an ankle injury in ballroom dance has been reported because of the shoes that females dance in. However, this study illustrates that ballroom dance may result in injuries that are unique from other dance injuries. Notably, all five of these studies indicate that women are at an increased risk for sustaining an injury compared to men.

2.7 Biomechanics of Ballroom Dance

DanceSport, like other sports, has been associated with high stress levels as well as a risk for injury, while recreational ballroom dance has been associated with enhanced mood, increased exercise and fitness, and improved balance and coordination. The benefits of recreational ballroom dance have led to it being recommended as a form of rehabilitation in individuals suffering from chronic physical ailments such as PD and MS. However, the underlying mechanisms for how ballroom dance is beneficial in rehabilitation among different populations remain unknown. Additionally, a selection of joint and muscle injuries have been associated with ballroom dance. To address these two knowledge gaps, it is vital to consider the biomechanics of this fun and social activity before broadly recommending it to various groups or populations.

An important characteristic of ballroom dance is the ability to adapt the timing of steps and dance figures to the accompanying music and the partner's motion (Zaletel et al. 2010). Therefore, a comparison of dance trajectory around the dance floor of three adult internationally ranked ballroom dance couples and three youth internationally ranked ballroom dance couples was made. The couples danced all of the standard dances – Waltz, Tango, Viennese Waltz, Foxtrot and Quickstep – in succession with 30-second breaks between each while their dances were recorded by a camera secured to the ceiling. The trajectory of the movements for each dance and couple was analyzed using a human measurement tracking system. Comparisons revealed that adult couples tend to utilize the whole dance floor while youth dancers remain primarily on the outside circle in most dances (Waltz, Tango, Foxtrot, and Quickstep). In this study, the Viennese Waltz showed the fewest differences between youth and adult couples with its quick and continuous rotations. On average, adult couples made trips around the dance floor that were 20-30 meters longer and about 0.3 meters per second faster than the youth couples. Because of the speed of these particular dances, there is a risk of colliding with other couples on the dance floor, so it is smart to utilize the space in the middle of the dance floor as the adult couples did.

The Viennese Waltz involves continuous turns, where couples constantly rotate around each other. These movements are characterized by powerful rotational body movements. A turn in dance involves external rotation of the lower extremities as a result of the interdependent hip, knee, shank, and foot-ankle movements, and dancers must have adequate strength in the structures around the trunk, hip joint, and ankle joint to make a turn perfect (Prosen et al. 2013). The speed of movement is also important for success in the Viennese Waltz (Zaletel et al. 2010). Therefore, a time-motion analysis study was conducted by Prosen and colleagues (2013) in which the natural (right) and reverse (left) turns were analyzed in the top 12 ranked and lowest 12 ranked couples in the Viennese Waltz at an International competition. The goal was to determine if the time and speed of the movement within a single turn differed between high- and low-ranked couples. Dances were again recorded using a video camera fixed to the ceiling. Both top- and lower-ranked dancers tended to perform similar proportionate frequencies of reverse and natural turns. Analysis of reverse turns showed that the top-ranked dancers performed fewer turns on a curved trajectory than the lower-ranked dancers. The top-ranked couples also performed all turns at similar speeds, all of which were significantly quicker than the lower-ranked couples.

This suggests that the ability to maintain a higher speed throughout the turn results in the dance appearing more fluent as the overall movement speed does not fluctuate as much.

Many of the Standard dances are known for the rise and fall of the dances, which is represented by the movement of dancers' center of gravity. A study was conducted to mechanically analyze the rise and fall movement that occurs in the Waltz, Foxtrot, Viennese Waltz, and Quickstep in order to be able to give dancers correct advice regarding these movements (Shioya 2018). A theoretical model was analyzed, and since standard dances utilize constant contact between partners, the center of gravity of the couple, rather than the individuals, was used. Outputs from the model showed that at the down position, potential energy is at its lowest. During the rise, maximum kinetic energy is gained when translational velocity is highest, at which point the velocity decreases, and the kinetic energy is transferred to potential energy. Potential energy is greatest when the body position is at its highest point. The rise and fall of basic figures can be modeled as a simple pendulum motion, where the rise is explained naturally as the change from kinetic to potential energy. However, the downward movement involves the change from potential to kinetic energy and requires dissipation. The analysis illustrated that the maximum height of the rise depends on the figure of each dance, and is limited by the acceleration, regardless of the dancer's height and weight.

Another study analyzed the Waltz in highly skilled dancers with the goal of assessing the effects of a partner on joint range of motion and step length (Yoshida et al. 2020). Dancers performed the first half of a natural turn individually and then with a partner while step length normalized to leg length and joint range of motion in the sagittal plane were assessed. Step length for the males was significantly longer during the first step in the individual condition. The step length for females during the first and second steps of the turn were significantly longer in the partner condition. In addition, the joint ROM for males tended to be smaller in the paired condition, while the joint ROM for females was seen to increase in the paired condition. These differences likely occur because the Waltz is performed in a closed hold position. Therefore, the lower extremity movement of the male is determined by the position of the legs relative to the female while the lower extremity movement of the female is determined by the propulsive movement of the male (Yoshida et al. 2020).

Spinning and sliding movements are also frequently performed by dancers (Perala, Wilson, and Dai 2018). Understanding the interaction between dancers and the floor can aid in performance and training. It is important to note that different dance styles also use different dance shoes. Different coefficients of friction from the shoes may result in different lower extremity kinematics and kinetics, thus resulting in different performances. For this reason, a study was conducted to quantify the coefficient of friction of different footwear and its effect on the free moments during rotational movements in country swing dance (Perala, Wilson, and Dai 2018). Participants performed 360-degree rotational movements in rubber-bottom boots, leather-bottom boots, running shoes, and barefoot. Results showed that coefficients of static friction were the greatest for the rubber-bottom boots and running shoes. The leather-bottom boots also illustrated the lowest peak and average free moments of the footwear conditions. This indicates that the leather-bottom boots may decrease twisting loads resulting from the free moments. This is important because a lower coefficient of friction between the shoe and the floor may result in a lower rotational load on the knee. However, coefficients of friction that are too low result in slippery shoe-floor interaction, which may increase the risk of falling during accelerating or decelerating movements.

A second study analyzing the effect of footwear investigated the effect of high heels on the center of mass, and lower extremity and spine joint angles (Pilar et al. 2020). In this study, experienced dancers performed Samba steps in two conditions – high heels and flats – at two different speeds. Researchers did not find a correlation between step execution speed and footwear, nor were there any differences in lumbar curvature, displacement of the center of mass or knee and hip joint amplitude. However, it was observed that left plantarflexion angle decreased with increasing speed. Additionally, there was a significant decrease in ankle plantarflexion in the flats condition compared to high heels.

Another study chose to investigate the relationship between skill level and angular momentum associated with different variables in the basic Cha-Cha step, which is a complex, multidirectional, asymmetrical Latin dance sequence (Chang et al. 2019). Participants included 29 dancers at three different skill levels – 10 beginners, 10 intermediates, and nine experts. Participants danced 12 cycles of the basic Cha-Cha step to music. Results illustrated that the sum of absolute segment angular momentum increased in all planes of motion with skill level. This was accompanied by an increase in cancellation of angular momentum between segments that occurred in all movement planes by skill level, which indicates a greater utilization of angular reaction elements with increasing skill. Taken together, these findings indicate that experts utilize increased whole-body angular momentum, which although energetically expensive, may increase the aesthetic value of dance movements.

Center of gravity and balance is a key component of ballroom dance. Thus, a study assessed the center of gravity trajectory during two basic Rumba dance steps in three novice dancers and one professional dancer (Outevsky and Justin 2018). Dance steps were performed on a Footscan which recorded the trajectory of the center of gravity, and weight distribution on the feet. Novice dancers portrayed left and right foot imbalances, and stepping on the outside of the foot instead of the medial side. In addition, they did not utilize the whole feet when stepping but instead stayed on the front of the foot, and they limited the volume of their movement. This is important because left/right asymmetries are common in sports overuse injuries (Outevsky and Justin 2018).

Posture is another key characteristic of dance. The normal spine has curves that increase the overall strength of the vertebral column, help maintain balance in an upright position, and help absorb stress from jumping and landing activities (Kruusamae et al. 2015). DanceSport athletes train for years to develop the appropriate posture and dance hold, which raises the question as to whether the adaptations made by dancers are habitual or cause permanent changes to the spine (Kruusamae et al. 2015). This led to a study exploring the differences in lumbar lordosis and thoracic kyphosis of 30 amateur or professional couples, ranked in the top six percent of the world rankings, that competed in either Standard, Latin American, or Ten Dance compared to track runners, which were used as a physically active control group (Kruusamae et al. 2015). Measurements of the spine were taken using a Vertebral Fracture Assessment scan. Results revealed that DanceSport athletes had a smaller S-shape in the vertebral curvatures compared to the runners. Both male and female dancers had smaller lumbar lordosis angles compared with same gender track athletes. Female dancers also had smaller thoracic kyphosis angles compared to female track athletes. These results may be due to the postural requirement of DanceSport athletes requiring them to maintain an elongated spine and forward rotated hips. Within the DanceSport participants, female Latin American dancers had smaller lumbar lordosis angles compared to female Standard and Ten Dance dancers. This difference may be a result of female Standard dancers needing to bend back, which involves hyperextending the spine from the waist, limiting the forward rotation of the hips seen in Latin American dancers.

A similar study analyzed the effects of professional Latin-style dance on spinal posture and pelvic tilt (Muyor, Zemkova, and Chren 2017). This study compared spinal curvatures and pelvic tilt in different positions, spinal sagittal plane mobility and hamstring flexibility, in addition to the influence of wearing dance heels on the sagittal plane spinal posture in 20 Latin American style professional dancers and 20 non-dancers. There were no significant differences between groups when standing. When slumped over, male dancers showed lower thoracic kyphosis and greater lumbar flexion and anterior pelvic tilt than male non-dancers, while female dancers showed greater thoracic kyphosis compared to female non-dancers. In maximal trunk flexion with knees flexed, male dancers illustrated lower thoracic flexion and greater lumbar flexion than male non-dancers, while female dancers showed greater anterior pelvic tilt than female non-dancers. In maximal trunk flexion with knees extended, all dancers had lower thoracic flexion and greater lumbar flexion and anterior pelvic tilt than male non-dancers. In a prone position, females showed a straighter thoracic spine than males. In maximal extension, non-dancers had greater lumbar extension than dancers. When looking at specific dance postures, lower thoracic kyphosis was seen in the forward walk, and greater lumbar lordosis was seen in the Paso-Doble posture compared to standing with dance heels on. Pelvic tilt was greater in the forward walk, and dancers showed significantly higher hamstring flexibility than non-dancers. Contrary to what Kruusaamae and colleagues found, these findings illustrate that specific dance postures and movements modify the spinal curvatures in Latin-style dancers, but they do not alter the spinal morphology when standing.

One study analyzed the kinetics associated with the triple step in recreational swing dancers (Wells and Yang 2021b). This study analyzed the ground reaction force (GRF), loading rate, joint power, and joint moments at the ankle, knee and hip during the triple step movement. Comparisons were made among the three steps within the triple step, and between individual and partnered conditions. Results illustrated a greater peak vertical GRF during the first two steps, a greater loading rate during the second step, and greater joint power absorption at the ankle and knee during the second step. Additionally, data showed minimal differences in the kinetics between individual and partnered dance conditions. To the best of our knowledge, this is the only study to have analyzed the kinetics of a ballroom-related dance movement, providing preliminary data for further analysis of ballroom dancing biomechanics.

3 METHODOLOGY

3.1 Participants and Study Design

This study adopted a cross-sectional design to analyze the biomechanics of rhythm movements across different ballroom dance levels and between genders. It enrolled 56 individuals – 20 participants with no ballroom dance experience (NEW), 18 recreational dancers (REC), and 18 professional dancers (PRO), with even genders in each group (Table 3.1). A power analysis was conducted using a pilot study to determine the number of participants needed for this study (Appendix D). Participants were not significantly different in height and mass, but participants in the inexperienced level were significantly younger than the recreational and professional levels. Within each level, males and females were not significantly different in age, height, mass, experience, or hours danced each week. A professional dancer was defined as an individual who competed as a professional (had the potential to win or earn money – Pro/Am or Pro/Pro) in a rhythm ballroom dance within the prior two years. Recreational dancers were anyone who completed a minimum of 50 dance sessions in a rhythm ballroom dance within the past two years but had never competed as a professional. Inexperienced dancers had completed no more than five sessions in a rhythm ballroom dance in their lifetime and did not have extensive experience in other dance forms. To be enrolled, participants must fit one of the three criteria listed, be free of any lower extremity injury in the previous three months, be in good cardiovascular health, and be free of any neurological or musculoskeletal condition that would inhibit their ability to balance or dance normally.

Participants were recruited in the greater Atlanta region through various approaches. Specifically, recruitment emails and fliers were shared on the university campus, at local ballroom dance studios and ballroom dance competitions, on social media, and by word of mouth. This study was approved by the Institutional Review Board at Georgia State University (Approval number: H19457), and written informed consent was obtained from each individual prior to data collection. The data collection lasted for 20 months between April 2019 and August 2021 (excluding March 2020 through November 2020 due to the laboratory shutdown resulting from the COVID-19 pandemic).

3.2 Instruments

3.2.1 Motion Capture

Participants' lower limb kinematics were collected from 16 reflective markers using a 9-camera VICON motion capture system (VICON, Denver, CO, USA) sampling at a frequency of 100 Hz. The markers were placed on specific anatomical landmarks following the Vicon Plug-in-Gait marker set (Fig. 3.1). The specific marker locations included the bilateral toes (between the first and second toe), calcaneal, lateral malleoli, shanks, lateral femoral condyles, thighs, anterior superior iliac spines (ASIS), and posterior superior iliac spines. The system was calibrated prior to each testing session.

Vicon Nexus 2.7 software (Oxford Metrics, Oxford, UK) was used for data collection. All VICON cameras were connected to Vicon Nexus. The Vicon Nexus software was also used to adjust the anthropometrical parameters, calibrate the cameras, and record the dance trials. All collected data was saved in a password-secured computer.

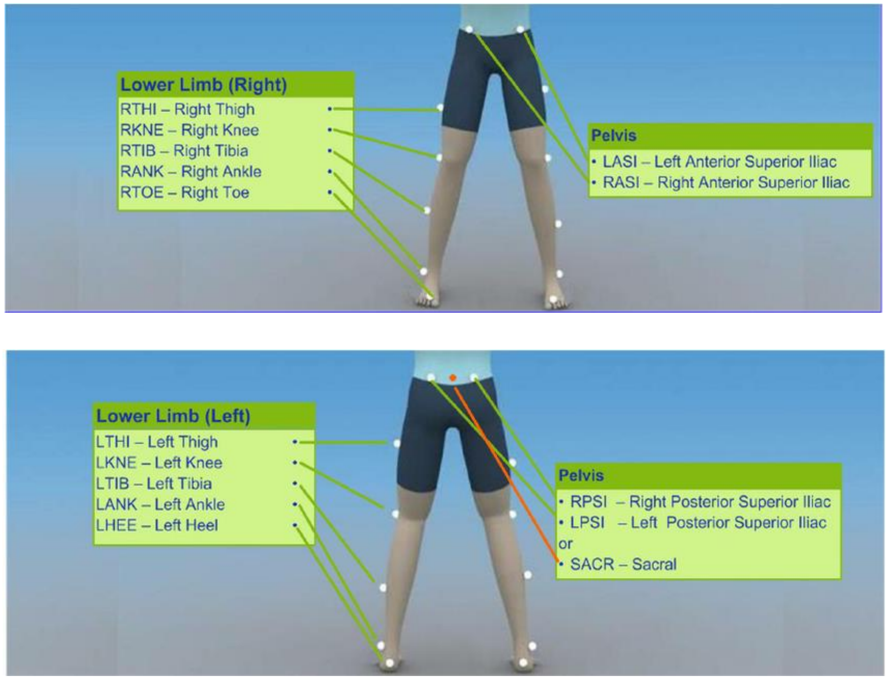

Figure 3.1. Vicon Plug-in-Gait Model
Figure 3.1. Illustration of the lower body Plug-in-Gait model from Vicon ("Lower body modeling," 2020).

3.2.2 Force Plates and Dance Floor

All movements were performed on a vinyl floor placed on the laboratory floor, covering a pair of force plates (Advanced Mechanical Technology, Inc., Watertown, MA, USA) (Fig. 3.2). The vinyl floor on the force plates was detached from the surrounding vinyl floor to avoid cross-talk between the readings of the two force plates. The force plates were connected to the Nexus platform and used to collect ground reaction forces (GRFs) and calculate joint powers and moments of the ankle, knee, and hip. Forces and moments were measured in the x, y, and z directions. The force plates sampled the data at a frequency of 1000 Hz.

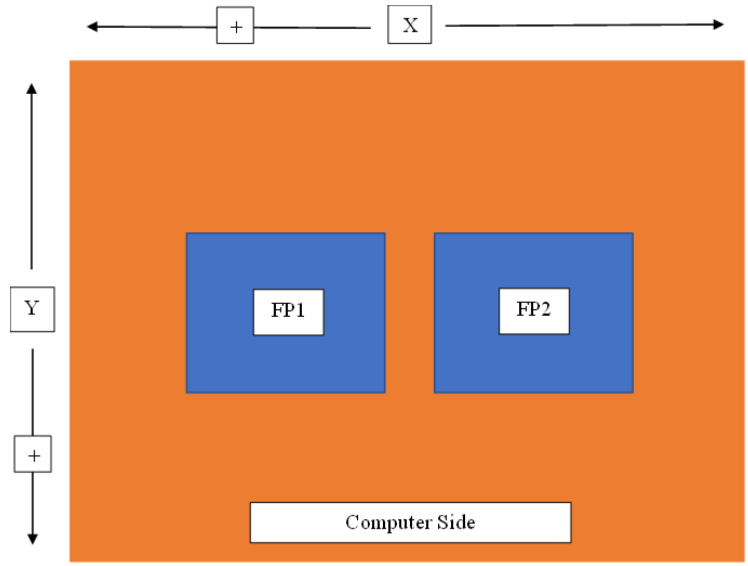

Figure 3.2 Floor Set-Up
Figure 3.2. Illustration of the force plates and vinyl floor set-up in the laboratory.

3.2.3 Electromyography

Muscle activity of five major lower extremity muscles – Tibialis Anterior (TA), Medial Gastrocnemius (MG), Vastus Lateral (VL), Biceps Femoris (BF), and Gluteus Medius (GM) (Fig. 3.3) – was collected bilaterally during each dance trial using 10 Delsys Trigno Wireless Electromyography (EMG) sensors (Delsys Inc., Natick, MA, USA). The EMG electrodes were placed over the belly of each muscle after appropriate preparation of the respective skin areas, and the data was collected at a frequency of 1000 Hz.

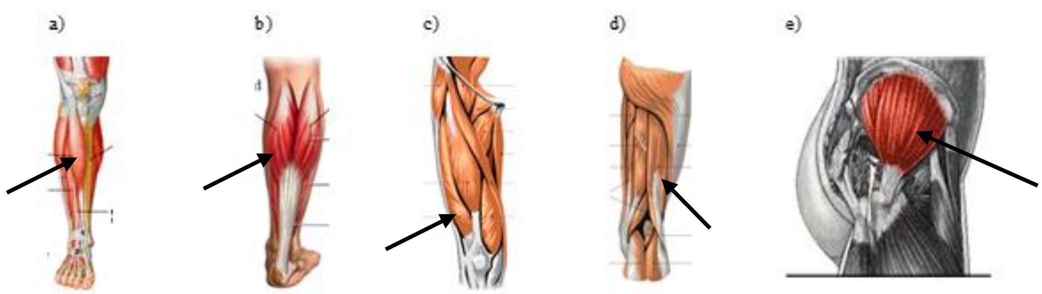

Figure 3.3. Selected Muscles
Figure 3.3. Depiction of the a) Tibialis Anterior, b) Medial Gastrocnemius, c) Vastus Lateralis, d) Biceps Femoris, and e) Gluteus Medius.

The motion capture system, force plates, and EMG system were synchronized during data collection through the Vicon Nexus system.

3.2.4 Biodex Dynamometer

Maximum Voluntary Isometric Contractions (MVIC) at the ankle and knee of the dominant limb were assessed using a Biodex Pro System 4 dynamometer (Biodex, NY, USA), sampling at a frequency of 100 Hz. The MVIC at the hip on the dominant limb was assessed manually using a handheld dynamometer (Hoggan Microfet 2). The MVICs collected included dorsiflexion and plantarflexion at the ankle, flexion and extension at the knee, and abduction at the hip. The Biodex is equipped with handles to hold onto and seatbelts to stabilize the position of the trunk and the tested leg. The MVICs were performed three times at each joint for each direction. Contractions lasted for five seconds, with one minute of rest between trials. The angle of the ankle during the plantarflexion and dorsiflexion trials was set to 0 degrees. The position of the knee during the flexion and extension trials was set to 35 degrees. The position of the hip during the abduction trials was approximately 10 degrees of abduction.

3.3 Experimental Protocol

Data collection took place in the Biomechanics Laboratory at Georgia State University. Prior to participant arrival, all of the instruments and equipment, such as the VICON cameras and AMTI force plates, were calibrated to ensure accurate data were collected.

3.3.1 Participant Preparation

When the participant arrived, they filled out a health history and dance questionnaire (Appendix A) to determine eligibility based on the inclusion and exclusion criteria established. If the participant was eligible, they read and signed the informed consent document. Any questions from them about the study and protocol were addressed adequately before signing the form.

Next, they changed into appropriate compression clothing as needed and standardized socks that were provided (Under Armour, Baltimore, MD, USA). Participants warmed up as they would normally for a dance session for five minutes where they were given the opportunity to familiarize themselves with the dance floor. Following the warm-up, anthropometric measurements were taken, including body height and body mass, bilateral ankle and knee width, inter-ASIS distance, and bilateral leg length. Retroreflective markers used for the motion capture were then placed on bony landmarks on the lower extremity using double-sided tape. The marker placement followed a Plug-in-Gait marker set as previously specified. This marker set was used to define the 3-dimensional kinematics of the pelvis, thighs, shanks, and feet. Wireless EMG sensors were then placed on the belly of the Tibialis Anterior, Medial Gastrocnemius, Vastus Lateralis, Biceps Femoris, and Gluteus Medius bilaterally. Prior to EMG placement, the electrode sites were shaved, scrubbed with sandpaper, and cleaned with alcohol in order to reduce impedance and ensure good transmittance of the signals. The EMG sensors were further secured with pre-wrap and EMG tape to ensure they did not move or fall off during the dance trials. Following reflective marker and EMG placement, the participant moved into the data collection area to ensure that all the markers were visible and the EMG sensors were transmitting clear signals.

3.3.2 Data Collection

Prior to the dance trials, a static-subject calibration was collected by the VICON motion capture system. The static calibration consisted of standing on the dance floor with one foot on each force plate, legs shoulder-width apart, and arms reaching out to the sides. Participants then performed five key dance elements that make up any rhythm ballroom dance: antero/posterior step, side step, rock step, triple step, and spot turn. Each of the first four movements were performed with both the right and left as the leading limb. Therefore, there were nine dance movements in total examined in this study (= 4 × 2 + 1): forward step with the left foot (FSL) (+X in Figure 3.2, Appendix B, Step 1.1) and backward step with the right foot (BSR) (-X, Step 1.2), side step to the right (SSR) (+X, Step 2.1) and left (SSL) (-X, Step 2.2), rock step forward with the left foot (RSFL) (+X, Step 3.1) and rock step backward with the right foot (RSBR) (-X, Step 3.2), triple step to the right (TSR) (+X, Step 4.1) and left (TSL) (-X, Step 4.2), and a spot turn (ST) (+X/Z, Step 5). See Appendix B for dance movement illustrations. All nine movements were executed with and without a partner for a total of 18 conditions. The forward and backward steps and the side steps are single steps, the rock steps and spot turn require two steps, and the triple step is an element with three steps, only two of which were analyzed (Table 3.1).

All nine movements included a preceding dance step in order to mimic the momentum present in dancing, and were performed in a randomized order to reduce the potential bias from the order effect. The leading dance step was the typical step prior to each of the basic steps chosen for this study. Thus, the forward and backward steps were preceded by a side step to either the left or right, and the side steps were preceded by either a forward or a backward step, the rock steps were preceded by triple steps, and the triple steps were preceded by rock steps. The spot turn did not include a leading step. Participants performed each of the movements to a rhythmic beat in an attempt to normalize the rate at which the steps were taken. The forward and backward steps and the side steps were performed to a 100 beat per minute rhythm; rock steps and triple steps were performed to a 90 beat per minute rhythm; and the spot turn was performed to an 80 beat per minute rhythm. These rhythms were verified with a ballroom dance instructor to be suitable tempos for all individuals.

As the landing phase of each movement likely causes higher joint loading, we chose to focus on the landing of the limb of interest of each of the five elements (Table 3.2). Each element was performed until three good trials were collected. A trial was considered good if the movement was performed correctly, all reflective markers were visible, the participant stepped on the correct force plate, and the EMG sensors gathered the muscle activity appropriately.

Table 3.2. Limb of Interest

Table 3.2. The limb of interest for each of the five/nine elements. Variables were analyzed for the limb of interest during the landing phase. See Appendix B for details on the dance elements.

Task	Single-stepping	Double-stepping	Triple-stepping
Movement	Forward & Backward step Side step	Rock step Spot turn	Triple step
Limb of interest	Stepping leg	First and second stepping legs for Rock step First step for Spot turn	First and third stepping legs

Following the motion capture trials, participants performed MVICs while seated on an isokinetic dynamometer and lying on a table. This order of tests was chosen to avoid the potential fatigue effect from the MVIC trials on dance trials if the order was reversed. They completed three MVICs of plantarflexion and dorsiflexion at the ankle, three MVICs of extension and flexion at the knee, and three MVICs of abduction at the hip. All assessments were performed on the dominant side.

Ballroom dancing is a partnered activity, so it is important to analyze what the movements look like with a partner. However, adding a partner creates a challenge in collecting complete motion data due to possible blockage of markers, simultaneous landing on the same force plate by both participants, and limited EMG sensors. So, to limit the loss of data and/or inaccurate data, participants performed the movements individually and partnered in the following order: the first participant completed the nine dance movements, followed by the two participants together (Fig. 3.4). The first participant then completed the MVICs. The markers and EMG sensors were switched to the second person whereby data was collected partnered again, followed by the second participant individually, and then the MVICs. Whether the male or female went first was randomly determined. For the purpose of this study, males always danced the lead role and females always danced the follow role. The entire procedure took 2 – 2.5 hours per person, and three hours per pair.

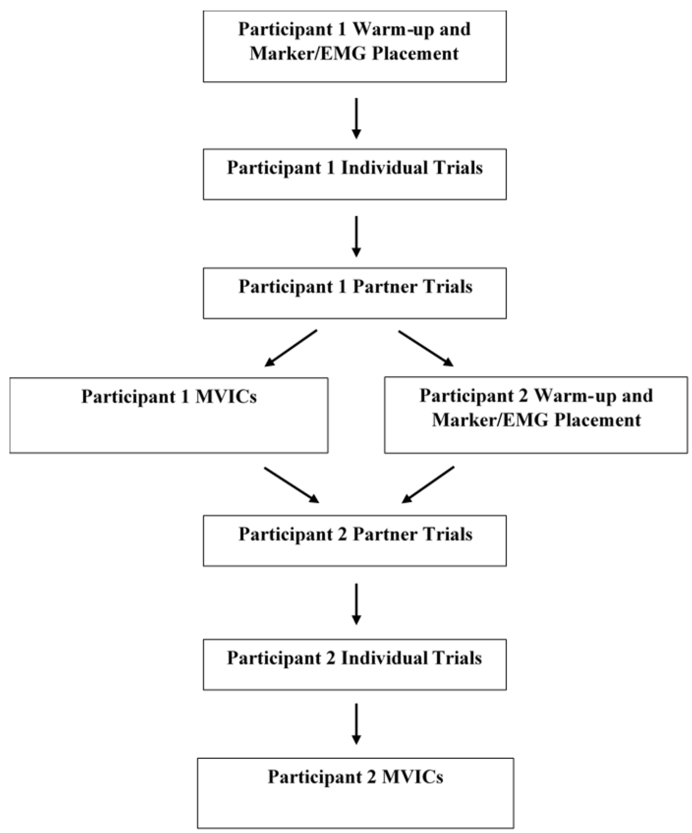

Figure 3.4 Data Collection Flowchart
Figure 3.4. Flowchart representing the order of data collection with two paired participants.

3.4 Data Processing

3.4.1 Data Processing

Vicon Nexus 2.7 (Oxford Metrics, Oxford, UK) was used to reconstruct and label the markers of the static calibration and dance trials. All outcome measures were then calculated over the determined landing phase. The landing phase was designated by the timing of touch-down (TD) and liftoff (LO) of each of the steps within each dance element which was manually determined by the foot kinematics. The duration of the stance phase for each step was defined by the time elapsed from TD to LO of the respective step.

Marker paths and GRF were low-pass filtered using fourth-order, zero-lag Butterworth filters with a cutoff frequency of 7 and 30Hz respectively (Pai et al. 2006). The centers of pressure of both feet were determined from the GRF. Joint centers were calculated from the filtered marker paths and measured anthropometric parameters. Angle and angular velocity in three planes were determined for bilateral lower limb joints based on the joint center data using inverse kinematics. Resultant maximum and minimum joint moments of the bilateral ankle, knee, and hip joints in three planes were calculated based on the filtered GRF, center of pressure, and joint angular parameters using inverse dynamics in conjunction with gender dependent segmental inertial parameters (de Leva 1996; Winter 2009). The joint power was calculated as the dot product of the three-dimensional joint moments and angular velocities for each joint. EMG data were filtered using a Butterworth band-pass, with a 6^{th} order zero-phase lag filter using 20 Hz and 500 Hz as the cut-offs to remove high- and low-frequency noise. The remaining signal was then full-wave rectified using a 6^{th} order zero-phase low-pass Butterworth filter with a cut-off frequency of 30 Hz. The EMG activity of each muscle was normalized to maximum contractions and reported as a percentage.

3.4.2 Outcome Variables

As stated, the landing phase of each movement was selected for analysis. The primary outcome variables of interest included the peak vertical GRF, the loading rate, and the peak joint power absorption and propulsion at the ankle, knee, and hip joints. The secondary outcome variables were the peak moment and angle at the ankle, knee, and hip joints in either direction in all three planes of motion (dorsiflexion vs. plantarflexion, flexion vs. extension, abduction vs. adduction, inversion vs. eversion, and internal rotation vs. external rotation). The tertiary outcome variables were the peak EMG of the Tibialis Anterior, Gastrocnemius Medialis, Vastus Lateralis, Biceps Femoris, and Gluteus Medius. The peak values of each outcome variable over the three trials were calculated for each of the limbs of interest during each dance movement.

The peak vertical GRF was the maximum value of the vertical component of the GRF and was normalized to body weight (BW). The loading rate was the slope of the vertical GRF from each TD to the peak vertical GRF and expressed in BW/s (Figure 3.5). Peak power absorption and propulsion were determined as the maximum and minimum values of the joint power and normalized to body mass (W/kg). The maximum and minimum angle and moment for the ankle, knee, and hip joints in the sagittal, frontal, and transverse planes during the landing phase were identified and normalized to body mass (Nm/kg). The peak of the EMG signals for the 10 muscles during the landing phase were calculated and expressed as a percentage of the signal during the respective MVICs. A custom MATLAB (Mathworks, MA) program was developed to conduct the calculations.

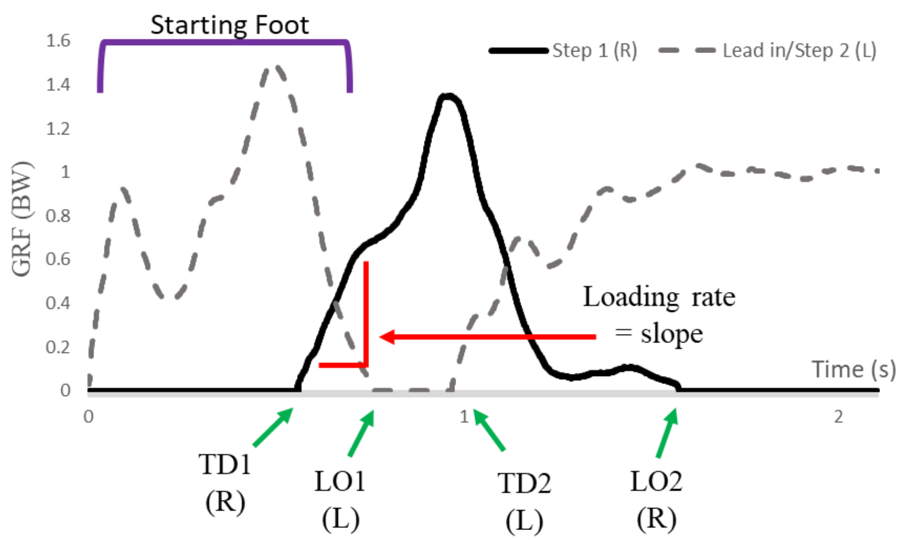

Figure 3.5. GRF and Loading Rate
Figure 3.5. Illustration of the GRF during the RSBR used to determine the touch down and lift off, and the calculation of loading rate.

3.5 Statistical Analysis

The Shapiro-Wilk' *W*-test was used to check the assumption of normality for all outcome variables during the 18 dance conditions (nine movements with and without a partner). Logarithmic transformations were attempted for all variables that were not normally distributed. Descriptive statistics are reported in mean and standard deviation to describe and summarize the data.

To test the first hypothesis, Kruskal-Wallis tests for non-normally distributed data and one-way analysis of variance (ANOVA) for normally distributed data, with the experience level (professional vs. recreational vs. inexperienced) as the independent variable, were used to compare variables of interest among dance levels. Hochberg's false discovery rate (FDR) test with appropriate corrections was run when main significant differences were seen. To test the second hypothesis, Mann-Whitney tests for non-normally distributed data and two-tailed independent *t*-tests for normally distributed data were used to compare variables between genders. Statistical analyses were conducted using SPSS 27 (Armonk, NY) with a significance level of $\alpha < 0.05$.

Table 3.1. Participant Characteristics

Table 3.1. Participant characteristics and dance experience (in mean ± standard deviation).

Level	Gender	Age (Years)	Height (m)	Mass (kg)	Ballroom Dance Experience (Years)	Range of Ballroom Dance Experience (Years)	Weekly Ballroom Training Hours
NEW	20 F + M	21.85 ± 4.57 *	1.73 ± 0.12	76.43 ± 17.14	0 $^{\#}$	0	0 $^{\#}$
	10 F	22.20 ± 4.21	1.64 ± 0.07	72.45 ± 16.65	0	0	0
	10 M	21.50 ± 5.10	1.81 ± 0.09$^{\$}$	80.40 ± 17.55	0	0	0
REC	18 F + M	30.22 ± 5.09	1.71 ± 0.08	72.14 ± 14.46	2.28 ± 1.98 $^{\#}$	0.50 – 7	6.44 ± 8.10 $^{\#}$
	9 F	30.67 ± 4.58	1.65 ± 0.05	62.28 ± 11.40	2.63 ± 2.33	0.58 – 7	7.67 ± 8.96
	9 M	29.78 ± 5.80	1.77 ± 0.06$^{\$}$	82.00 ± 9.79$^{\$}$	1.92 ± 1.61	0.50 – 6	5.22 ± 7.48
PRO	18 F + M	30.78 ± 6.13	1.72 ± 0.11	71.61 ± 16.52	10.49 ± 8.62	1.25 – 30	30.28 ± 17.10
	9 F	28.00 ± 5.79	1.63 ± 0.06	62.28 ± 12.86	8.75 ± 9.07	1.25 – 28	30.11 ± 17.32
	9 M	33.56 ± 5.39	1.80 ± 0.06$^{\$}$	80.94 ± 14.79$^{\$}$	12.22 ± 8.30	2.50 – 30	30.44 ± 17.92
ANOVA *p*-value		$p < 0.001$	$p = 0.870$	$p = 0.599$	$p < 0.001$		$p < 0.001$

Note: NEW = inexperienced; REC = recreational; PRO = professional; F = female; M = male.

*: $p < 0.001$ vs. REC and PRO; $^{\$}$: $^{\#}$: $p < 0.001$ vs. PRO.

$^{\$}$: $p < 0.013$ vs. Females

4 RESULTS

All 56 participants completed the protocol with no adverse events or discomforts reported. There were no differences in mass or height across the three experience levels ($p \geq 0.870$), however, individuals in the inexperienced level were considerably younger than the individuals in the recreational and professional levels ($p < 0.001$). Males were significantly taller than females in all three levels ($p < 0.001$ for all), and males had a significantly greater mass than females in the recreational ($p = 0.001$) and professional ($p = 0.012$) levels. The inexperienced level had no ballroom dance experience, the recreational level had an average of 2.28 years of experience, and the professional level had an average of 10.49 years of experience. Recreational dancers trained an average of 6.44 hours per week while professionals trained an average of 30.28 hours per week (Table 3.1).

Due to the force plate set-up in the lab, there were three partnered dance elements in which the kinetic data were found to be inaccurate for one of the steps as the partners had a foot on the same force plate concurrently. In addition, there were three dance elements in which the results were incorrect for one of the steps because the participant placed two feet on the same force plate, regardless of whether they performed the steps with a partner or not. In both of these cases, the data for the confounded steps were excluded from the analysis (Table 4.1). In addition, a large number of the variables were not normally distributed, in which case non-parametric statistical tests were run (Appendix C).

This section was organized to report the results for the primary outcome measures first, followed by the secondary and then the tertiary outcome measures. Under each category of variables, results for all of the dance movements (individual and partnered) with valid data were reported. The results for each movement began with the comparison among experience levels followed by the comparisons between genders. If there were multiple steps involved in a single dance movement, for example, the rock step involves two steps, the results for each individual step were presented. Non-significant results are not listed in this section.

4.1 Primary Outcome Variables: Force, Loading Rate, and Joint Power

4.1.1 Backward Step Right (BSR)

4.1.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA displayed significant differences among experience levels in the peak vertical GRF ($p < 0.001$), loading rate ($p < 0.001$), peak knee power propulsion ($p < 0.001$), and peak hip power absorption ($p = 0.003$) during the BSR (Table 4.2). Post-hoc tests illustrated a significantly greater peak vertical GRF and loading rate in the inexperienced level compared to both the recreational level ($p <$ 0.001 for both) and the professional level ($p < 0.001$ for both). There was significantly greater peak knee power propulsion in the professional level compared to the inexperienced level ($p <$ 0.001), and significantly less peak hip power absorption in the inexperienced level compared to the recreational level ($p = 0.002$).

4.1.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level illustrated lower ankle power absorption ($p = 0.004$), greater knee power propulsion ($p = 0.001$), and greater hip power absorption ($p = 0.029$) and propulsion ($p = 0.015$) compared to females. There were no significant differences in GRF, loading rate or joint power observed between males and females in the recreational level during the BSR ($p \geq$ 0.190). In the professional level, males illustrated significantly greater hip power absorption compared to females ($p = 0.004$) (Table 4.2).

4.1.2 Backward Step Right with Partner (BSRP)

4.1.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA displayed significant differences among experience levels in the peak vertical GRF ($p < 0.001$), loading rate ($p < 0.001$), peak knee power propulsion ($p = 0.006$), and peak hip power absorption ($p = 0.002$) during the BSRP (Table 4.3). Post-hoc tests revealed a significantly greater peak vertical GRF and loading rate in the inexperienced level compared to both the recreational ($p < 0.001$ for both) and professional ($p < 0.001$ for both) levels. Peak knee power propulsion was significantly greater in the professional level compared to the inexperienced level ($p = 0.005$). Peak hip power absorption was significantly lower in the inexperienced level compared to both the recreational ($p = 0.002$) and professional ($p = 0.040$) levels.

4.1.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly less ankle power absorption ($p = 0.001$) and propulsion ($p = 0.002$), and greater knee ($p = 0.003$) and hip ($p < 0.001$) power propulsion compared to females. There were no significant differences in GRF, loading rate or joint power observed between males and females during the BSRP in either the recreational or professional levels ($p \geq 0.093$) (Table 4.3).

4.1.3 Forward Step Left (FSL)

4.1.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA exhibited significant differences among experience levels in peak vertical GRF ($p = 0.003$), peak ankle ($p < 0.001$), knee ($p < 0.001$) and hip ($p < 0.001$) power absorption, and peak hip power propulsion ($p < 0.001$) during the FSL (Table 4.4). Post-hoc tests illustrated a lower peak vertical GRF in the inexperienced level compared to both the recreational ($p = 0.007$) and professional ($p = 0.011$) levels. Peak power absorption was significantly lower in the inexperienced level compared to both the recreational and professional levels for the ankle ($p = 0.034$ and $p = 0.001$, respectively), knee ($p = 0.025$ and $p < 0.001$, respectively), and hip ($p = 0.001$ and $p < 0.001$, respectively). Additionally, peak power propulsion at the hip was significantly lower in the inexperienced ($p < 0.001$) and recreational ($p = 0.047$) levels compared to the professional level.

4.1.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly lower peak GRF ($p = 0.014$) and loading rate ($p = 0.017$) compared to females. There were no significant differences in GRF, loading rate or joint power between males and females during the FSL in the recreational level ($p \geq 0.077$). Males in the professional level exhibited significantly less hip power absorption than females ($p = 0.014$) (Table 4.4).

4.1.4 Rock Step Back Right (RSBR)

4.1.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA exhibited significant differences among experience levels in peak vertical GRF during the first ($p < 0.001$) and second ($p = 0.016$) steps, ankle ($p < 0.001$) and knee ($p = 0.002$) power propulsion during the first step, ankle power absorption during the second step ($p = 0.017$), knee power absorption ($p = 0.004$) and propulsion ($p = 0.004$) during the second step, and hip power absorption and propulsion during both the first ($p < 0.001$ for both) and second ($p < 0.001$ for both) steps (Table 4.5).

Post-hoc tests revealed that the inexperienced level had a significantly greater GRF compared to both the recreational ($p < 0.001$) and professional ($p = 0.001$) levels during the first step, but a lower GRF compared to recreational level ($p = 0.013$) during the second step. The inexperienced level also had a significantly greater loading rate during the first step compared to both the recreational ($p = 0.009$) and professional ($p < 0.001$) levels. Ankle power propulsion during the first step was greater for the professional level compared to the inexperienced ($p < 0.001$) and recreational (p = 0.001) levels. Ankle power absorption during the second step was greater for the professional level than the inexperienced level (p = 0.016). Peak knee power propulsion during the first step was also greater in the professional level than the inexperienced level (p = 0.002). The inexperienced level exhibited significantly lower peak knee power absorption and propulsion during the second step compared to both the recreational (p = 0.047 and p = 0.043, respectively) and professional (p = 0.004 and p = 0.006, respectively) levels. Peak hip power absorption during the first step was greater in the professional level compared to the inexperienced level ($p < 0.001$), while peak hip power propulsion during the first step was greater in the professional level compared to both the inexperienced ($p < 0.001$) and recreational (p = 0.011) levels. Peak hip power absorption during the second step was significantly different across all comparisons with the recreational level displaying significantly greater peak hip power absorption compared to the inexperienced level (p = 0.015) and the professional level displaying significantly greater peak hip power absorption compared to both the inexperienced ($p < 0.001$) and recreational (p = 0.048) levels. Finally, the professional level demonstrated significantly greater peak hip power propulsion during the second step compared to both the inexperienced (p = 0.001) and recreational (p = 0.007) levels.

4.1.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly lower GRF during the second step (p = 0.043), less ankle power absorption (p = 0.009), and greater knee and hip power absorption (p = 0.043 and $p < 0.001$, respectively) and propulsion (p = 0.035 and p = 0.007, respectively) during the first step compared to females. Males in the recreational level illustrated significantly less hip power absorption during the second step compared to females (p = 0.003). In the professional level, males exhibited a significantly lower peak vertical GRF ($p = 0.014$), and less peak hip power absorption ($p = 0.008$) during the second step compared to females (Table 4.5).

4.1.5 Rock Step Back Right with Partner (RSBRP)

4.1.5.1 Comparison Among Experience Levels. Results for the second step of the RSBRP were affected by the partner. Therefore, results are only presented for the first step. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF ($p < 0.001$), loading rate ($p < 0.001$), peak ankle ($p = 0.012$) and knee ($p = 0.011$) power propulsion, and peak hip power absorption ($p < 0.001$) and propulsion ($p < 0.001$) (Table 4.6).

Post-hoc results showed a significantly greater peak GRF and loading rate in the inexperienced level compared to the recreational ($p < 0.001$ and $p = 0.027$, respectively) and professional ($p < 0.001$ for both) levels. The inexperienced level also demonstrated less peak ankle ($p = 0.009$) and knee ($p = 0.011$) power propulsion and less hip power absorption ($p < 0.001$) compared to the professional level. Peak hip power propulsion was greater in the professional level compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.031$) levels.

4.1.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level illustrated significantly less peak ankle power absorption ($p < 0.001$) and propulsion ($p = 0.002$), but significantly greater peak knee and hip power absorption ($p = 0.008$ and $p < 0.001$, respectively) and propulsion ($p = 0.017$ and $p < 0.001$, respectively) compared to females. No differences in GRF, loading rate or joint power were seen between males and females in the recreational level during the RSBRP ($p \geq 0.114$). Amid the professional level, males had a significantly greater peak vertical GRF than females ($p = 0.024$) (Table 4.6).

4.1.6 Rock Step Forward Left (RSFL)

4.1.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA displayed significant differences among experience levels in the peak vertical GRF and loading rate during the first ($p < 0.001$ and $p = 0.010$, respectively) and second ($p < 0.001$ for both) steps, peak ankle power propulsion ($p = 0.001$) and peak knee power absorption during the first step ($p < 0.001$), peak knee power propulsion during the first ($p < 0.001$) and second ($p < 0.001$) steps, and peak hip power absorption and propulsion during the first ($p < 0.001$ and $p < 0.001$, respectively) and second ($p = 0.033$ and $p = 0.004$, respectively) steps of the RSFL (Table 4.7).

Post-hoc tests revealed a significantly lower peak GRF in the inexperienced level compared to both the recreational ($p = 0.006$) and professional ($p < 0.001$) levels in the first step. However, the professional level illustrated a significantly lower peak GRF compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.020$) levels during the second step. The inexperienced level also exhibited a significantly greater loading rate during both the first ($p = 0.008$) and second ($p < 0.001$) steps compared to the professional level.

For joint power, the inexperienced level illustrated significantly less peak ankle power propulsion during the first step than the recreational ($p = 0.012$) and professional ($p = 0.003$) levels. Peak knee power absorption during the first step was significantly different across all comparisons with the recreational level displaying significantly greater knee power absorption than the inexperienced level ($p = 0.017$), and the professional level displaying significantly greater knee power absorption than both the inexperienced ($p < 0.001$) and recreational ($p = 0.043$) levels. Peak knee power propulsion during the first step was significantly greater in the professional level than in the inexperienced ($p < 0.001$) and recreational ($p = 0.024$) levels, while peak knee power propulsion during the second step was significantly different across all comparisons, with the recreational level showing significantly greater knee power propulsion than the inexperienced level ($p = 0.014$) and the professional level exhibiting significantly greater knee power propulsion than both the inexperienced ($p < 0.001$) and recreational ($p = 0.035$) levels. At the hip, peak power absorption and propulsion were significantly different across all comparisons during the first step, with the recreational level displaying greater hip power absorption and propulsion than the inexperienced level ($p = 0.008$ and $p = 0.014$, respectively), and the professional level displaying greater power absorption and propulsion than both the inexperienced ($p < 0.001$ for both) and recreational ($p = 0.006$ and $p = 0.009$, respectively) levels. During the second step, the professional level demonstrated greater peak hip power absorption ($p = 0.027$) and propulsion ($p = 0.003$) than the inexperienced level.

4.1.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests demonstrated that in the inexperienced level, males illustrated significantly less peak ankle power absorption ($p = 0.023$), and greater knee ($p = 0.002$) and hip ($p = 0.011$) power propulsion during the second step compared to females. There were no significant differences in GRF, loading rate or joint power between males and females during the RFSL in the recreational or professional levels ($p \geq 0.136$) (Table 4.7).

4.1.7 Rock Step Forward Left with Partner (RSFLP)

4.1.7.1 Comparison Among Experience Levels. Results for the first step of the RSFLP were affected by the partner. Thus, results are only reported for the second step. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF ($p < 0.001$), loading rate ($p < 0.001$), peak knee power absorption ($p = 0.006$) and propulsion ($p < 0.001$), and peak hip power propulsion ($p = 0.029$) (Table 4.8).

Post-hoc results revealed a significantly greater peak vertical GRF and loading rate in the inexperienced level compared to both the recreational ($p < 0.001$ and $p = 0.020$, respectively) and professional ($p < 0.001$ for both) levels. At the knee, the inexperienced level illustrated significantly less joint power absorption and propulsion than both the recreational ($p = 0.040$ and $p = 0.030$, respectively) and professional ($p = 0.009$ and $p < 0.001$, respectively) levels. The inexperienced level also showed significantly less hip power propulsion compared to the professional level ($p = 0.026$).

4.1.7.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the inexperienced level displayed significantly less peak ankle power absorption ($p = 0.022$), and greater peak knee ($p = 0.043$) and hip ($p = 0.017$) power propulsion compared to females. In the recreational level, males illustrated a significantly higher loading rate than females ($p = 0.046$). Males in the professional level exhibited a significantly greater peak vertical GRF than females ($p = 0.024$) (Table 4.8).

4.1.8 Side Step Left (SSL)

4.1.8.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the loading rate ($p = 0.013$), peak ankle power absorption ($p < 0.001$), peak knee power propulsion ($p = 0.013$) and peak hip power absorption ($p = 0.010$) (Table 4.9).

Post-hoc tests revealed a greater loading rate in the inexperienced level compared to the professional level ($p = 0.011$). The inexperienced level displayed greater peak ankle power absorption compared to both the recreational ($p = 0.006$) and professional ($p = 0.003$) levels, less peak knee power propulsion compared to the professional level ($p = 0.011$), and less peak hip power absorption compared to the recreational level ($p = 0.007$).

4.1.8.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated significantly greater peak knee ($p = 0.002$) and hip ($p = 0.003$) power propulsion than females. Males in the recreational level exhibited significantly greater peak ankle power absorption than females ($p = 0.014$). There were no significant differences in GRF, loading rate or joint power between genders during the SSL in the professional level ($p \geq 0.113$) (Table 4.9).

4.1.9 Side Step Left with Partner (SSLP)

4.1.9.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the loading rate ($p = 0.041$), peak ankle power absorption ($p < 0.001$), and peak hip power absorption ($p = 0.049$) and propulsion ($p = 0.002$) (Table 4.10).

Post-hoc results showed that the professional level demonstrated a significantly lower loading rate than the recreational level ($p = 0.046$). The inexperienced level illustrated significantly greater peak ankle power absorption compared to both the recreational ($p < 0.001$) and professional ($p = 0.004$) levels. Differences in peak hip power absorption were insignificant following post-hoc comparisons ($p \geq 0.053$), Peak hip power propulsion was significantly greater in the professional level than the inexperienced ($p = 0.004$) and recreational ($p = 0.011$) levels.

4.1.9.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males exhibited significantly greater knee ($p = 0.035$) and hip ($p = 0.002$) power propulsion compared to females. In both the recreational and professional levels, males exhibited a significantly greater peak vertical GRF ($p = 0.011$ and $p = 0.004$, respectively) than females (Table 4.10).

4.1.10 Side Step Right (SSR)

4.1.10.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF ($p = 0.044$), peak ankle power absorption ($p = 0.002$), peak knee power absorption ($p < 0.001$) and propulsion ($p = 0.032$), and peak hip power absorption ($p < 0.001$) and propulsion ($p < 0.001$) (Table 4.11).

Post-hoc comparisons showed that the inexperienced level demonstrated a lower peak vertical GRF than the recreational level ($p = 0.046$), and greater peak ankle power absorption compared to both the recreational ($p = 0.004$) and professional ($p = 0.014$) levels. The inexperienced level also illustrated less peak knee and hip power absorption compared to both the recreational ($p < 0.001$ for both) and professional ($p < 0.001$ for both) levels, as well as less peak hip power propulsion compared to the recreational ($p = 0.014$) and professional ($p < 0.001$) levels. Knee power propulsion became insignificant following post-hoc comparisons ($p \geq 0.063$).

4.1.10.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed a significantly lower peak vertical GRF than females ($p = 0.040$). There were no significant differences in GRF, loading rate, or joint power between males and females during the SSR in the recreational level during the SSR ($p \geq 0.094$). In the professional level, males exhibited significantly greater peak ankle power absorption ($p = 0.031$) and propulsion ($p = 0.002$), as well as greater peak knee power propulsion ($p = 0.036$) compared to females (Table 4.11).

4.1.11 Side Step Right with Partner (SSRP)

4.1.11.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the loading rate (*p*

= 0.002), peak ankle ($p = 0.004$) and knee ($p < 0.001$) power absorption, and peak hip power absorption ($p = 0.002$) and propulsion ($p < 0.001$) (Table 4.12).

Post-hoc results indicated that the inexperienced level displayed a greater loading rate than both the recreational ($p = 0.038$) and professional ($p = 0.002$) levels, greater peak ankle power absorption compared to the recreational level ($p = 0.003$), less peak knee and hip power absorption than both the recreational ($p < 0.001$ and $p = 0.005$, respectively) and professional ($p < 0.001$ and $p = 0.009$, respectively) levels, and less peak hip power propulsion compared to the recreational ($p = 0.001$) and professional ($p < 0.001$) levels.

4.1.11.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in the GRF, loading rate or joint power between males and females during the SSRP in the inexperienced level ($p \geq 0.075$). Males exhibited a greater GRF than females in both the recreational ($p = 0.008$) and the professional ($p = 0.014$) levels (Table 4.12).

4.1.12 Spot Turn (ST)

4.1.12.1 Comparison Among Experience Levels. Results for the final step of the ST were inaccurate due to participants having two feet on the same force plate, leading to results only being presented for the initial step. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF ($p < 0.001$), peak ankle ($p = 0.002$) and knee ($p < 0.001$) power absorption, and peak hip power absorption ($p = 0.008$) and propulsion ($p < 0.001$) (Table 4.13).

Post-hoc results revealed that the inexperienced level exhibited a significantly lower peak vertical GRF compared to the recreational ($p = 0.001$) and professional ($p = 0.003$) levels, less peak ankle power absorption compared to the professional level ($p = 0.002$), and less peak knee power absorption and hip power propulsion compared to the recreational ($p = 0.005$ and $p =$

0.043, respectively) and professional ($p = 0.001$ and $p < 0.001$, respectively) levels. Peak hip power absorption was also significantly greater in the professional level compared to the inexperienced ($p = 0.013$) and recreational ($p = 0.034$) levels.

4.1.12.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly lower peak ankle power propulsion ($p < 0.001$), and greater peak knee power propulsion ($p = 0.023$) compared to females. Males in the recreational level demonstrated greater peak ankle power absorption ($p = 0.019$) and greater peak hip power propulsion ($p = 0.031$) than females. In the professional level, males had a lower peak GRF ($p = 0.040$), greater peak knee power propulsion ($p = 0.019$) and greater peak hip power absorption ($p = 0.014$) compared to females (Table 4.13).

4.1.13 Spot Turn with Partner (STP)

4.1.13.1 Comparison Among Experience Levels. Results are only presented for the initial step since the GRF for the final step of the STP were inaccurate due to participants having two feet on the same force plate. Kruskal-Wallis/ANOVA results displayed significant differences among experience levels in the peak vertical GRF ($p = 0.002$), peak ankle ($p = 0.009$) and knee ($p < 0.001$) power absorption, and peak knee ($p = 0.035$) and hip ($p < 0.001$) power propulsion (Table 4.14).

Post-hoc tests illustrated that the inexperienced level exhibited a lower peak vertical GRF compared to the recreational ($p = 0.005$) and professional ($p = 0.011$) levels, lower peak ankle and knee power absorption compared to the recreational ($p = 0.014$ and $p < 0.001$, respectively) and professional ($p = 0.045$ and $p < 0.001$, respectively) levels, greater peak knee power propulsion compared to the recreational level ($p = 0.030$), and lower peak hip power propulsion than both the recreational ($p = 0.001$) and professional ($p = 0.001$) levels.

4.1.13.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males displayed significantly less peak ankle power propulsion ($p = 0.018$), and greater peak knee power propulsion ($p = 0.043$) compared to females. In the recreational level, males demonstrated a greater loading rate ($p = 0.021$), and greater peak ankle power absorption compared to females ($p < 0.001$). Males in the professional level exhibited greater peak hip power propulsion than females ($p = 0.019$) (Table 4.14).

4.1.14 Triple Step Left (TSL)

4.1.14.1 Comparison Among Experience Levels. Results for the middle step (step two) of the TSL were inexact because the participants placed two feet on the same force plate. Thus, results are only presented for steps one and three. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF during the first ($p = 0.007$) and third ($p = 0.044$) steps, loading rate ($p = 0.004$) and peak ankle power absorption ($p = 0.013$) during the third step, peak knee power absorption and propulsion during the first ($p = 0.006$ and $p = 0.002$, respectively) and third ($p < 0.001$ and $p = 0.007$, respectively) steps, peak hip power absorption ($p = 0.003$) and propulsion ($p < 0.001$) during the first step, and peak hip power propulsion during the third step ($p = 0.003$) (Table 4.15).

Post-hoc comparisons revealed that the inexperienced level demonstrated a significantly greater peak vertical GRF during the first step and loading rate during the third step compared to the recreational ($p = 0.034$ and $p = 0.045$, respectively) and professional ($p = 0.011$ and $p = 0.006$, respectively) levels. Differences in the peak vertical GRF during the third step were insignificant following post-hoc comparisons ($p \geq 0.062$). The inexperienced level also illustrated greater peak ankle power absorption during the third step compared to the recreational level ($p = 0.015$), and less peak knee power absorption compared to the recreational and professional levels during both the first (p = 0.022 and p = 0.017, respectively) and third (p = 0.001 and p = 0.008, respectively) steps. Knee power propulsion was significantly greater in the professional level compared to both the inexperienced (p = 0.001) and recreational (p = 0.036) levels during the first step, and knee power propulsion was significantly greater in the professional level compared to the inexperienced level during the third step (p = 0.005). The inexperienced level exhibited significantly less peak hip power absorption compared to the professional level (p = 0.002), and less peak hip power propulsion compared to both the recreational (p = 0.003) and professional ($p < 0.001$) levels during the first step, and lower peak hip power propulsion compared to the professional level (p = 0.002) during the second step.

4.1.14.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly lower peak vertical GRF during the first step (p = 0.016), lower peak hip power absorption during the first step (p = 0.009), and greater peak hip power propulsion during the third step (p = 0.007) compared to females. There were no significant differences in GRF, loading rate or joint power between males and females during the TSL in the recreational and professional levels ($p \geq 0.063$) (Table 4.15).

4.1.15 Triple Step Left with Partner (TSLP)

4.1.15.1 Comparison Among Experience Levels. Results are only presented for steps one and three because results for the middle step (step two) of the TSLP were inaccurate due to the participant placing two feet on the same force plate. Results of the Kruskal-Wallis/ANOVA displayed significant differences among experience levels in the peak vertical GRF of the first (p = 0.003) and third (p = 0.008) steps, the loading rate of the third step ($p < 0.001$), peak ankle power propulsion during the first step (p = 0.040) and peak ankle power absorption during the third step (p = 0.047), peak knee absorption and propulsion during the first (p = 0.008 and p =

0.002, respectively) and third ($p < 0.001$ and $p = 0.010$, respectively) steps, and peak hip absorption and propulsion during the first ($p < 0.001$ for both) and third ($p = 0.017$ and $p = 0.031$, respectively) steps of the TSLP (Table 4.16).

Post-hoc results showed that the inexperienced level exhibited a greater peak vertical GRF compared to the recreational ($p = 0.046$) and professional ($p = 0.004$) levels during the first step, and a greater peak vertical GRF compared to the professional level ($p = 0.010$) during the third step. The professional level illustrated a significantly lower loading rate compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.005$) levels during the third step, and greater peak ankle power propulsion during the first step compared to the inexperienced level ($p = 0.041$), however, differences in ankle power absorption during the third step were insignificant following post-hoc comparisons ($p \geq 0.082$). The inexperienced level displayed significantly less peak knee power absorption compared to both the recreational and professional levels during the first ($p = 0.016$ and $p = 0.035$, respectively) and third ($p < 0.001$ and $p = 0.018$, respectively) steps, and significantly less peak knee power propulsion compared to the professional level during the first ($p = 0.001$) and third ($p = 0.008$) steps. The professional level illustrated significantly greater peak hip power absorption compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.030$) levels, while peak hip power propulsion was significantly lower in the inexperienced level compared to the recreational ($p = 0.002$) and professional ($p < 0.001$) levels during the first step. The inexperienced level displayed lower peak hip power absorption compared to the recreational level ($p = 0.016$) and lower peak hip power propulsion compared to the professional level ($p = 0.030$) during the third step.

4.1.15.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level exhibited significantly greater peak knee ($p = 0.009$) and hip ($p = 0.002$) power propulsion during the third step compared to females. There were no significant differences in GRF, loading rate or joint power between males and females during the TSLP in the recreational level ($p \geq 0.063$). In the professional level, males illustrated a significantly greater peak vertical GRF ($p = 0.004$), and lower peak hip power absorption ($p = 0.040$) during the third step than females (Table 4.16).

4.1.16 Triple Step Right (TSR)

4.1.16.1 Comparison Among Experience Levels. Results for the second step of the TSR were confounded due to the participant placing two feet on the same force plate, so results are only presented for steps one and three. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF during the first ($p < 0.001$) and third ($p = 0.012$) steps, loading rate ($p < 0.001$) and peak ankle power absorption ($p = 0.014$) during the third step, peak knee power absorption during the first ($p = 0.002$) and third ($p < 0.001$) steps, peak knee power propulsion during the first step ($p = 0.017$), peak hip power propulsion during the first ($p < 0.001$) and third ($p < 0.001$) steps, and peak hip power absorption during the third step ($p < 0.001$) (Table 4.17).

Post-hoc tests illustrated that the inexperienced level exhibited a greater peak vertical GRF compared to both the recreational ($p = 0.003$) and professional ($p = 0.001$) levels during the first step, and compared to the professional level during the third step ($p = 0.011$), as well as a greater loading rate compared to both the recreational ($p = 0.020$) and professional ($p < 0.001$) levels during the third step. The inexperienced level also displayed greater peak ankle power absorption compared to the recreational level during the third step ($p = 0.026$), less peak knee power absorption ($p = 0.002$) and propulsion ($p = 0.017$) compared to the professional level during the first step, and less peak knee power absorption compared to both the recreational ($p <$

0.001) and professional ($p < 0.001$) levels during the third step. For the hip, the inexperienced level demonstrated significantly lower peak hip power absorption and propulsion compared to both the recreational ($p = 0.010$ and $p = 0.022$, respectively) and professional ($p < 0.001$ for both) levels during the first step. Peak hip power propulsion during the third step was significantly different across all comparisons with the recreational level demonstrating greater hip power propulsion than the inexperienced level ($p = 0.003$), and the professional level displaying greater hip power propulsion than both the inexperienced ($p < 0.001$) and recreational ($p = 0.042$) levels.

4.1.16.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that in the inexperienced level, males illustrated a significantly lower peak vertical GRF ($p = 0.035$) during the third step, a lower loading rate ($p = 0.002$), and less peak ankle power absorption ($p < 0.001$) during the first step, and less hip power absorption during both the first ($p = 0.007$) and third ($p = 0.020$) steps compared to females. There were no significant differences in the GRF, loading rate or joint power between males and females during the TSR in the recreational and professional levels ($p \geq 0.063$) (Table 4.17).

4.1.17 Triple Step Right with Partner (TSRP)

4.1.17.1 Comparison Among Experience Levels. Results for the second step of the TSRP were inaccurate since the participant placed two feet on the same force plate. Therefore, results are only presented for steps one and three. Results of the Kruskal-Wallis/ANOVA demonstrated significant differences among experience levels in the peak vertical GRF during the first step ($p = 0.003$), loading rate during the third step ($p = 0.001$), peak knee power absorption during the first ($p = 0.013$) and third ($p < 0.001$) steps, peak knee power propulsion during the first step ($p = 0.049$), peak hip power propulsion during the first ($p < 0.001$) and third ($p < 0.001$) steps, and peak hip power absorption during the third step ($p = 0.003$) (Table 4.18).

Post-hoc comparisons showed that the inexperienced level illustrated a significantly greater peak vertical GRF during the first step and loading rate during the third step compared to both the recreational ($p = 0.008$ and $p = 0.037$, respectively) and professional ($p = 0.017$ and $p = 0.001$) levels. The inexperienced level also exhibited lower peak knee power absorption ($p = 0.019$) and propulsion ($p = 0.048$) during the first step compared to the professional level, and lower peak knee power absorption during the third step than both the recreational ($p = 0.003$) and professional ($p < 0.001$) levels, lower peak hip power propulsion relative to the recreational and professional levels during the first ($p < 0.001$ for both) and third ($p = 0.003$ and $p < 0.001$, respectively) steps, and lower peak hip power absorption during the third step compared to the professional level ($p = 0.003$).

4.1.17.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly lower loading rate ($p = 0.030$) and decreased power absorption at the ankle ($p < 0.001$) and hip ($p = 0.035$) during the first step compared to females during the first step. Males in the recreational level showed lower peak hip power absorption than females during the third step ($p = 0.008$). There were no significant differences in loading or joint power between males and females during the TSRP in the professional level ($p \geq 0.050$) (Table 4.18).

4.2 Secondary Outcome Variables: Joint Moments and Joint Angles

4.2.1 Backward Step Right (BSR)

4.2.1.1 Sagittal Plane Joint Moments.

4.2.1.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated no significant differences among experience levels for any of the peak sagittal plane joint moments during the BSR ($p \geq 0.202$) (Table 4.19).

4.2.1.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly greater ankle dorsiflexion moment ($p = 0.002$), knee extension moment ($p = 0.009$), and hip flexion moment ($p = 0.015$) compared to females. There were no significant differences in peak sagittal plane joint moments between males and females during the BSR in the recreational level ($p \geq 0.161$). In the professional level, males showed a significantly greater knee extension moment than females ($p = 0.031$) (Table 4.19).

4.2.1.2 Frontal Plane Joint Moments.

4.2.1.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSR in the peak ankle inversion moment ($p = 0.005$), and peak knee ($p = 0.004$) and hip ($p = 0.004$) adduction moments (Table 4.20). Post-hoc comparisons showed that the inexperienced level displayed significantly smaller ankle inversion ($p = 0.005$), knee adduction ($p = 0.003$) and hip adduction ($p = 0.003$) moments compared to the professional level.

4.2.1.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males exhibited significantly greater peak knee ($p = 0.011$) and hip ($p = 0.011$) adduction moments compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the BSR in the recreational or professional levels ($p \geq 0.050$) (Table 4.20).

4.2.1.3 Transverse Plane Joint Moments.

4.2.1.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSR in the peak ankle ($p = 0.001$) and knee ($p < 0.001$) internal rotation moments (Table 4.21). Post-hoc comparisons showed that the professional level illustrated a significantly greater ankle internal rotation moment compared to both the inexperienced ($p = 0.003$) and recreational ($p = 0.004$) levels, and a significantly greater knee internal rotation moment compared to the inexperienced level ($p < 0.001$).

4.2.1.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly greater peak hip external rotation moment compared to females ($p = 0.002$). In the recreational level, males demonstrated greater peak ankle ($p = 0.004$) and knee ($p < 0.001$) external rotation moments compared to females. There were no significant differences in peak transverse plane joint moments between males and females in the professional level during the BSR ($p \geq 0.161$) (Table 4.21).

4.2.1.4 Sagittal Plane Joint Angles.

4.2.1.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSR in the peak ankle plantarflexion ($p = 0.034$) and hip flexion ($p < 0.001$) angles (Table 4.22). Post-hoc comparisons showed that the professional level demonstrated a significantly greater peak plantarflexion angle than the recreational level ($p = 0.049$). The inexperienced level demonstrated a significantly smaller peak hip flexion angle compared to both the recreational ($p < 0.001$) and professional ($p < 0.001$) levels.

4.2.1.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males displayed significantly greater peak knee extension angles and smaller peak knee flexion angles compared to females in both the inexperienced ($p = 0.004$ and $p = 0.001$, respectively) and recreational ($p < 0.001$ for both) levels. There were no significant differences in sagittal plane joint angles between males and females during the BSR in the professional level ($p \geq 0.149$) (Table 4.22).

4.2.1.5 Frontal Plane Joint Angles.

4.2.1.5.1 Comparison Among Experience Levels. Results of the ANOVA illustrated significant differences among experience levels during the BSR in the peak knee and hip abduction ($p < 0.001$ and $p = 0.038$, respectively) and adduction ($p < 0.001$ and $p = 0.046$, respectively) joint angles (Table 4.23). Post-hoc comparisons revealed that the professional level illustrated a significantly greater peak knee abduction angle compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.039$) levels, a significantly greater peak knee adduction angle compared to the inexperienced level ($p < 0.001$), and a significantly greater peak hip abduction angle compared to the recreational level ($p = 0.034$). The recreational level displayed a significantly greater peak hip adduction angle than the inexperienced level ($p = 0.044$).

4.2.1.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males showed a significantly smaller peak ankle eversion angle ($p = 0.029$), and a greater peak ankle inversion angle ($p = 0.011$) compared to females. In the recreational level, males demonstrated a significantly greater peak hip adduction angle relative to females (p = 0.040). There were no significant differences in peak frontal plane joint angles between males and females during the BSR in the professional level ($p \geq 0.136$) (Table 4.23).

4.2.1.6 Transverse Plane Joint Angles.

4.2.1.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSR in the peak ankle internal rotation angle (p = 0.027), and peak knee external ($p < 0.001$) and internal (p = 0.003) rotation angles (Table 4.24). Post-hoc comparisons showed that the professional level displayed a significantly greater peak ankle internal rotation angle compared to the recreational level (p = 0.023), and a greater peak knee external rotation angle and smaller knee internal rotation angle compared to both the inexperienced ($p < 0.001$ and p = 0.004, respectively) and recreational (p = 0.006 and p = 0.024, respectively) levels.

4.2.1.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males displayed a significantly greater peak ankle external rotation angle (p = 0.015), a smaller peak ankle internal rotation angle (p = 0.018), a smaller peak knee external rotation angle (p = 0.011) and a larger peak knee internal rotation angle (p = 0.005) compared to females. In the recreational level, males exhibited a smaller peak hip external rotation angle (p = 0.004), and a greater peak hip internal rotation angle compared to females (p = 0.035). There were no significant differences in peak transverse plane joint angles between males and females during the BSR in the professional level ($p \geq 0.486$) (Table 4.24).

4.2.2 Backward Step Right with Partner (BSRP)

4.2.2.1 Sagittal Plane Joint Moments.

4.2.2.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated a significant difference among experience levels during the BSRP in only the peak knee flexion moment ($p = 0.011$) (Table 4.25). Post-hoc tests indicated that the inexperienced level exhibited a significantly smaller peak knee flexion moment than the recreational level ($p = 0.014$).

4.2.2.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a significantly greater peak ankle dorsiflexion moment ($p = 0.004$), a smaller peak ankle plantarflexion moment ($p = 0.002$), a smaller peak knee flexion moment ($p = 0.006$), a greater peak knee extension moment ($p = 0.001$), a greater peak hip flexion moment ($p < 0.001$), and a smaller peak hip extension moment ($p = 0.011$) compared to females. There were no significant differences in peak sagittal plane joint moments between males and females during the BSRP in the recreational or professional levels ($p \geq 0.200$) (Table 4.25).

4.2.2.2 Frontal Plane Joint Moments.

4.2.2.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated no significant differences in frontal plane joint moments among experience levels during the BSRP ($p \geq 0.096$) (Table 4.26).

4.2.2.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited a significantly greater peak ankle inversion moment ($p < 0.001$), and peak knee ($p = 0.003$) and hip ($p = 0.004$) adduction moments in comparison to the females. There were no significant differences in frontal plane joint moments between males and females during the BSRP in the recreational or professional levels ($p \geq 0.290$) (Table 4.26).

4.2.2.3 Transverse Plane Joint Moments.

4.2.2.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated a significant difference among experience levels during the BSRP in only the peak ankle internal rotation moment ($p = 0.002$) (Table 4.27). Post-hoc results showed that the professional level had a significantly greater peak ankle internal rotation moment compared to the inexperienced level ($p = 0.001$).

4.2.2.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated a greater peak knee internal rotation moment ($p = 0.006$) and a greater peak hip external rotation moment ($p = 0.004$) compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the BSRP in the recreational or professional levels ($p \geq 0.055$) (Table 4.27).

4.2.2.4 Sagittal Plane Joint Angles.

4.2.2.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSRP in the peak ankle plantarflexion angle ($p = 0.021$) and peak hip flexion angle ($p < 0.001$) (Table 4.28). Post-hoc comparisons revealed that the professional level illustrated greater peak ankle plantarflexion than the inexperienced level ($p = 0.017$). The inexperienced level displayed less peak hip flexion than both the recreational ($p = 0.001$) and professional ($p < 0.001$) levels.

4.2.2.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males demonstrated a significantly smaller peak knee flexion angle ($p = 0.016$) compared to females. In the recreational level, males exhibited significantly less peak plantarflexion ($p = 0.026$), greater peak knee extension ($p < 0.001$) and less peak knee flexion ($p < 0.001$) compared to females. In the professional level, males displayed significantly greater peak ankle dorsiflexion ($p = 0.036$), and significantly less peak hip extension ($p = 0.034$) compared to females (Table 4.28).

4.2.2.5 Frontal Plane Joint Angles.

4.2.2.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSRP in the peak knee abduction ($p < 0.001$) and adduction ($p = 0.002$) angles, and in the peak hip abduction ($p = 0.019$) angle (Table 4.29). Post-hoc comparisons showed that the professional level illustrated significantly greater peak knee abduction compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.019$) levels, greater peak knee adduction compared to the inexperienced level ($p = 0.002$), and greater peak hip abduction compared to the recreational level ($p = 0.036$).

4.2.2.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly less peak knee abduction than females ($p = 0.006$). In the recreational level, males demonstrated greater peak ankle eversion compared to females ($p = 0.005$). There were no significant differences in peak frontal plane joint angles between males and females in the professional level ($p \geq 0.541$) (Table 4.29).

4.2.2.6 Transverse Plane Joint Angles.

4.2.2.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the BSRP in the peak knee external ($p = 0.002$) and internal ($p = 0.003$) rotation angles (Table 4.30). Post-hoc results showed significantly greater peak knee external rotation in the professional level compared to both the inexperienced ($p = 0.002$) and recreational ($p = 0.040$) levels, and less peak knee internal rotation compared to the inexperienced level ($p = 0.003$).

4.2.2.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the recreational level, males exhibited significantly less peak ankle internal rotation (p = 0.008), less peak hip external rotation (p = 0.041), and greater peak hip internal rotation (p = 0.026) than females. There were no significant differences in peak transverse plane joint angles between males and females in the inexperienced or professional levels ($p \geq 0.050$) (Table 4.30).

4.2.3 Forward Step Left (FSL)

4.2.3.1 Sagittal Plane Joint Moments.

4.2.3.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSL in the peak ankle dorsiflexion ($p < 0.001$) and peak hip flexion (p = 0.039) moments (Table 4.31). Post-hoc comparisons showed that the inexperienced level demonstrated a significantly greater peak ankle dorsiflexion moment compared to the recreational (p = 0.018) and professional ($p < 0.001$) levels, and a smaller peak hip flexion moment compared to the professional level (p = 0.035).

4.2.3.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated a significantly greater peak knee flexion moment (p = 0.010) and a greater peak hip extension moment (p = 0.022) compared to females. In the recreational level, males also had a greater peak hip extension moment compared to females (p = 0.028). In the professional level, males exhibited a greater peak knee flexion moment (p = 0.006) and smaller peak knee extension moment (p = 0.006), and a smaller peak hip flexion moment ($p < 0.001$) and greater peak hip extension moment ($p < 0.001$) compared to females (Table 4.31).

4.2.3.2 Frontal Plane Joint Moments.

4.2.3.2.1 Comparison Among Experience Levels. Results of the ANOVA illustrated no significant differences in peak frontal plane joint moments among experience levels during the FSL ($p \geq 0.068$) (Table 4.32).

4.2.3.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the professional level, males displayed a significantly greater peak ankle inversion moment ($p = 0.008$), a smaller peak ankle eversion moment ($p = 0.049$), and a greater peak hip adduction moment ($p = 0.001$) compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the FSL in the inexperienced or recreational levels ($p \geq 0.083$) (Table 4.32).

4.2.3.3 Transverse Plane Joint Moments.

4.2.3.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSL in the peak hip internal ($p = 0.024$) and external ($p = 0.015$) rotation moments (Table 4.33). Post-hoc tests showed that the peak hip internal rotation moment was significantly smaller in the inexperienced level compared to the recreational level ($p = 0.027$). The peak hip external rotation moment was significantly greater in the professional level than both the inexperienced ($p = 0.031$) and recreational ($p = 0.039$) levels.

4.2.3.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in peak transverse joint moments between males and females during the FSL in any level ($p \geq 0.156$) (Table 4.33).

4.2.3.4 Sagittal Plane Joint Angles.

4.2.3.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSL in the peak ankle dorsiflexion angle ($p = 0.038$), and peak knee ($p < 0.001$) and hip ($p < 0.001$) flexion angles (Table 4.34). Post-hoc tests revealed that the inexperienced level displayed significantly less peak ankle dorsiflexion compared to the recreational level ($p = 0.033$), and less peak knee flexion compared to the professional level ($p < 0.001$). Peak hip flexion was significantly different across all comparisons with a greater hip flexion angle in the recreational level compared to the inexperienced level ($p = 0.017$), and a greater hip flexion angle in the professional level compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.007$) levels.

4.2.3.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests demonstrated that in the inexperienced level, males exhibited significantly less peak ankle plantarflexion ($p = 0.041$), peak ankle dorsiflexion ($p = 0.006$) and peak hip flexion ($p = 0.003$) than females. In the recreational level, males displayed significantly less peak hip flexion compared to females ($p = 0.014$). In the professional level, males demonstrated significantly less peak ankle plantarflexion than females ($p = 0.023$) (Table 4.34).

4.2.3.5 Frontal Plane Joint Angles.

4.2.3.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSL in the peak knee adduction ($p = 0.040$) and peak hip abduction ($p < 0.001$) angles (Table 4.35). Post-hoc results revealed significant differences across all comparisons in the peak hip abduction angle, with the recreational level exhibiting greater peak hip abduction than the inexperienced level ($p = 0.047$), and the professional level revealing greater peak hip abduction compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.001$) levels. Differences in peak knee adduction were insignificant following post-hoc comparisons ($p \geq 0.063$).

4.2.3.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in peak frontal plane joint angles between males and females during the FSL in the inexperienced level ($p \geq 0.065$). In the recreational level, males illustrated significantly greater peak knee adduction than females ($p = 0.028$). In the professional level, males displayed significantly less peak ankle eversion ($p = 0.027$) and peak knee abduction ($p = 0.024$), and greater peak ankle inversion ($p = 0.003$) and peak knee adduction ($p = 0.001$) compared to females (Table 4.35).

4.2.3.6 Transverse Plane Joint Angles.

4.2.3.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the FSL in the peak hip external ($p < 0.001$) and internal ($p = 0.008$) rotation angles (Table 4.36). Post-hoc tests revealed that the professional level displayed significantly greater peak hip external rotation, but less peak hip internal rotation compared to both the inexperienced ($p < 0.001$ and $p = 0.017$, respectively) and the recreational ($p = 0.013$ and $p = 0.025$, respectively) levels.

4.2.3.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly less peak hip external rotation ($p = 0.010$) and greater peak hip internal rotation ($p = 0.007$) compared to females. In the recreational level, males demonstrated significantly less peak knee external rotation ($p = 0.033$) and greater peak knee internal rotation ($p = 0.034$) compared to females. In the professional level, males exhibited significantly greater peak ankle external rotation (p = 0.003) and peak hip internal rotation (p = 0.011), and significantly less peak ankle internal rotation (p = 0.007) and peak hip external rotation (p = 0.008) compared to females (Table 4.36).

4.2.4 Forward Step Left with Partner (FSLP)

Kinetic data for the FSLP were confounded due to the partner having a foot on the same force plate. Therefore, sagittal, frontal and transverse plane moments for the FSLP were excluded from the analysis.

4.2.4.1 Sagittal Plane Joint Angles.

4.2.4.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSLP in the peak ankle plantarflexion angle (p = 0.045), and peak knee (p = 0.016) and hip (p < 0.001) flexion angles (Table 4.37). Post-hoc comparisons illustrated that the inexperienced level demonstrated significantly less peak ankle plantarflexion (p = 0.045) and peak knee flexion (p = 0.016) compared to the professional level. Additionally, the professional level displayed significantly greater peak hip flexion compared to both the inexperienced (p < 0.001) and recreational (p = 0.002) levels.

4.2.4.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that in the inexperienced level, males displayed significantly less peak hip flexion than females (p = 0.003). In the recreational level, males demonstrated significantly greater peak hip extension (p = 0.046), but less peak hip flexion (p = 0.003) compared to females. There were no significant differences in peak sagittal plane joint angles between males and females during the FSLP in the professional level ($p \geq 0.167$) (Table 4.37).

4.2.4.2 Frontal Plane Joint Angles.

4.2.4.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the FSLP in only the peak hip abduction angle ($p < 0.001$) (Table 4.38). Post-hoc comparisons demonstrated greater peak hip abduction in the professional level compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.002$) levels.

4.2.4.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in peak frontal plane joint angles between males and females during the FSLP in the inexperienced or recreational level ($p \geq 0.073$). In the professional level, males demonstrated significantly less peak ankle eversion ($p = 0.011$), greater peak ankle inversion ($p = 0.006$), less peak knee abduction ($p = 0.015$), and greater peak knee adduction ($p = 0.031$) compared to females (Table 4.38).

4.2.4.3 Transverse Plane Joint Angles.

4.2.4.3.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results displayed significant differences among experience levels during the FSLP in the peak hip external ($p = 0.003$) and internal ($p = 0.006$) rotation angles (Table 4.39). Post-hoc comparisons illustrated that the professional level displayed significantly greater peak hip external rotation than the inexperienced level ($p = 0.002$), and significantly less peak hip internal rotation than both the inexperienced ($p = 0.041$) and recreational ($p = 0.040$) levels.

4.2.4.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated significantly less peak external hip rotation ($p = 0.005$) and greater peak hip internal rotation ($p < 0.001$) compared to females. In the recreational level, males displayed significantly less peak knee external rotation ($p = 0.008$) and greater peak knee internal rotation ($p < 0.001$) compared to females. In the professional level, males illustrated significantly greater peak ankle external rotation ($p = 0.006$), less peak ankle internal rotation ($p = 0.005$), and less peak hip external rotation ($p = 0.011$), and greater peak hip internal rotation ($p = 0.009$) compared to females (Table 4.39).

4.2.5 Rock Step Back Right (RSBR)

4.2.5.1 Sagittal Plane Joint Moments.

4.2.5.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results demonstrated significant differences among experience levels during the RSBR in the peak ankle dorsiflexion moment during the second step ($p = 0.012$), peak knee flexion ($p < 0.001$) and extension ($p = 0.014$) moments during the first step, and the peak hip flexion moment during the second step ($p = 0.003$) (Table 4.40).

Post-hoc tests revealed that the inexperienced level demonstrated a significantly greater peak ankle dorsiflexion moment during the second step compared to the recreational level ($p = 0.021$), a smaller peak knee flexion moment ($p < 0.001$) and greater peak knee extension moment ($p = 0.018$) during the first step compared to the professional level, and a smaller peak hip flexion moment during the second step compared to the professional level ($p = 0.003$).

4.2.5.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males exhibited a greater peak knee flexion moment ($p = 0.011$) and smaller peak knee extension moment ($p = 0.024$) during the second step, a smaller peak hip extension moment during the first step ($p = 0.044$), and a smaller hip flexion moment ($p = 0.006$) and larger hip extension moment ($p = 0.002$) during the second step than females. In the recreational level, males demonstrated a greater peak dorsiflexion moment during the second step compared to females ($p = 0.019$). Males in the professional level illustrated a greater peak ankle dorsiflexion ($p = 0.002$) and ankle plantarflexion ($p = 0.011$) moment during the first step, a greater peak ankle plantarflexion moment ($p = 0.027$) during the second step, a smaller peak knee flexion moment ($p = 0.002$) and larger peak knee extension moment ($p = 0.011$) during the first step, a greater peak hip flexion moment during the first step ($p = 0.003$), and a smaller peak hip flexion moment during the second step ($p = 0.029$) compared to females (Table 4.40).

4.2.5.2 Frontal Plane Joint Moments.

4.2.5.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSBR in the peak knee adduction moment during the second step ($p = 0.002$), and peak hip adduction moment during the first ($p = 0.003$) and second ($p < 0.001$) steps (Table 4.41). Post-hoc comparisons showed that the inexperienced level exhibited a significantly smaller peak knee adduction moment during the second step compared to both the recreational ($p = 0.012$) and professional ($p = 0.004$) levels, and a significantly smaller peak hip adduction moment during the first step compared to the professional level ($p = 0.002$). The professional level illustrated a significantly greater peak hip adduction moment during the second step compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.015$) levels.

4.2.5.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed a significantly greater peak ankle inversion moment ($p < 0.001$), greater peak knee ($p = 0.009$) and hip ($p = 0.005$) adduction moments, and smaller peak knee ($p = 0.001$) and hip ($p = 0.002$) abduction moments during the first step compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the RSBR in the recreational level ($p \geq 0.130$). In the professional level, males demonstrated a significantly greater peak ankle inversion moment ($p < 0.001$), and a smaller peak ankle eversion moment ($p = 0.015$) during the second step compared to females (Table 4.41).

4.2.5.3 Transverse Plane Joint Moments.

4.2.5.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA exhibited significant differences among experience levels during the RSBR in the peak ankle internal rotation moment during the first ($p < 0.001$) and second ($p = 0.017$) steps, the peak knee internal rotation moment during the first step ($p < 0.001$), peak knee external rotation moment during the second step ($p = 0.017$), and the peak hip internal rotation moment during the first step ($p < 0.001$) and external rotation moment during the second step ($p = 0.027$) (Table 4.42).

Post-hoc comparisons revealed that the professional level demonstrated a significantly greater peak ankle internal rotation moment compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.035$) levels during the first step, and compared to the inexperienced level during the second step ($p = 0.013$), and a significantly greater peak knee internal rotation moment during the first step compared to the inexperienced level ($p = 0.001$). The peak knee external rotation moment during the second step was significantly smaller in the inexperienced level compared to the recreational level ($p = 0.018$). The professional level also demonstrated a significantly greater peak hip internal rotation moment than both the inexperienced ($p < 0.001$ and recreational ($p = 0.004$) levels during the first step, and a greater peak hip external rotation moment than the inexperienced level ($p = 0.036$) during the second step.

4.2.5.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited a significantly greater peak knee internal rotation moment ($p = 0.009$) and peak hip external rotation moment ($p = 0.005$) during the first step compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the RSBR in the recreational level ($p \geq 0.077$). Males in the professional level demonstrated a significantly greater peak hip external rotation moment during the first step ($p = 0.019$) compared to females (Table 4.42).

4.2.5.4 Sagittal Plane Joint Angles.

4.2.5.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSBR in the peak ankle plantarflexion angle during the first step ($p < 0.001$), peak ankle dorsiflexion angle during the second step ($p < 0.001$), and peak knee and hip flexion angles during the first ($p = 0.034$ and $p < 0.001$, respectively) and second ($p < 0.001$ for both) steps (Table 4.43).

Post-hoc tests illustrated that the inexperienced level displayed significantly less peak ankle plantarflexion compared to the professional level during the first step ($p = 0.001$), less peak ankle dorsiflexion during the second step compared to the recreational level ($p < 0.001$), and less peak knee flexion during the first step compared to the professional level ($p = 0.030$). The peak knee flexion angle during the second step was significantly different across all comparisons, with the recreational level illustrating greater peak knee flexion compared to the inexperienced level ($p = 0.015$) and the professional level illustrating greater peak knee flexion compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.035$) levels. The inexperienced level demonstrated significantly less peak hip flexion during the first step than both the recreational ($p <$

0.001) and professional ($p < 0.001$) levels, while peak hip flexion during the second step was significantly greater in the professional level than both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels.

4.2.5.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males demonstrated less peak ankle plantarflexion during the second step ($p = 0.016$), and greater peak knee extension ($p = 0.004$) and less peak knee flexion during the first step ($p = 0.002$) compared to females. Males in the recreational level illustrated less peak ankle plantarflexion during the first step ($p = 0.010$), greater peak knee extension ($p < 0.001$) and less peak knee flexion during the first step ($p < 0.001$), less peak hip flexion during the first ($p = 0.035$) and second ($p = 0.003$) steps and greater peak hip extension during the second step ($p = 0.020$) compared to females. In the professional level, males displayed less peak ankle plantarflexion during the first step ($p = 0.020$), and less peak hip flexion during the second step compared to females ($p = 0.039$) (Table 4.43).

4.2.5.5 Frontal Plane Joint Angles.

4.2.5.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSBR in the peak knee abduction ($p = 0.001$) and adduction ($p < 0.001$) angles during the first step, the peak knee adduction angle during the second step ($p = 0.020$), and the peak hip abduction and adduction angles during the first ($p = 0.013$ and $p = 0.025$, respectively) and second ($p < 0.001$ and $p = 0.036$, respectively) steps (Table 4.44).

Post-hoc comparisons illustrated significantly less peak knee abduction in the inexperienced level compared to the professional level during the first step ($p = 0.001$). Peak knee adduction during the first step was significantly different across all comparisons with the recreational level displaying a significantly greater peak knee adduction angle than the inexperienced level ($p = 0.014$), and the professional level displaying a greater peak knee adduction angle than both the inexperienced ($p < 0.001$) and the recreational ($p < 0.001$) levels. The recreational level also demonstrated significantly greater peak knee adduction compared to the inexperienced level ($p = 0.040$) during the second step, and greater peak hip adduction compared to the inexperienced level during the first step ($p = 0.021$). The professional level exhibited significantly greater peak hip abduction compared to the recreational level during the first step ($p = 0.014$), and greater peak hip abduction compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.002$) levels during the second step. Differences in peak hip adduction among experience levels during the second step were insignificant following post-hoc comparisons ($p \geq 0.076$).

4.2.5.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males showed significantly greater peak ankle inversion compared to females during the second step ($p = 0.027$). In the recreational level, males demonstrated significantly less peak ankle eversion ($p = 0.004$) and knee adduction ($p = 0.010$) during the first step compared to females. Within the professional level, males exhibited significantly less peak ankle eversion ($p = 0.024$), greater peak ankle inversion ($p = 0.002$), less peak knee abduction ($p = 0.016$), and greater peak knee adduction ($p = 0.001$) during the second step compared to females (Table 4.44).

4.2.5.6 Transverse Plane Joint Angles.

4.2.5.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSBR in the peak knee external ($p < 0.001$) and internal ($p = 0.040$) rotation angles during the first step, and peak hip external ($p < 0.001$) and internal ($p = 0.008$) rotation angles during the second step (Table 4.45).

Post-hoc comparisons revealed that the professional level demonstrated significantly greater peak knee external rotation compared to both the inexperienced ($p = 0.001$) and recreational ($p = 0.006$) levels during the first step. Differences in peak knee internal rotation during the first step were insignificant following post-hoc comparisons ($p \geq 0.052$). The professional level also exhibited significantly greater peak hip external rotation and less peak hip internal rotation compared to the inexperienced ($p < 0.001$ and $p = 0.020$, respectively) and recreational ($p = 0.022$ and $p = 0.018$, respectively) levels during the second step.

4.2.5.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that in the inexperienced level, males displayed greater peak ankle external rotation during the second step ($p = 0.030$), less peak knee external rotation during the first step ($p = 0.029$), less peak hip external rotation ($p = 0.002$), and greater hip internal rotation ($p = 0.001$) during the second step compared to females. In the recreational level, males displayed significantly less peak ankle internal rotation ($p = 0.003$) and less peak hip external rotation during the first step ($p = 0.020$) compared to females. In the professional level, males demonstrated significantly greater peak ankle external rotation ($p = 0.002$), less peak ankle internal rotation ($p = 0.011$), less peak hip external rotation ($p = 0.003$), and greater peak hip internal rotation ($p = 0.003$) during the second step compared to females (Table 4.45).

4.2.6 Rock Step Back Right with Partner (RSBRP)

4.2.6.1 Sagittal Plane Joint Moments.

4.2.6.1.1 Comparison Among Experience Levels. The second step of the RSBRP was affected by the partner, so results are only presented for the first step. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSBRP in the peak knee flexion ($p < 0.001$) and extension ($p = 0.016$) moments, and in the peak hip extension moment ($p = 0.011$) (Table 4.46). Post-hoc comparisons revealed that the inexperienced level displayed a smaller peak knee flexion moment than both the recreational ($p = 0.003$) and professional ($p < 0.001$) levels, and a greater peak knee extension moment ($p = 0.013$) and smaller peak hip extension moment ($p = 0.009$) than the professional level.

4.2.6.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed a significantly greater peak ankle dorsiflexion moment ($p = 0.003$), a smaller peak knee flexion moment ($p = 0.001$), a greater peak hip flexion moment ($p = 0.010$), and a smaller peak hip extension moment ($p < 0.001$) compared to females. There were no significant differences in peak sagittal plane joint moments between males and females during the RSBRP in the recreational level ($p \geq 0.093$). In the professional level, males exhibited a smaller peak hip extension moment compared to females ($p = 0.046$) (Table 4.46).

4.2.6.2 Frontal Plane Joint Moments.

4.2.6.2.1 Comparison Among Experience Levels. Results for the second step of the RSBRP were confounded by the partner. Thus, results are only presented for the first step. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSBRP in only the peak hip adduction moment ($p = 0.011$) (Table 4.47). Post-hoc comparisons demonstrated a significantly smaller peak hip adduction moment in the inexperienced level than the professional level ($p = 0.008$).

4.2.6.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly greater peak ankle inversion moment ($p = 0.001$), greater peak knee ($p = 0.010$) and hip ($p = 0.010$) adduction moments, and smaller peak knee ($p < 0.001$) and hip ($p = 0.003$) abduction moments compared to females.

There were no significant differences in peak frontal plane joint moments between males and females during the RSBRP in the recreational or professional levels ($p \geq 0.094$) (Table 4.47).

4.2.6.3 Transverse Plane Joint Moments.

4.2.6.3.1 Comparison Among Experience Levels. Results are only presented for the first step of the RSBRP because the second step was affected by the partner. Results of the Kruskal-Wallis/ANOVA displayed significant differences among experience levels during the RSBRP in the peak ankle ($p = 0.003$), knee ($p = 0.009$), and hip ($p < 0.001$) internal rotation moments (Table 4.48). Post-hoc results showed that the professional level exhibited significantly greater peak ankle ($p = 0.002$) and knee ($p = 0.007$) internal rotation moments compared to the inexperienced level, and a significantly greater peak hip internal rotation moment compared to both the inexperienced ($p = 0.002$) and recreational ($p = 0.005$) levels.

4.2.6.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males showed a significantly greater peak knee internal rotation moment ($p = 0.006$) and peak hip external rotation moment ($p = 0.002$) compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the RSBRP in the recreational or professional levels ($p \geq 0.114$) (Table 4.48).

4.2.6.4 Sagittal Plane Joint Angles.

4.2.6.4.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSBRP in the peak ankle plantarflexion angle during the first step ($p = 0.008$), peak ankle dorsiflexion angle during the second step ($p = 0.021$), peak knee flexion angle during the first ($p = 0.034$) and second ($p < 0.001$) steps, and peak hip flexion angles during the first ($p < 0.001$) and second ($p < 0.001$) steps (Table 4.49).

Post-hoc tests revealed that the inexperienced level exhibited significantly less peak ankle plantarflexion ($p = 0.011$) and less peak knee flexion ($p = 0.031$) compared to the professional level during the first step, less peak ankle dorsiflexion compared to the recreational level during the second step ($p = 0.036$), and compared to both the recreational ($p = 0.007$) and professional ($p < 0.001$) levels during the second step, and less peak hip flexion compared to both the recreational ($p = 0.002$) and professional ($p < 0.001$) levels during the first step. Peak hip flexion during the second step was significantly different across all comparisons with the recreational level displaying a greater peak hip flexion angle compared to the inexperienced level ($p = 0.014$) and the professional level displaying a greater peak hip flexion angle compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.005$) levels.

4.2.6.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males demonstrated significantly greater peak knee extension ($p = 0.025$) and less knee flexion ($p = 0.041$) during the first step, and less peak hip flexion ($p = 0.017$) during the second step compared to females. In the recreational level, males displayed significantly less peak ankle plantarflexion ($p = 0.023$), greater peak knee extension ($p = 0.002$) and less peak knee flexion ($p = 0.001$) during the first step, and less peak hip flexion during the second step ($p = 0.003$) compared to females. In the professional level, males demonstrated significantly less peak ankle plantarflexion during the first step ($p < 0.001$), and greater peak hip flexion during the second step ($p = 0.003$) compared to females (Table 4.49).

4.2.6.5 Frontal Plane Joint Angles.

4.2.6.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSBRP in the peak knee abduction ($p < 0.001$) and adduction ($p < 0.001$) angles during the first step, peak knee adduction angle during the second step ($p = 0.005$), peak hip abduction angle during the first step ($p = 0.023$), and peak hip abduction ($p < 0.001$) and adduction ($p = 0.005$) angles during the second step (Table 4.50).

Post-hoc comparisons illustrated significantly greater peak knee abduction in the professional level compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.004$) levels during the first step. Peak knee adduction during the first step was significantly different across all comparisons with a greater peak knee adduction angle in the recreational level compared to the inexperienced level ($p < 0.001$), and a greater peak knee adduction angle in the professional level compared to both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels. The inexperienced level demonstrated significantly less peak knee and hip adduction compared to the recreational ($p = 0.013$ and $p = 0.012$, respectively) and professional ($p = 0.017$ and $p = 0.022$, respectively) levels during the second step. The professional level displayed significantly greater peak hip abduction than the inexperienced level during the first step ($p = 0.020$), and compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.001$) levels during the second step.

4.2.6.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that in the inexperienced level, males displayed significantly greater peak knee adduction during the first step compared to females ($p = 0.035$). In the recreational level, males demonstrated significantly less peak ankle eversion during the first step compared to females ($p = 0.010$). In the professional level, males demonstrated significantly greater peak ankle inversion during the second step ($p = 0.005$), and less peak knee abduction ($p = 0.024$) and greater peak knee adduction ($p = 0.014$) during the second step compared to females (Table 4.50).

4.2.6.6 Transverse Plane Joint Angles.

4.2.6.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the RSBRP in the peak knee external rotation angle during the first step ($p = 0.002$), and peak hip external ($p = 0.005$) and internal ($p = 0.008$) rotation angles during the second step (Table 4.51). Post-hoc comparisons showed that the professional level illustrated significantly greater peak knee external rotation compared to the inexperienced ($p = 0.003$) and recreational ($p = 0.012$) levels during the first step, greater peak hip external rotation compared to the inexperienced level ($p = 0.004$), and less peak internal hip rotation compared to both the inexperienced ($p = 0.015$) and recreational ($p = 0.029$) levels during the second step.

4.2.6.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited significantly greater peak knee internal rotation during the first step ($p = 0.022$), and less hip external ($p = 0.008$) and greater hip internal rotation ($p < 0.001$) during the second step compared to females. In the recreational level, males demonstrated significantly less peak ankle internal rotation ($p = 0.003$) and less hip external rotation ($p = 0.035$) during the first step, and less knee external rotation ($p = 0.047$) and greater knee internal rotation ($p = 0.007$) during the second step compared to females. In the professional level, males displayed greater peak ankle external ($p = 0.008$) and less ankle internal ($p = 0.008$) rotation during the second step, and less hip external ($p = 0.014$) and greater hip internal rotation ($p = 0.010$) during the second step compared to females (Table 4.51).

4.2.7 Rock Step Forward Left (RSFL)

4.2.7.1 Sagittal Plane Joint Moments.

4.2.7.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFL in the peak ankle dorsiflexion moment during the first step (p = 0.002), peak ankle plantarflexion moment during the second step (p = 0.017), and peak hip flexion moment during the second step (p = 0.047) (Table 4.52). Post-hoc comparisons illustrated a significantly greater peak ankle dorsiflexion moment in the inexperienced level compared to the professional level during the first step (p = 0.001). The recreational level displayed a significantly greater peak ankle plantarflexion moment (p = 0.018), and a smaller peak hip flexion moment (p = 0.041) than the professional level during the second step.

4.2.7.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results showed that within the inexperienced level, males illustrated a significantly greater peak ankle dorsiflexion moment during the first (p = 0.023) and second (p = 0.003) steps, a greater peak ankle plantarflexion moment during the first step (p = 0.027), a greater peak knee flexion moment during the first step (p = 0.043), a greater peak knee extension moment during second step (p = 0.023), a greater peak hip extension moment during the first step (p = 0.017), and a greater peak hip flexion moment during the second step (p = 0.005) compared to females. In the recreational level, males exhibited a significantly greater peak ankle plantarflexion moment during the first step (p = 0.042), and a smaller peak hip flexion moment during the first step (p = 0.031) than females. In the professional level, males displayed a significantly greater peak ankle plantarflexion moment during the first step (p = 0.016), a greater peak knee flexion moment during the first step

($p = 0.004$) and peak knee extension moment during the second step ($p = 0.040$), and a greater peak hip extension moment during the first step ($p = 0.002$) compared to females (Table 4.52).

4.2.7.2 Frontal Plane Joint Moments.

4.2.7.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSFL in the peak ankle inversion moment during the second step ($p = 0.006$), peak knee abduction moment during the first step ($p < 0.001$), peak knee adduction moment during the second step ($p = 0.005$), peak hip adduction ($p = 0.017$) and abduction ($p < 0.001$) moments during the first step, and peak hip adduction moment during second step ($p = 0.022$) (Table 4.53).

Post-hoc comparisons showed a significantly greater peak ankle inversion moment during the second step in the professional level compared to the inexperienced level ($p = 0.004$). The peak knee abduction moment during the first step was significantly different across all comparisons with the recreational level demonstrating a greater knee abduction moment than the inexperienced level ($p = 0.041$), and the professional level demonstrating a greater knee abduction moment than both the inexperienced ($p < 0.001$) and the recreational ($p = 0.009$) levels. The professional level also displayed a greater peak knee adduction moment compared to the inexperienced ($p = 0.007$) and recreational ($p = 0.037$) groups during the second step, a significantly greater peak hip adduction moment compared to the inexperienced level during the first ($p = 0.013$) and second ($p = 0.017$) steps. The peak hip abduction moment during the first step was significantly different across all comparisons, with the recreational level illustrating a greater moment than the inexperienced level ($p = 0.004$), and the professional level displaying a greater moment than both the inexperienced ($p < 0.001$) and recreational ($p = 0.002$) levels.

4.2.7.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed significantly greater peak ankle inversion (p = 0.005) and eversion (p = 0.008) moments during the second step, and greater peak knee (p = 0.011) and hip (p = 0.003) adduction moments during the second step compared to females. In the recreational level, males demonstrated a greater peak hip adduction moment (p = 0.031) and a smaller peak hip abduction moment (p = 0.024) during the first step compared to females. In the professional level, males illustrated a greater peak knee abduction moment during the first step compared to females (p = 0.042) (Table 4.53).

4.2.7.3 Transverse Plane Joint Moments.

4.2.7.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFL in the peak ankle (p = 0.002) and knee (p = 0.002) external rotation moments during the first step, peak ankle (p = 0.010) and knee (p = 0.002) internal rotation moments during the second step, and peak hip internal and external rotation moments during the first (p = 0.028 and p < 0.001, respectively) and second (p < 0.001 and p = 0.007, respectively) steps (Table 4.54).

Post-hoc comparisons revealed that the professional level demonstrated significantly greater peak ankle (p = 0.001) and knee (p = 0.001) external rotation moments compared to the inexperienced level during the first step, greater peak ankle (p = 0.010) and knee (p = 0.001) internal rotation moments compared to the inexperienced level during the second step, a greater peak hip external rotation moment during the first step and a greater peak hip internal rotation moment during the second step compared to both the inexperienced (p = 0.001 and p < 0.001, respectively) and recreational (p = 0.002 and p = 0.003, respectively) levels, and a greater peak hip external rotation moment compared to the inexperienced level during the second step (p

= 0.008). The recreational level exhibited a significantly greater peak hip internal rotation moment than the inexperienced level during the first step ($p = 0.046$).

4.2.7.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results showed that in the inexperienced level, males displayed significantly greater peak knee internal rotation ($p = 0.035$) and peak hip external rotation ($p = 0.007$) moments during the second step compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the RSFL in the recreational or professional levels ($p \geq 0.113$) (Table 4.54).

4.2.7.4 Sagittal Plane Joint Angles.

4.2.7.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFL in the peak ankle plantarflexion angle during the first step ($p < 0.001$), peak knee flexion angle during the first ($p < 0.001$) and second ($p = 0.011$) steps, peak hip flexion angle during the first ($p < 0.001$) and second ($p < 0.001$) steps, and peak hip extension angle during the second step ($p = 0.034$) (Table 4.55).

Post-hoc comparisons illustrated significantly greater peak plantarflexion in the professional level compared to the inexperienced level during the first step ($p < 0.001$). Peak knee flexion during the first step was significantly different across all comparisons, with the recreational level displaying a greater peak knee flexion angle than the inexperienced level ($p = 0.003$), and the professional level displaying a greater peak knee flexion angle than both the inexperienced ($p < 0.001$) and recreational ($p = 0.026$) levels. The professional level demonstrated significantly greater peak knee flexion compared to the inexperienced level during the second step ($p = 0.009$), greater hip flexion during the first step compared to both the inexperienced ($p < 0.001$)

and recreational ($p = 0.005$) levels, and greater hip extension compared to the recreational level ($p = 0.029$) during the second step. The inexperienced level displayed significantly less peak hip flexion compared to both the recreational ($p < 0.001$) and professional ($p < 0.001$) levels during the second step.

4.2.7.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited significantly less peak knee flexion during the second step ($p = 0.001$), and greater peak hip extension ($p = 0.002$) and less peak hip flexion ($p = 0.001$) during the first step compared to females. Males in the recreational level illustrated significantly less peak knee flexion during the second step ($p = 0.001$), and less peak hip flexion during the first step ($p = 0.003$) compared to females. In the professional level, males demonstrated significantly less peak ankle plantarflexion during the first step ($p = 0.012$), and greater peak hip extension ($p = 0.033$) and less peak hip flexion ($p = 0.013$) during the first step compared to females (Table 4.55).

4.2.7.5 Frontal Plane Joint Angles.

4.2.7.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSFL in the peak knee abduction ($p < 0.001$) and adduction ($p = 0.005$) angles during the second step, and peak hip abduction ($p < 0.001$) and adduction ($p < 0.001$) angles during the first step (Table 4.56).

Post-hoc comparisons revealed significant differences across all comparisons in the peak knee abduction angle during the second step with the recreational level displaying a greater knee abduction angle than the inexperienced level ($p = 0.037$) and the professional level displaying a greater knee abduction angle than both the inexperienced ($p < 0.001$) and recreational ($p = 0.046$)

levels. The professional level exhibited greater peak knee adduction compared to the inexperienced level during the second step ($p = 0.004$), and greater peak hip abduction during the first step compared to both the inexperienced ($p = 0.001$) and recreational ($p = 0.002$) levels. The peak hip adduction angle during the first step was also found to be significantly different across all comparisons with the recreational level illustrating a greater hip adduction angle than the inexperienced level ($p < 0.001$), and the professional level illustrating a greater hip adduction angle compared to both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels.

4.2.7.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that in the inexperienced level, males showed decreased peak ankle eversion and increased ankle inversion during the first ($p = 0.029$ and $p = 0.005$, respectively) and second ($p = 0.035$ and $p = 0.011$, respectively) steps compared to females. In the recreational level, males exhibited less ankle eversion during the second step ($p = 0.036$), and less knee abduction ($p = 0.031$) and increased knee adduction ($p = 0.029$) during the first step compared to females. Males in the professional level demonstrated less peak ankle eversion ($p = 0.024$) and knee abduction ($p < 0.001$), and greater peak ankle inversion ($p = 0.001$) and knee adduction ($p < 0.001$) during the first step compared to females (Table 4.56).

4.2.7.6 Transverse Plane Joint Angles.

4.2.7.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFL in the peak knee external ($p < 0.001$) and internal ($p = 0.008$) rotation angles during the second step, and the peak hip external rotation angle during the first step ($p = 0.006$) (Table 4.57).

Post-hoc comparisons revealed that the professional level displayed significantly greater peak knee external rotation and significantly less peak knee internal rotation compared to both the inexperienced ($p < 0.001$ and $p = 0.013$, respectively) and the recreational ($p = 0.006$ and $p = 0.031$, respectively) levels during the second step, and greater peak hip external rotation during the first step compared to the inexperienced level ($p = 0.006$).

4.2.7.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males demonstrated significantly greater peak external rotation during the first ($p = 0.006$) and second ($p = 0.014$) steps, less peak ankle internal rotation during the first step ($p = 0.022$), less peak knee external rotation ($p = 0.005$) during the second step, less peak hip external rotation ($p = 0.007$) during the first step, greater peak knee internal rotation ($p = 0.003$) during the second step, and greater peak hip internal rotation ($p = 0.002$) during the first step compared to females. In the recreational level, males displayed less peak ankle internal rotation during the second step ($p = 0.014$), greater peak knee internal rotation during the first step ($p = 0.037$), and less peak hip external rotation ($p = 0.019$) and greater peak hip internal rotation ($p = 0.005$) during the second step compared to females. In the professional level, males exhibited significantly greater peak ankle external rotation ($p = 0.001$) and decreased peak internal ankle rotation ($p = 0.014$) during the first step, and significantly less peak hip external rotation ($p = 0.002$) and greater peak hip internal rotation ($p = 0.013$) during the first step compared to females (Table 4.57).

4.2.8 Rock Step Forward Left with Partner (RSFLP)

4.2.8.1 Sagittal Plane Joint Moments.

4.2.8.1.1 Comparison Among Experience Levels. Results are only presented for the second step of the RSFLP as the first step was affected by the partner stepping on the same force plate. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFLP in only the peak knee flexion moment ($p = 0.012$) (Table 4.58).

Post-hoc results exhibited a significantly greater peak knee flexion moment in the professional level than the inexperienced level (p = 0.021).

4.2.8.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males exhibited significantly greater peak ankle dorsiflexion (p = 0.004) and peak hip flexion (p = 0.028) moments than females. There were no significant differences in peak sagittal plane joint moments between males and females during the RSFLP in the recreational or professional level ($p \geq 0.063$) (Table 4.58).

4.2.8.2 Frontal Plane Joint Moments.

4.2.8.2.1 Comparison Among Experience Levels. Results for the first step of the RSFLP were affected by the partner, therefore results are only presented for the second step (Table 4.59). Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFLP in the peak knee (p = 0.009) and hip (p = 0.008) adduction moments (Table 4.59). Post-hoc comparisons showed significantly greater peak adduction moments at the knee (p = 0.012) and hip (p = 0.006) in the professional level than the inexperienced level.

4.2.8.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males demonstrated a significantly greater peak ankle inversion moment ($p < 0.001$), and peak knee (p = 0.003) and hip (p = 0.001) adduction moments compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the RSFLP in the recreational or professional levels ($p \geq 0.340$) (Table 4.59).

4.2.8.3 Transverse Plane Joint Moments.

4.2.8.3.1 Comparison Among Experience Levels. The first step of the RSFLP was affected by to the partner stepping on the same force plate. Therefore, results are only presented for the second step. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFLP in the peak ankle ($p = 0.003$) and knee ($p = 0.038$) internal rotation moments, and the peak hip external rotation moment ($p < 0.001$) (Table 4.60).

Post-hoc results showed that the professional level illustrated a significantly greater peak ankle internal rotation moment compared to both the inexperienced ($p = 0.003$) and recreational ($p = 0.032$) levels, and a greater peak knee internal rotation moment compared to the inexperienced level ($p = 0.032$). The inexperienced level displayed a significantly smaller peak hip external rotation moment compared to the recreational ($p = 0.005$) and professional ($p = 0.002$) levels.

4.2.8.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results revealed that in the inexperienced level, males demonstrated significantly greater peak ankle ($p = 0.043$) and knee ($p < 0.001$) internal rotation moments, and a significantly greater peak hip external rotation moment ($p = 0.022$) compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the RSFLP in the recreational or professional level ($p \geq 0.200$) (Table 4.60).

4.2.8.4 Sagittal Plane Joint Angles.

4.2.8.4.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSFLP in the peak ankle plantarflexion angle during the first step ($p = 0.015$), peak knee ($p < 0.001$) and hip ($p < 0.001$) flexion angles during the first step, and peak hip extension ($p = 0.027$) and flexion ($p < 0.001$) angles during the second step (Table 4.61).

Post-hoc comparisons showed that the professional level displayed significantly greater peak ankle plantarflexion during the first step compared to the recreational level ($p = 0.023$), greater peak hip flexion during the first step compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.022$) levels, and greater peak hip extension during the second step compared to the recreational level ($p = 0.023$). The inexperienced level demonstrated significantly less peak knee flexion during the first step compared to both the recreational ($p = 0.024$) and professional ($p < 0.001$) levels, and less peak hip flexion during the second step compared to the recreational ($p < 0.001$) and professional ($p < 0.001$) levels.

4.2.8.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed significantly greater peak knee extension ($p = 0.008$) and less knee flexion during the second step ($p = 0.005$), and greater peak hip extension ($p = 0.012$) and less hip flexion during the first step ($p = 0.001$) compared to females. In the recreational level, males demonstrated significantly less peak ankle plantarflexion during the second step ($p = 0.036$), greater peak knee extension ($p < 0.001$) and less peak knee flexion during the second step ($p = 0.002$), and less hip flexion during the first step ($p = 0.005$) compared to females. In the professional level, males exhibited greater knee extension during the second step ($p = 0.040$), and greater hip extension ($p = 0.026$) and less hip flexion ($p = 0.002$) during the first step compared to females (Table 4.61).

4.2.8.5 Frontal Plane Joint Angles.

4.2.8.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the RSFLP in the peak ankle eversion angle during the second step ($p = 0.035$), peak knee adduction angle during the first ($p = 0.015$) and second ($p = 0.019$) steps, peak knee abduction angle during the second step ($p < 0.001$), and peak hip abduction ($p = 0.007$) and adduction ($p < 0.001$) angles during the first step (Table 4.62).

Differences in the peak ankle eversion angle were insignificant following post-hoc comparisons ($p \geq 0.053$). Further post-hoc results indicated that the recreational level displayed significantly greater peak knee adduction compared to the inexperienced level during the first step ($p = 0.015$). The professional level demonstrated significantly greater peak knee abduction compared to both the inexperienced ($p < 0.001$) and recreational ($p = 0.034$) levels, greater peak adduction compared to the inexperienced level ($p = 0.015$) during the second step, and greater peak hip abduction compared to the inexperienced ($p = 0.013$) and recreational ($p = 0.027$) levels during the first step. Peak hip adduction during the first step was significantly different across all comparisons, with the recreational level showing greater peak hip adduction than the inexperienced level ($p < 0.001$) and the professional level showing greater peak hip adduction than both the inexperienced ($p < 0.001$) and recreational ($p = 0.008$) levels.

4.2.8.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level demonstrated significantly greater peak ankle inversion during both the first ($p = 0.040$) and second ($p = 0.030$) steps compared to females. In the recreational level, males displayed significantly less peak ankle eversion ($p < 0.001$), greater peak ankle inversion ($p = 0.020$), and less peak knee adduction ($p = 0.039$) during the second step compared to females. In the professional level, males displayed significantly greater peak ankle inversion ($p = 0.017$), less peak knee ($p = 0.015$) and hip ($p = 0.035$) abduction, and greater peak knee adduction ($p = 0.031$) during the first step compared to females (Table 4.62).

4.2.8.6 Transverse Plane Joint Angles.

4.2.8.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the RSFLP in the peak knee external ($p = 0.002$) and internal ($p = 0.011$) rotation angles during the second step, and the peak hip external rotation angle during the first step (p = 0.016) (Table 4.63). Post-hoc comparisons illustrated that the professional level demonstrated significantly greater peak knee external rotation during the second step compared to the inexperienced (p = 0.002) and recreational (p = 0.025) levels, and less peak knee internal rotation during the second step (p = 0.012) and greater peak hip external rotation during the first step (p = 0.014) compared to the inexperienced level.

4.2.8.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly greater peak ankle external rotation during the first (p = 0.041) and second (p = 0.034) steps, less knee external rotation during the second step (p = 0.035), and less hip external rotation (p = 0.006) and greater hip internal rotation (p = 0.006) during the first step compared to females. Males in the recreational level demonstrated greater peak ankle external rotation (p = 0.024) and less peak ankle internal rotation (p = 0.002) during the second step, less peak knee external rotation during the first step (p = 0.029), greater peak hip internal rotation during the first (p = 0.049) and second (p = 0.032) steps, and less peak hip external rotation (p = 0.011) during the second step compared to females. In the professional level, males exhibited greater peak ankle external rotation (p = 0.019) and peak hip internal rotation (p = 0.011), and less peak ankle internal rotation (p = 0.024) and peak hip external rotation (p = 0.004) during the first step compared to females (Table 4.63).

4.2.9 Side Step Left (SSL)

4.2.9.1 Sagittal Plane Joint Moments.

4.2.9.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated no significant differences in peak sagittal plane joint moments among experience levels during the SSL ($p \geq 0.389$) (Table 4.64).

4.2.9.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed a significantly greater peak hip flexion moment than females ($p < 0.001$). There were no significant differences in peak sagittal plane joint moments between males and females during the SSL in the recreational or professional levels ($p \geq 0.050$) (Table 4.64).

4.2.9.2 Frontal Plane Joint Moments.

4.2.9.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated a significant difference among experience levels during the SSL in the peak hip adduction moment ($p = 0.030$) (Table 4.65). Post-hoc results showed a significantly greater peak hip adduction moment in the professional level than the recreational level ($p = 0.046$).

4.2.9.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed a significantly greater peak knee adduction moment ($p = 0.004$), and decreased peak knee ($p = 0.001$) and hip ($p = 0.003$) abduction moments compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the SSL in the recreational or professional levels ($p \geq 0.267$) (Table 4.65).

4.2.9.3 Transverse Plane Joint Moments.

4.2.9.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSL in the peak ankle internal ($p = 0.026$) and external ($p = 0.041$) rotation moments, and the peak hip external rotation moment ($p = 0.033$) (Table 4.66). Differences in peak ankle internal and external rotation moments were insignificant following post-hoc comparisons ($p \geq 0.050$). Further post-hoc comparisons revealed that the peak hip external rotation moment was significantly greater in the professional level than the inexperienced level (p = 0.035).

4.2.9.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results illustrated that males in inexperienced level exhibited significantly greater peak ankle internal rotation (p = 0.043) and peak hip external rotation (p = 0.005) moments than females. There were no significant differences in peak transverse plane joint moments between males and females during the SSL in the recreational or professional levels ($p \geq 0.113$) (Table 4.66).

4.2.9.4 Sagittal Plane Joint Angles.

4.2.9.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSL in the peak ankle plantarflexion ($p < 0.001$) and dorsiflexion (p = 0.049) angles, and in the peak knee flexion angle ($p < 0.001$) (Table 4.67). Post-hoc comparisons revealed that the inexperienced level displayed significantly greater peak ankle plantarflexion and significantly less peak knee flexion compared to both the recreational ($p < 0.001$ and p = 0.011, respectively) and professional (p = 0.014 and $p < 0.001$, respectively) levels. Differences among experience levels were insignificant in the peak ankle dorsiflexion angle following post-hoc analysis ($p \geq 0.068$).

4.2.9.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level exhibited significantly less peak ankle plantarflexion (p = 0.035), and greater peak hip extension (p = 0.002) and less peak hip flexion (p = 0.005) than females. There were no significant differences in peak sagittal plane joint angles between males and females during the SSL in the recreational or professional levels ($p \geq 0.062$) (Table 4.67).

4.2.9.5 Frontal Plane Joint Angles.

4.2.9.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed a significant difference among experience levels during the SSL in the peak hip abduction angle ($p < 0.001$) (Table 4.68). Post-hoc analysis showed a significantly different peak hip abduction angle across all comparisons with the recreational level illustrating significantly greater peak hip abduction than the inexperienced level ($p = 0.042$), and the professional level demonstrating significantly greater peak hip abduction than both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels.

4.2.9.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results demonstrated that males in the inexperienced level illustrated significantly less peak ankle eversion compared to females ($p = 0.035$). There were no significant differences in peak frontal plane joint angles between males and females during the SSL in the recreational level ($p \geq 0.050$). Males in the professional level demonstrated significantly less peak ankle eversion ($p = 0.036$), greater peak ankle inversion ($p = 0.003$), less peak knee abduction ($p = 0.001$), and greater peak knee adduction ($p = 0.036$) compared to females (Table 4.68).

4.2.9.6 Transverse Plane Joint Angles.

4.2.9.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSL in the peak hip external ($p = 0.006$) and internal ($p = 0.013$) rotation angles (Table 4.69). Post-hoc comparisons revealed that the professional level displayed significantly greater peak hip external rotation compared to the inexperienced level ($p = 0.007$), and significantly less peak hip internal rotation compared to both the inexperienced ($p = 0.030$) and recreational ($p = 0.028$) levels.

4.2.9.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated significantly less peak hip external rotation (p = 0.011) and greater peak hip internal rotation (p = 0.002) compared to females. Males in the recreational level displayed significantly greater peak hip internal rotation compared to females (p = 0.029). In the professional level, males illustrated significantly greater peak ankle external rotation (p = 0.002) and peak hip internal rotation (p = 0.007), and less peak ankle internal rotation (p = 0.003) and hip external rotation (p = 0.004) compared to females (Table 4.69).

4.2.10 Side Step Left with Partner (SSLP)

4.2.10.1 Sagittal Plane Joint Moments.

4.2.10.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated no significant differences in peak sagittal plane joint moments among experience levels during the SSLP ($p \geq 0.175$) (Table 4.70).

4.2.10.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results showed in the inexperienced level, males exhibited a significantly greater peak hip flexion moment compared to females (p = 0.003). There were no significant differences in peak sagittal plane joint moments between males and females during the SSLP in the recreational level ($p \geq$ 0.200). Males in the professional level displayed a significantly greater peak ankle plantarflexion moment compared to females (p = 0.042) (Table 4.70).

4.2.10.2 Frontal Plane Joint Moments.

4.2.10.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the SSLP in the peak knee (p = 0.017) and hip (p = 0.012) adduction moments (Table 4.71). Post-hoc comparisons revealed that the professional level exhibited significantly greater peak knee and hip adduction moments than both the inexperienced (p = 0.045 and p = 0.031, respectively) and recreational (p = 0.035 and p = 0.026, respectively) levels.

4.2.10.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level exhibited significantly greater peak ankle inversion (p = 0.043), knee adduction ($p < 0.001$), and hip adduction (p = 0.011) moments compared to females. There were no significant differences in frontal plane joint moments between males and females during the SSLP in the recreational or professional levels ($p \geq 0.113$) (Table 4.71).

4.2.10.3 Transverse Plane Joint Moments.

4.2.10.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSLP in the peak ankle internal (p = 0.006) and external (p = 0.036) rotation moments, and in the peak knee internal rotation moment (p = 0.008) (Table 4.72). Post-hoc results indicated that the professional level demonstrated significantly greater peak ankle and knee internal rotation moments compared to both the inexperienced (p = 0.033 and p = 0.023, respectively) and recreational (p = 0.009 and p = 0.018, respectively) levels. Significant differences in peak ankle external rotation disappeared following post-hoc comparisons ($p \geq 0.061$).

4.2.10.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level showed significantly greater peak ankle (p = 0.019) and knee (p = 0.023) internal rotation moments, and a greater peak hip external rotation moment (p = 0.011) compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the SSLP in the recreational level ($p \geq 0.436$). In the professional level, males displayed significantly greater peak ankle (p = 0.008) and knee (p = 0.024) internal rotation moments than females (Table 4.72).

4.2.10.4 Sagittal Plane Joint Angles.

4.2.10.4.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the SSLP in the peak ankle plantarflexion angle ($p < 0.001$), and in the peak knee flexion angle ($p < 0.001$) (Table 4.73). Post-hoc comparisons revealed that the recreational level displayed significantly less peak ankle plantarflexion compared to the inexperienced ($p < 0.001$) and professional ($p = 0.017$) levels. The inexperienced level also demonstrated significantly less peak knee flexion than the recreational ($p = 0.006$) and professional ($p = 0.004$) levels.

4.2.10.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-test results revealed that in the inexperienced level, males demonstrated significantly greater peak hip extension ($p = 0.019$) and significantly less peak hip flexion ($p = 0.019$) compared to females. There were no significant differences in the peak sagittal plane joint angles between males and females during the SSLP in the recreational level ($p \geq 0.177$). Males in the professional level exhibited significantly less peak ankle plantarflexion than females ($p = 0.028$) (Table 4.73).

4.2.10.5 Frontal Plane Joint Angles.

4.2.10.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA revealed a significant difference among experience levels during the SSLP in only the peak hip abduction angle ($p < 0.001$) (Table 4.74). Post-hoc results showed that the professional level demonstrated significantly greater peak hip abduction compared to both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels.

4.2.10.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed significantly less peak ankle eversion than females ($p = 0.043$). There were no significant differences in frontal plane joint angles between males and females during the SSLP in the recreational level ($p \geq 0.050$). Males in the professional level exhibited significantly greater peak ankle inversion ($p = 0.003$) and peak knee adduction ($p = 0.040$), and significantly less peak knee abduction ($p = 0.011$) compared to females (Table 4.74).

4.2.10.6 Transverse Plane Joint Angles.

4.2.10.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSLP in the peak hip external ($p = 0.014$) and internal ($p = 0.008$) rotation angles (Table 4.75). Post-hoc results indicated that the professional level illustrated significantly greater peak hip external rotation compared to the inexperienced level ($p = 0.016$), and less peak hip internal rotation compared to both the inexperienced ($p = 0.017$) and recreational ($p = 0.024$) levels.

4.2.10.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed significantly less peak hip external rotation ($p = 0.005$) and greater peak hip internal rotation ($p = 0.002$) than females. In the recreational level, males displayed significantly less peak knee external rotation ($p = 0.031$), and greater peak hip internal rotation ($p = 0.040$) than females. Males in the professional level exhibited greater peak ankle external rotation ($p = 0.004$) and peak hip internal rotation ($p = 0.011$), and less peak ankle internal rotation ($p = 0.010$) and peak hip external rotation ($p = 0.011$) than females (Table 4.75).

4.2.11 Side Step Right (SSR)

4.2.11.1 Sagittal Plane Joint Moments.

4.2.11.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the SSR in the peak ankle dorsiflexion moment ($p < 0.001$) and the peak hip flexion moment ($p < 0.001$) (Table 4.76). Post-hoc tests revealed a significantly greater peak ankle dorsiflexion moment in the inexperienced level than in both the recreational ($p = 0.003$) and professional ($p = 0.001$) levels, and a peak hip flexion moment that was significantly greater in the professional level compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.028$) levels.

4.2.11.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly smaller peak hip flexion moment ($p = 0.019$) and a greater peak hip extension moment ($p = 0.043$) compared to females. Males in the recreational level demonstrated a significantly greater peak ankle plantarflexion moment compared to females ($p = 0.036$). There were no significant differences in peak sagittal plane joint moments during the SSR in the professional level ($p \geq 0.077$) (Table 4.76).

4.2.11.2 Frontal Plane Joint Moments.

4.2.11.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSR in the peak knee ($p = 0.007$) and hip ($p = 0.008$) abduction moments (Table 4.77). Post-hoc results showed that the inexperienced level exhibited a significantly smaller peak knee abduction moment than the professional level ($p = 0.006$), and a smaller peak hip abduction moment than both the recreational ($p = 0.012$) and professional ($p = 0.041$) levels.

4.2.11.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level demonstrated a significantly greater peak ankle inversion moment ($p = 0.002$) and a smaller peak ankle eversion moment ($p = 0.004$) than females. There were no differences in peak frontal plane joint moments between males and females during the SSR in the recreational level ($p \geq 0.223$). In the professional level, males displayed a significantly greater peak ankle inversion moment than females ($p = 0.014$) (Table 4.77).

4.2.11.3 Transverse Plane Joint Moments.

4.2.11.3.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the SSR in the peak ankle internal (p = 0.041) and external (p = 0.002) rotation moments, peak knee internal (p = 0.047) and external (p < 0.001) rotation moments, and the peak hip external rotation moment (p < 0.001) (Table 4.78).

Post-hoc comparisons illustrated that the inexperienced level demonstrated a significantly smaller peak ankle internal rotation moment compared to the professional level (p = 0.036), and a significantly smaller peak external rotation moment compared to both the recreational and professional levels at the ankle (p = 0.111 and p = 0.001, respectively), knee (p = 0.002 and p < 0.001, respectively), and hip (p = 0.014 and p < 0.001, respectively). Differences in the peak knee internal rotation moment were insignificant following post-hoc comparisons ($p \geq 0.050$).

4.2.11.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated no significant differences in peak transverse plane joint moments between males and females during the SSR in any level ($p \geq 0.077$) (Table 4.78).

4.2.11.4 Sagittal Plane Joint Angles.

4.2.11.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSR in the peak ankle plantarflexion angle (p < 0.001), and the peak hip extension (p = 0.022) and flexion (p < 0.001) angles (Table 4.79). Post-hoc tests showed that the inexperienced level exhibited significantly greater peak ankle plantarflexion compared to the recreational level (p < 0.001), and less peak hip flexion compared to both the recreational (p < 0.001) and professional (p < 0.001) levels. The professional level displayed significantly greater peak hip extension than the recreational level ($p = 0.018$).

4.2.11.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level exhibited less peak ankle plantarflexion ($p = 0.021$) and peak knee flexion ($p = 0.003$), and greater peak knee extension ($p = 0.010$) compared to females. In the recreational level, males displayed less peak ankle plantarflexion than females ($p = 0.041$). There were no significant differences in peak sagittal plane joint angles between males and females during the SSR in the professional level ($p \geq 0.077$) (Table 4.79).

4.2.11.5 Frontal Plane Joint Angles.

4.2.11.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSR in the peak ankle eversion ($p = 0.006$) and inversion ($p = 0.023$) angles, and the peak knee abduction angle ($p < 0.001$) (Table 4.80). Post-hoc comparisons illustrated that the recreational level demonstrated significantly less peak ankle eversion compared to both the inexperienced ($p = 0.011$) and professional ($p = 0.025$) levels, and greater peak ankle inversion compared to the professional level ($p = 0.043$). The peak knee abduction angle was significantly different across all comparisons with the recreational level demonstrating greater peak knee abduction than the inexperienced level ($p = 0.003$), and the professional level demonstrating greater peak knee abduction than both the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels.

4.2.11.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly less peak ankle eversion ($p = 0.043$) and greater peak ankle inversion ($p = 0.024$) compared to females. Males in the recreational level exhibited significantly less peak ankle eversion compared to females ($p = 0.021$). There were no significant differences in peak frontal plane joint angles between males and females during the SSR in the professional level ($p \geq 0.297$) (Table 4.80).

4.2.11.6 Transverse Plane Joint Angles.

4.2.11.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSR in the peak ankle internal rotation angle ($p = 0.025$), and peak knee external ($p = 0.002$) and internal ($p = 0.042$) rotation angles (Table 4.81). Post-hoc comparisons demonstrated that the professional level exhibited significantly greater peak ankle internal rotation than the recreational level ($p = 0.037$), and greater peak knee external rotation than both the inexperienced ($p = 0.003$) and recreational ($p = 0.011$) levels. Differences in peak knee internal rotation were insignificant following post-hoc analyses ($p \geq 0.066$).

4.2.11.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level demonstrated significantly greater peak external ankle rotation ($p = 0.030$) and less peak ankle internal rotation ($p = 0.043$), and less peak knee external rotation ($p = 0.009$) and greater peak knee internal rotation ($p = 0.008$) compared to females. In the recreational level, males demonstrated significantly greater peak ankle external rotation ($p = 0.040$), less peak ankle internal rotation ($p = 0.011$), less peak hip external rotation ($p = 0.009$) and greater peak hip internal rotation ($p = 0.015$) compared to females. There were no significant differences in peak transverse plane joint angles between males and females during the SSR in the professional level ($p \geq 0.594$) (Table 4.81).

4.2.12 Side Step Right with Partner (SSRP)

4.2.12.1 Sagittal Plane Joint Moments.

4.2.12.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the SSRP in the peak ankle dorsiflexion moment ($p < 0.001$), peak knee flexion moment ($p < 0.001$), and peak hip extension moment ($p = 0.018$) (Table 4.82). Post-hoc comparisons revealed that the inexperienced level exhibited a significantly greater peak ankle dorsiflexion moment and smaller peak knee flexion moment compared to the recreational ($p < 0.001$ and $p = 0.002$, respectively) and professional ($p < 0.001$ for both) levels, and a smaller peak hip extension moment compared to the professional level ($p = 0.037$).

4.2.12.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly greater peak hip extension moment than females ($p = 0.002$). Males in the recreational level demonstrated a significantly greater peak ankle plantarflexion moment compared to females ($p = 0.019$). In the professional level, males exhibited significantly greater peak knee ($p = 0.043$) and hip ($p = 0.002$) extension moments compared to females (Table 4.82).

4.2.12.2 Frontal Plane Joint Moments.

4.2.12.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSRP in the peak ankle eversion moment ($p = 0.020$) and the peak knee ($p = 0.006$) and hip ($p = 0.034$) abduction moments (Table 4.83). Post-hoc comparisons revealed that the professional level displayed significantly greater peak ankle eversion ($p = 0.016$) and peak knee abduction ($p = 0.005$)

moments compared to the inexperienced level. Differences in the peak hip abduction moment were insignificant following post-hoc analyses ($p \geq 0.052$).

4.2.12.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level demonstrated a significantly greater peak ankle inversion moment ($p = 0.008$) and smaller peak ankle eversion moment ($p = 0.027$) compared to females. There were no significant differences in frontal plane joint moments between males and females during the SSRP in the recreational level ($p \geq 0.134$). In the professional level, males exhibited a significantly greater peak hip adduction moment than females ($p = 0.043$) (Table 4.83).

4.2.12.3 Transverse Plane Joint Moments.

4.2.12.3.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the SSRP in the peak ankle ($p < 0.001$), knee ($p < 0.001$), and hip ($p < 0.001$) external rotation moments, and the peak knee internal rotation moment ($p = 0.004$) (Table 4.84). Post-hoc comparisons showed that the inexperienced level illustrated significantly smaller peak ankle and knee external rotation moments compared to the recreational ($p = 0.018$ and $p = 0.003$, respectively) and professional ($p < 0.001$ for both) levels. The professional level exhibited significantly greater peak knee internal rotation and less peak hip external rotation compared to the inexperienced ($p = 0.009$ and $p < 0.001$, respectively) and recreational ($p = 0.011$ and $p = 0.003$, respectively) levels.

4.2.12.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly greater peak hip external rotation moment compared to females ($p = 0.011$). There were no significant differences in peak transverse plane joint moments between males and females during the SSRP in the recreational or professional levels ($p \geq 0.258$) (Table 4.84).

4.2.12.4 Sagittal Plane Joint Angles.

4.2.12.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSRP in the peak ankle plantarflexion angle ($p = 0.001$), and the peak hip extension ($p = 0.024$) and flexion ($p = 0.009$) angles (Table 4.85). Post-hoc comparisons revealed that the inexperienced level demonstrated significantly greater peak ankle plantarflexion than the recreational level ($p < 0.001$), and less peak hip flexion than both the recreational ($p = 0.024$) and professional ($p = 0.022$) levels. The professional level displayed significantly greater peak hip extension compared to the recreational level ($p = 0.022$).

4.2.12.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level demonstrated significantly less peak ankle plantarflexion ($p = 0.004$) and peak knee flexion ($p = 0.009$) compared to females. In the recreational level, males demonstrated significantly less peak ankle plantarflexion ($p = 0.001$) compared to females. There were no significant differences in peak sagittal plane joint angles between males and females during the SSRP in the professional level ($p \geq 0.055$) (Table 4.85).

4.2.12.5 Frontal Plane Joint Angles.

4.2.12.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the SSRP in the peak ankle inversion angle ($p = 0.028$), and the peak knee ($p < 0.001$) and hip ($p = 0.009$) abduction angles (Table 4.86). Post-hoc results showed that the recreational level exhibited significantly greater peak ankle inversion compared to the professional level ($p = 0.026$). Peak knee abduction was significantly different across all comparisons with the recreational level displaying greater knee abduction compared to the inexperienced level ($p = 0.009$), and the professional level displaying greater knee abduction compared to the inexperienced ($p < 0.001$) and recreational ($p < 0.001$) levels. At the hip, peak abduction was significantly greater in the professional level compared to the inexperienced ($p = 0.012$) and recreational ($p = 0.041$) levels.

4.2.12.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males illustrated significantly less peak ankle eversion ($p = 0.043$) and greater peak ankle inversion ($p = 0.026$) compared to females. Males in the recreational level illustrated less peak ankle eversion ($p = 0.015$) and greater peak ankle inversion ($p = 0.048$), and significantly greater peak hip adduction compared to females ($p = 0.024$). There were no significant differences in peak frontal plane joint angles between males and females during the SSRP in the professional level ($p \geq 0.101$) (Table 4.86).

4.2.12.6 Transverse Plane Joint Angles.

4.2.12.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the SSRP in the peak knee external ($p = 0.003$) and internal ($p = 0.018$) rotation angles (Table 4.87). Post-hoc comparisons showed that the professional level displayed significantly greater peak knee external rotation than the inexperienced ($p = 0.006$) and recreational ($p = 0.014$) levels, and less peak knee internal rotation than the recreational level ($p = 0.025$).

4.2.12.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated significantly greater peak ankle external rotation ($p = 0.028$), less peak ankle internal rotation ($p = 0.043$), and greater peak knee internal rotation ($p = 0.048$) compared to females. Males in the recreational level exhibited significantly greater peak ankle external rotation ($p = 0.049$), less peak ankle internal rotation ($p = 0.003$), less peak hip external rotation ($p = 0.004$) and greater peak hip internal rotation ($p = 0.013$) compared to females. There were no significant differences in peak transverse plane joint angles between males and females during the SSRP in the professional level ($p \geq 0.543$) (Table 4.87).

4.2.13 Spot Turn (ST)

Only the results for the first step of the ST are reported as the second step was affected due to the participant having two feet on the same force plate (Tables 4.88 – 4.93).

4.2.13.1 Sagittal Plane Joint Moments.

4.2.13.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the ST in the peak ankle plantarflexion moment ($p = 0.012$), peak knee extension moment ($p = 0.008$), and peak hip flexion moment ($p = 0.001$) (Table 4.88). Post-hoc comparisons showed that the inexperienced level demonstrated a significantly smaller peak ankle plantarflexion moment than the recreational level ($p = 0.009$), and significantly smaller peak knee extension and peak hip flexion moments than both the recreational ($p = 0.028$ and $p = 0.004$, respectively) and professional ($p = 0.018$ and $p = 0.006$, respectively) levels.

4.2.13.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that males in the inexperienced level displayed a significantly greater peak knee flexion moment compared to females ($p = 0.045$). In the recreational level, males demonstrated a significantly greater peak ankle plantarflexion moment ($p = 0.001$) and peak hip extension moment ($p = 0.024$) compared to females. In the professional level, males exhibited a significantly greater peak ankle plantarflexion moment compared to females ($p = 0.025$) (Table 4.88).

4.2.13.2 Frontal Plane Joint Moments.

4.2.13.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the ST in the peak knee and hip adduction (p = 0.013 and p < 0.001, respectively) and abduction (p = < 0.001 for both) moments (Table 4.89). Post-hoc comparisons showed that the inexperienced level exhibited a significantly greater peak knee adduction moment compared to the recreational level (p = 0.010), a smaller peak knee abduction moment compared to the professional level (p < 0.001), and a smaller peak hip abduction moment compared to the recreational (p < 0.001) and professional (p < 0.001) levels. The peak knee adduction moment was significantly smaller in the recreational level than the inexperienced (p < 0.001) and professional (p = 0.001) levels.

4.2.13.2.2 Comparison Between Genders. Mann-Whitney/independent t-test results revealed that in the inexperienced level, males exhibited a significantly greater peak ankle inversion moment (p = 0.035) and a smaller peak ankle eversion moment (p = 0.001) compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the ST in the recreational level ($p \geq 0.094$). Males in the professional level showed a significantly greater peak ankle inversion moment compared to females (p = 0.019) (Table 4.89).

4.2.13.3 Transverse Plane Joint Moments.

4.2.13.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the ST in the peak ankle (p = 0.045) and knee (p = 0.003) external rotation moments (Table 4.90). Post-hoc comparisons revealed significantly greater peak ankle (p = 0.038) and knee (p = 0.003) external rotation moments in the professional level than the inexperienced level.

4.2.13.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in peak transverse plane joint moments between males and females during the ST in the inexperienced level ($p \geq 0.063$). In the recreational level, males displayed a significantly smaller peak ankle external rotation moment compared to females ($p = 0.031$). Males in the professional level exhibited a significantly greater peak ankle internal rotation moment compared to females ($p = 0.018$) (Table 4.90).

4.2.13.4 Sagittal Plane Joint Angles.

4.2.13.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA tests illustrated significant differences among experience levels during the ST in the peak ankle dorsiflexion angle ($p = 0.001$), and peak knee ($p < 0.001$) and hip ($p < 0.001$) flexion angles (Table 4.91). Post-hoc results showed that the inexperienced level displayed significantly less peak ankle dorsiflexion than both the recreational ($p = 0.022$) and professional ($p = 0.002$) levels. The professional level demonstrated significantly greater peak knee and hip flexion compared to the inexperienced ($p < 0.001$ for both) and recreational ($p = 0.012$ and $p = 0.013$, respectively) levels.

4.2.13.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level demonstrated significantly less peak ankle plantarflexion ($p = 0.012$), greater peak knee extension ($p = 0.025$), and less peak hip flexion ($p < 0.001$) compared to females. In the recreational level, males displayed significantly greater peak hip extension ($p = 0.011$) and less peak hip flexion ($p = 0.015$) than females. Males in the professional level exhibited significantly less peak ankle plantarflexion ($p = 0.019$) and greater peak hip extension ($p = 0.010$) compared to females (Table 4.91).

4.2.13.5 Frontal Plane Joint Angles.

4.2.13.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the ST in the peak ankle inversion angle (p = 0.046), peak knee (p = 0.033) and hip (p < 0.001) adduction angles, and peak hip abduction angle (p = 0.018) (Table 4.92). Post-hoc results showed that the inexperienced level displayed significantly greater peak ankle inversion compared to the professional level (p = 0.048), greater peak hip abduction compared to the recreational level (p = 0.017), and less peak hip adduction compared to the recreational (p < 0.001) and professional (p < 0.001) levels. The recreational level demonstrated significantly greater peak knee adduction than the professional level (p = 0.031).

4.2.13.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated significantly greater peak ankle inversion (p = 0.005) and peak knee adduction (p = 0.011) compared to females. Males in the recreational level displayed significantly greater peak knee adduction (p = 0.006) and peak hip abduction (p = 0.023) compared to females. In the professional level, males displayed significantly less peak ankle eversion (p = 0.008) and peak knee abduction (p = 0.011), and greater peak ankle inversion (p = 0.001) and peak knee adduction (p = 0.004) compared to females (Table 4.92).

4.2.13.6 Transverse Plane Joint Angles.

4.2.13.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the ST in the peak knee internal rotation angle (p = 0.008), and the peak hip external (p = 0.006) and internal (p = 0.017) rotation angles (Table 4.93). Post-hoc comparisons illustrated that the professional level displayed significantly greater peak hip external rotation and less peak hip internal rotation compared to the inexperienced (*p* = 0.023 and *p* = 0.032, respectively) and recreational (*p* = 0.010 and *p* = 0.045, respectively) levels. Differences in peak knee internal rotation were insignificant following post-hoc analyses ($p \geq 0.082$).

4.2.13.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests indicated that males in the inexperienced and the recreational levels exhibited significantly greater peak ankle external rotation (*p* = 0.005 and *p* = 0.031, respectively) and peak hip internal rotation (*p* = 0.001 and *p* = 0.049, respectively) compared to females. In the professional level, males demonstrated significantly greater peak ankle external rotation (*p* = 0.001) and peak hip internal rotation (*p* = 0.005), and less peak ankle internal rotation (*p* = 0.003) and peak hip external rotation (*p* = 0.006) compared to females (Table 4.93).

4.2.14 Spot Turn with Partner (STP)

Results for the second step of the STP were not reported due to inaccuracy resulting from the participant having two feet on the same force plate. Therefore, results are only presented for the first step of the STP (Table 4.94 – 4.99).

4.2.14.1 Sagittal Plane Joint Moments.

4.2.14.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated a significant difference among experience levels during the STP in the peak ankle dorsiflexion moment (*p* = 0.003) (Table 4.94). Post-hoc tests revealed a significantly greater peak ankle dorsiflexion moment in the inexperienced level than the professional level (*p* = 0.002).

4.2.14.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level demonstrated a significantly greater peak knee flexion moment than females ($p = 0.035$). In the recreational level, males displayed a significantly greater peak hip extension moment than females ($p = 0.024$). Males in the professional level exhibited significantly greater peak ankle plantarflexion ($p = 0.002$), peak knee flexion ($p = 0.031$), and peak hip extension ($p = 0.004$) moments compared to females (Table 4.94).

4.2.14.2 Frontal Plane Joint Moments.

4.2.14.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the STP in the peak knee and hip adduction ($p < 0.001$ for both) and abduction ($p < 0.001$ for both) moments (Table 4.95). Post-hoc comparisons revealed that the inexperienced level displayed significantly greater peak knee and hip adduction moments compared to the recreational ($p < 0.001$ for both) and professional ($p = 0.013$ and $p = 0.045$, respectively) levels, and a significantly smaller peak hip abduction moment compared to the recreational ($p = 0.017$) and professional ($p < 0.001$) levels. The peak knee abduction moment was significantly different across all comparisons, with the recreational level displaying a greater peak knee abduction moment compared to the inexperienced level ($p = 0.012$) and the professional level displaying a greater peak knee abduction moment than both the inexperienced ($p < 0.001$) and recreational ($p = 0.042$) levels.

4.2.14.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited a significantly greater peak ankle inversion moment ($p = 0.006$), and significantly smaller peak ankle eversion ($p < 0.001$) and hip abduction ($p = 0.029$) moments compared to females. In the recreational level, males displayed a significantly smaller peak knee abduction moment compared to females ($p = 0.033$). Males in the professional level illustrated a significantly greater peak ankle inversion moment compared to females (p = 0.024) (Table 4.95).

4.2.14.3 Transverse Plane Joint Moments.

4.2.14.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the STP in the peak ankle internal rotation moment (p = 0.016), and the peak knee internal (p = 0.027) and external (p = 0.001) rotation moments (Table 4.96). Post-hoc results revealed that the inexperienced level exhibited significantly greater peak ankle (p = 0.026) and knee (p = 0.023) internal rotation moments than the recreational level, and a significantly smaller peak knee external rotation moment than the professional level (p = 0.001).

4.2.14.3.2 Comparison Between Genders. Mann-Whitney/independent t-tests illustrated no significant differences in peak transverse plane joint moments between males and females during the STP in the inexperienced level ($p \geq 0.449$). In the recreational level, males exhibited a significantly greater peak ankle internal rotation moment (p = 0.001) and a smaller peak ankle external rotation moment ($p < 0.001$) compared to females. Males in the professional level demonstrated significantly greater peak ankle (p = 0.014) and knee (p = 0.025) internal rotation moments compared to females (Table 4.96).

4.2.14.4 Sagittal Plane Joint Angles.

4.2.14.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the STP in the peak ankle dorsiflexion angle ($p < 0.001$), and the peak knee (p = 0.002) and hip ($p < 0.001$) flexion angles (Table 4.97). Post-hoc comparisons illustrated that the professional level demonstrated significantly greater peak ankle dorsiflexion compared to the inexperienced level (p =

0.001), and greater peak knee and hip flexion compared to the inexperienced (p = 0.002 and p < 0.001, respectively) and recreational (p = 0.019 and p = 0.007, respectively) levels.

4.2.14.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the inexperienced level exhibited significantly less peak ankle plantarflexion (p = 0.010), greater peak knee extension (p = 0.039), and less peak hip flexion (p = 0.002) compared to females. In the recreational level, males demonstrated significantly greater peak ankle dorsi-flexion (p = 0.040) and peak hip extension (p = 0.018), and less peak hip flexion (p = 0.002) compared to females. In the professional level, males showed significantly less peak ankle plantarflexion (p = 0.005) and greater peak hip extension (p = 0.005) than females (Table 4.97).

4.2.14.5 Frontal Plane Joint Angles.

4.2.14.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illus-trated significant differences among experience levels during the STP in the peak ankle inversion angle (p = 0.035), and peak hip abduction (p = 0.001) and adduction (p < 0.001) angles (Table 4.98). Post-hoc tests revealed that the inexperienced level demonstrated significantly greater peak ankle inversion than the professional level (p = 0.029), and significantly greater peak hip abduction and less peak hip adduction than both the recreational (p = 0.007 and p < 0.001, re-spectively) and professional (p = 0.003 and p < 0.001, respectively) levels.

4.2.14.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males exhibited significantly greater peak ankle inversion (p = 0.010), and peak knee adduction (p = 0.012) compared to females. Males in the recreational level displayed significantly greater peak ankle inversion (p = 0.006), peak knee adduction (p = 0.004), and peak hip abduction (p = 0.004) compared to females. In the professional level, males demonstrated significantly less peak ankle eversion (p = 0.019) and peak knee abduction (p =

0.021), and significantly greater peak ankle inversion (p = 0.002) and peak knee adduction (p = 0.004) compared to females (Table 4.98).

4.2.14.6 Transverse Plane Joint Angles.

4.2.14.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the STP in the peak hip internal rotation angle (p = 0.027) (Table 4.99). However, differences were insignificant following post-hoc comparisons ($p \geq 0.053$).

4.2.14.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males illustrated significantly greater peak ankle external rotation (p = 0.025) and peak hip internal rotation (p = 0.003) compared to females. In the recreational level, males displayed significantly greater peak ankle external rotation (p = 0.004) compared to females. In the professional level, males exhibited significantly greater peak ankle external rotation (p = 0.002) and peak hip internal rotation (p = 0.005), and less peak ankle internal rotation (p = 0.004) and peak hip external rotation (p = 0.014) compared to females (Table 4.99).

4.2.15 Triple Step Left (TSL)

Results for the second step of the TSL were affected due to participants placing two feet on the same force plate, therefore, results are only presented for the first and third steps.

4.2.15.1 Sagittal Plane Joint Moments.

4.2.15.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSL in the peak knee extension moment ($p < 0.001$) and the peak hip flexion moment (p = 0.002) during the first step (Table 4.100). Post-hoc comparisons revealed that the professional level exhibited a significantly greater peak knee extension moment during the first step compared to both the inexperienced (p

< 0.001) and recreational ($p = 0.035$) levels, and a significantly greater peak hip flexion moment during the first step compared to the inexperienced level ($p = 0.001$).

4.2.15.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed a significantly greater peak hip extension moment during the first step ($p = 0.011$), and a greater peak hip flexion moment during the third step ($p = 0.003$) compared to females. In the recreational level, males displayed a significantly greater peak ankle plantarflexion moment during the first step than females ($p = 0.037$). In the professional level, males illustrated a significantly greater peak ankle dorsiflexion moment ($p = 0.006$), a smaller peak knee extension moment ($p = 0.002$), and a greater peak hip extension moment ($p = 0.031$) during the first step compared to females (Table 4.100).

4.2.15.2 Frontal Plane Joint Moments.

4.2.15.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSL in the peak ankle inversion moment during the first step ($p = 0.006$), peak hip abduction moment during the first step ($p = 0.009$), and the peak hip adduction moment during the third step ($p = 0.044$) (Table 4.101). Post-hoc comparisons showed a significantly greater peak ankle inversion moment in the inexperienced level compared to the recreational ($p = 0.018$) and professional ($p = 0.020$) levels during the first step. The professional level displayed a significantly greater peak hip abduction moment than the inexperienced level during the third step ($p = 0.012$). Differences in the peak hip adduction moment during the third step were insignificant following post-hoc analyses ($p \geq 0.063$).

4.2.15.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males illustrated a significantly greater peak ankle inversion moment during both the first ($p = 0.004$) and third ($p = 0.002$) steps, greater peak knee ($p = 0.003$) and hip ($p = 0.003$) adduction moments during the third step, and a smaller peak hip abduction moment ($p = 0.013$) during the third step compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the TSL in the recreational level ($p \geq 0.094$). Males in the professional level displayed a significantly greater peak ankle inversion moment ($p = 0.008$) and a greater peak knee abduction moment ($p = 0.044$) during the first step compared to females (Table 4.101).

4.2.15.3 Transverse Plane Joint Moments.

4.2.15.3.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSL in the peak ankle ($p = 0.027$) and knee ($p < 0.001$) external rotation moments during the first step, the peak ankle internal rotation moment during the third step ($p = 0.039$), peak hip internal ($p = 0.004$) and external ($p < 0.001$) rotation moments during the first step, and the peak hip external rotation moment during the third step ($p = 0.002$) (Table 4.102).

Post-hoc comparisons illustrated that the professional level displayed a significantly greater peak ankle external rotation moment during the first step ($p = 0.046$) and ankle internal rotation moment during the third step ($p = 0.035$) compared to the inexperienced level, a greater peak knee external rotation moment and hip internal rotation moment compared to both the inexperienced ($p = 0.005$ and $p = 0.038$, respectively) and recreational ($p < 0.001$ and $p = 0.006$, respectively) levels during the first step, and a greater peak hip external rotation moment ($p =$

0.002) during the third step compared to the inexperienced level. Peak hip external rotation during the first step was significantly different across all comparisons with the recreational level demonstrating a greater peak hip external rotation moment than the inexperienced level (p = 0.046), and the professional level displaying a greater peak hip external rotation moment than both the inexperienced ($p < 0.001$) and recreational (p = 0.001) levels.

4.2.15.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed significantly greater peak ankle (p = 0.007) and knee (p = 0.004) internal rotation moments during the third step compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the TSL in the recreational or professional levels ($p \geq 0.190$) (Table 4.102).

4.2.15.4 Sagittal Plane Joint Angles.

4.2.15.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSL in the peak ankle plantarflexion angle during the first (p = 0.004) and third (p = 0.002) steps, peak knee extension angle during the first step (p = 0.026), peak knee flexion angle during the first ($p < 0.001$) and third ($p < 0.001$) steps, and peak hip flexion angle during the first (p = 0.015) and third (p = 0.027) steps (Table 4.103).

Post-hoc comparisons revealed that the inexperienced level demonstrated significantly greater peak ankle plantarflexion compared to both the recreational (p = 0.005) and professional (p = 0.045) levels during the first step, greater peak ankle plantarflexion compared to the recreational level during the third step (p = 0.001), greater peak knee extension compared to the professional level during the first step (p = 0.025), less peak knee flexion during the third step compared to both the recreational (p = 0.002) and professional ($p < 0.001$) levels, and less peak hip flexion during the first step compared to the professional level ($p = 0.014$). Peak knee flexion during the first step was significantly different across all comparisons with the recreational level displaying significantly greater peak knee flexion than the inexperienced level ($p < 0.001$) and the professional level displaying greater peak knee flexion than both the inexperienced ($p < 0.001$) and recreational ($p = 0.017$) levels. Differences in peak hip flexion during the third step were insignificant following post-hoc analyses ($p \geq 0.051$).

4.2.15.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the inexperienced level exhibited significantly greater peak hip extension during the first ($p = 0.001$) and third ($p = 0.040$) steps, and less peak hip flexion during the first ($p = 0.002$) and third ($p = 0.007$) steps compared to females. There were no significant differences in peak sagittal plane joint angles between males and females during the TSL in the recreational level ($p \geq 0.132$). In the professional level, males displayed significantly less peak ankle plantarflexion in the first ($p = 0.032$) and third ($p = 0.009$) steps, and greater peak hip extension ($p = 0.026$) and less peak hip flexion ($p = 0.040$) during the first step compared to females (Table 4.103).

4.2.15.5 Frontal Plane Joint Angles.

4.2.15.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the TSL in the peak knee and hip abduction angles during the first ($p = 0.048$ and $p < 0.001$, respectively) and third ($p = 0.003$ and $p < 0.001$, respectively) steps, and peak knee ($p = 0.036$) and hip ($p = 0.028$) adduction angles during the first step (Table 4.104).

Post-hoc comparisons revealed that the professional level demonstrated significantly greater peak knee abduction than the inexperienced ($p = 0.005$) and recreational ($p = 0.018$) levels during the third step, greater peak hip abduction than the inexperienced and recreational levels during the first ($p < 0.001$ for both) and third ($p = 0.001$ and $p < 0.001$, respectively) steps, and greater peak hip adduction than the inexperienced level during the first step ($p = 0.032$). Differences in peak knee abduction and adduction during the first step were insignificant following post-hoc analyses ($p \geq 0.067$).

4.2.15.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited significantly less peak ankle eversion during the first ($p = 0.043$) and third ($p = 0.023$) steps, less peak knee abduction during the first ($p = 0.008$) and third ($p = 0.020$) steps, and greater peak knee adduction during the first step ($p = 0.002$) compared to females. Males in the recreational level demonstrated significantly less peak ankle eversion during the first step ($p = 0.024$), less peak knee abduction during the first ($p = 0.022$) and third ($p = 0.045$) steps, and less peak knee ($p = 0.004$) and hip ($p = 0.019$) adduction during the first step compared to females. In the professional level, males exhibited significantly less peak ankle eversion during the first ($p = 0.024$) and third ($p = 0.036$) steps, greater peak ankle inversion during the first ($p = 0.002$) and third ($p = 0.011$) steps, less knee abduction during the first ($p < 0.001$) and third ($p < 0.001$) steps, and greater peak knee adduction during the first ($p < 0.001$) and third ($p = 0.016$) steps compared to females (Table 4.104).

4.2.15.6 Transverse Plane Joint Angles.

4.2.15.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSL in the peak knee internal rotation angle during the first ($p = 0.014$) and third ($p = 0.047$) steps, and in the peak hip external and internal rotation angles during the first ($p = 0.004$ and $p = 0.016$, respectively) and third ($p = 0.012$ for both) steps (Table 4.105).

Post-hoc comparisons revealed that the professional level displayed significantly greater peak knee internal rotation than the inexperienced level during the first ($p = 0.018$) and third ($p = 0.044$) steps, greater peak hip external rotation than the inexperienced ($p = 0.007$) and recreational ($p = 0.018$) levels during the first step, less peak hip internal rotation than the inexperienced ($p = 0.047$) and recreational ($p = 0.027$) levels during the first step, greater peak hip external rotation than the inexperienced level during the third step ($p = 0.014$), and less peak hip internal rotation than both the inexperienced ($p = 0.027$) and recreational ($p = 0.030$) levels during the third step.

4.2.15.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated significantly less peak ankle internal rotation during the first step ($p = 0.038$), and less hip external rotation and greater hip internal rotation during the first ($p = 0.004$ and $p = 0.001$, respectively) and third ($p = 0.007$ and $p = 0.003$, respectively) steps compared to females. In the recreational level, males displayed significantly less peak ankle internal rotation during the first step ($p = 0.039$), less peak knee external rotation during the first ($p = 0.028$) and third ($p = 0.019$) steps, greater knee internal rotation during the third step ($p = 0.018$), and increased hip internal rotation during the first step ($p = 0.049$) compared to females. Males in the professional level exhibited significantly greater peak ankle external rotation during the first ($p = 0.003$) and third ($p = 0.004$) steps, less peak ankle internal rotation during the first ($p = 0.005$) and third ($p = 0.003$) steps, less peak hip external rotation during the first ($p = 0.006$) and third ($p = 0.004$) steps, and greater peak hip internal rotation during the first ($p = 0.005$) and third ($p = 0.005$) steps compared to females (Table 4.105).

4.2.16 Triple Step Left with Partner (TSLP)

Results are only presented for the first and third steps of the TSLP because results for the middle step (step two) were confounded by participants placing two feet on the same force plate.

4.2.16.1 Sagittal Plane Joint Moments.

4.2.16.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSLP in the peak knee extension moment during the first step (p = 0.013), peak knee flexion moment during the third step (p = 0.012) and peak hip flexion moment during the first step (p = 0.005) (Table 4.106). Post-hoc comparisons showed that the professional level displayed a significantly greater peak knee extension moment during the first step (p = 0.010), peak knee flexion moment during the third step (p = 0.010), and peak hip flexion moment during the first step (p = 0.003) compared to the inexperienced level.

4.2.16.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males displayed a significantly greater peak knee flexion moment during the first step (p = 0.015), a greater peak knee extension moment during the third step (p = 0.029), a greater peak hip extension moment during the first step (p = 0.005), and a greater peak hip flexion moment during the third step (p = 0.002) compared to females. There were no significant differences in peak sagittal plane joint moments between males and females during the TSLP in the recreational level ($p \geq 0.093$). Males in the professional level demonstrated a significantly greater peak dorsiflexion moment during the first step ($p < 0.001$), a greater peak ankle plantarflexion moment during the first (p = 0.014) and third (p = 0.014) steps, a smaller peak knee extension moment (p = 0.011), and greater peak hip extension moment (p = 0.014) during the first step compared to females (Table 4.106).

4.2.16.2 Frontal Plane Joint Moments.

4.2.16.2.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSLP in the peak knee adduction moment during the first step ($p = 0.027$), peak knee ($p = 0.043$) and hip ($p < 0.001$) abduction moments during the first step, and peak knee ($p = 0.025$) and hip ($p = 0.022$) adduction moments during the third step (Table 4.107). Post-hoc comparisons revealed that the professional level displayed a significantly greater peak knee adduction moment than the recreational level ($p = 0.043$) during the first step and a greater peak knee adduction moment than the inexperienced level ($p = 0.021$) during the third step. The inexperienced level displayed a significantly smaller peak hip abduction moment than the recreational ($p = 0.022$) and professional ($p < 0.001$) levels during the first step, and a smaller peak hip adduction moment than the professional level ($p = 0.020$) during the third step. Differences in the peak knee abduction moment during the first step were insignificant after post-hoc analyses ($p \geq 0.066$).

4.2.16.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the inexperienced level exhibited significantly greater peak knee and hip adduction moments during the first ($p = 0.029$ and $p = 0.019$, respectively) and third ($p < 0.001$ for both) steps compared to females. There were no significant differences in peak frontal plane joint moments between males and females during the TSLP in the recreational level ($p \geq 0.093$). In the professional level, males illustrated a significantly greater peak ankle inversion moment during the third step ($p = 0.040$), and greater peak knee abduction ($p = 0.003$) and hip adduction ($p = 0.014$) moments during the first step compared to females (Table 4.107).

4.2.16.3 Transverse Plane Joint Moments.

4.2.16.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSLP in the peak ankle (p = 0.011), knee (p = 0.038), and hip (p < 0.001) internal rotation moments during the first step, and the peak ankle (p = 0.005 and p = 0.002), knee (p < 0.001 and p = 0.030) and hip (p < 0.001 and p = 0.017) external rotation moments during the first and third steps, respectively (Table 4.108).

Post-hoc comparisons revealed that the inexperienced level demonstrated a smaller peak ankle internal rotation moment than the professional level during the first step (p = 0.012), a smaller peak ankle external rotation moment compared to the recreational and professional levels during the first (p = 0.033 and p = 0.008, respectively) and third (p = 0.015 and p = 0.005, respectively) steps, a smaller peak knee internal rotation moment compared to the professional level during the first step (p = 0.033), a smaller peak knee external rotation moment compared to both the recreational (p < 0.001) and professional (p < 0.001) levels during the first step, and a significantly smaller peak hip internal rotation moment than the recreational (p = 0.004) and professional (p < 0.001) levels during the first step. Differences in the peak knee external rotation moment during the third step were insignificant following post-hoc analyses ($p \geq 0.068$). The professional level also illustrated a significantly greater peak hip external rotation moment compared to the inexperienced (p < 0.001) and recreational (p = 0.043) levels during the first step, and compared to the inexperienced level (p = 0.027) during the third step.

4.2.16.3.2 Comparison Between Genders. Mann-Whitney/independent t-tests revealed that in the inexperienced level, males exhibited significantly greater peak ankle (p = 0.015) and knee (p = 0.011) internal rotation moments, and a greater peak hip external rotation moment (p =

0.002) during the third step compared to females. There were no significant differences in peak transverse plane moments between males and females during the TSLP in the recreational level ($p \geq 0.190$). Males in the professional level displayed a significantly greater peak knee internal rotation moment during the third step compared to females ($p = 0.024$) (Table 4.108).

4.2.16.4 Sagittal Plane Joint Angles.

4.2.16.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSLP in the peak ankle plantarflexion angle during the first ($p < 0.001$) and third ($p = 0.014$) steps, peak ankle dorsiflexion angle during the first step ($p < 0.001$), peak knee extension angle during the first step ($p = 0.040$), and peak knee and hip flexion angles during the first ($p < 0.001$ for both) and third ($p < 0.001$ and $p = 0.005$, respectively) steps (Table 4.109).

Post-hoc comparisons revealed that the inexperienced level exhibited significantly greater peak ankle plantarflexion compared to the recreational ($p = 0.001$) and professional ($p = 0.002$) levels during the first step, and compared to the recreational level ($p = 0.010$) during the third step, and less peak ankle dorsiflexion ($p < 0.001$) and greater peak knee extension ($p = 0.048$) compared to the professional level during the first step. Peak knee flexion during the first step was significantly different across all comparisons, with the recreational level showing greater peak knee flexion than the inexperienced level ($p < 0.001$) and the professional level exhibiting greater peak knee flexion than both the inexperienced ($p < 0.001$) and recreational ($p = 0.044$) levels. Peak knee flexion during the third step was significantly smaller in the inexperienced level compared to both the recreational ($p = 0.001$) and professional ($p = 0.002$) levels. The professional level demonstrated significantly greater peak hip flexion during the first and third steps than both the inexperienced ($p < 0.001$ and $p = 0.005$, respectively) and the recreational ($p = 0.035$ and $p = 0.044$, respectively) levels.

4.2.16.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed significantly greater peak hip extension and less peak hip flexion during the first ($p = 0.007$ for both) and third ($p = 0.004$ and $p = 0.013$, respectively) steps compared to females. In the recreational level, males demonstrated significantly greater peak hip extension during the third step compared to females ($p = 0.019$). In the professional level, males exhibited significantly less peak ankle plantarflexion during the first ($p = 0.018$) and third ($p = 0.020$) steps, and less peak hip flexion during the first step ($p = 0.022$) compared to females (Table 4.109).

4.2.16.5 Frontal Plane Joint Angles.

4.2.16.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels during the TSLP in the peak knee and hip abduction angle during the first ($p = 0.010$ and $p < 0.001$, respectively) and third ($p = 0.008$ and $p < 0.001$) steps, and the peak knee ($p = 0.027$) and hip ($p = 0.015$) adduction angle during the first step (Table 4.110).

Post-hoc comparisons revealed that the professional level demonstrated significantly greater peak knee abduction compared to the inexperienced ($p = 0.016$) and recreational ($p = 0.033$) levels during the first step, greater peak knee abduction compared to the inexperienced level during the third step ($p = 0.007$), less peak knee adduction compared to the recreational level during the first step ($p = 0.040$), greater peak hip abduction compared to the inexperienced and recreational levels during the first ($p < 0.001$ for both) and third ($p < 0.001$ for both) steps, and greater peak hip adduction than the inexperienced level during the first step ($p = 0.012$).

4.2.16.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males demonstrated significantly less peak knee abduction (p = 0.008) and greater peak knee adduction (p = 0.004) during the first step compared to females. In the recreational level, males displayed significantly less peak knee abduction during the first (p = 0.031) and third (p = 0.039) steps, and greater peak knee adduction during the first step (p = 0.011) compared to females. Males in the professional level exhibited significantly less peak ankle eversion and greater peak ankle inversion during the first (p = 0.011 and p = 0.002, respectively) and third (p = 0.015 and p = 0.007, respectively) steps, less peak knee abduction during the first (p = 0.003) and third (p = 0.002) steps, and greater peak knee adduction (p = 0.001) during the first step compared to females (Table 4.110).

4.2.16.6 Transverse Plane Joint Angles.

4.2.16.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSLP in the peak hip external and internal rotation angles during the first (p = 0.008 and p = 0.041, respectively) and third (p = 0.022 and p = 0.016, respectively) steps (Table 4.111). Post-hoc results illustrated that the professional level demonstrated significantly greater peak hip external rotation compared to the inexperienced (p = 0.015) and recreational (p = 0.029) levels during the first step, and greater peak hip external rotation (p = 0.022) and less peak hip internal rotation (p = 0.021) compared to the inexperienced level during the third step. Differences in peak hip internal rotation during the first step were insignificant following post-hoc analyses ($p \geq 0.072$).

4.2.16.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited significantly less peak hip external rotation during the first (p = 0.001) and third (p = 0.005) steps, and greater peak hip internal rotation during the first ($p = 0.001$) and third ($p = 0.004$) steps compared to females. Males in the recreational level showed significantly less peak hip external rotation during the first step ($p = 0.040$), and greater peak hip internal rotation during the first ($p = 0.041$) and third ($p = 0.043$) steps compared to females. In the professional level, males displayed significantly greater peak ankle external rotation during the first ($p = 0.002$) and third ($p = 0.002$) steps, less peak ankle internal rotation during the first ($p = 0.002$) and third ($p = 0.002$) steps, less peak hip external rotation during the first ($p = 0.011$) and third ($p = 0.008$) steps, and greater peak hip internal rotation during the first ($p = 0.005$) and third ($p = 0.003$) steps compared to females (Table 4.111).

4.2.17 Triple Step Right (TSR)

Results for the middle step of the TSR were confounded due to participants placing two feet on the same force plate. Thus, results are only presented for the first and third steps.

4.2.17.1 Sagittal Plane Joint Moments.

4.2.17.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSR in the peak ankle dorsiflexion moment during the third step ($p = 0.004$), peak knee flexion moment during the first ($p = 0.005$) and third ($p < 0.001$) steps, and peak hip flexion ($p = 0.001$) and extension ($p = 0.001$) moments during the third step (Table 4.112).

Post-hoc comparisons revealed a significantly greater peak ankle dorsiflexion moment in the inexperienced level than the recreational ($p = 0.008$) and professional ($p = 0.016$) levels during the third step. The inexperienced level displayed a significantly smaller peak knee flexion moment than the professional level ($p = 0.003$) during the first step, and a significantly smaller peak knee flexion moment than both the recreational ($p = 0.042$) and professional ($p < 0.001$) levels during the third step. The professional level demonstrated a significantly greater peak hip flexion moment compared to both the inexperienced ($p = 0.001$) and recreational ($p = 0.029$) levels during the third step, and a greater peak hip extension moment compared to the inexperienced level ($p = 0.001$) during the third step.

4.2.17.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males exhibited a significantly greater peak dorsiflexion moment ($p = 0.025$), smaller peak plantarflexion moment ($p = 0.023$) and a greater peak hip extension moment ($p = 0.001$) during the first step, and a smaller peak hip flexion moment during the first ($p = 0.019$) and third ($p = 0.035$) steps compared to females. There were no significant differences in peak sagittal plane joint moments between males and females during the TSR in the recreational or professional levels ($p \geq 0.059$) (Table 4.112).

4.2.17.2 Frontal Plane Joint Moments.

4.2.17.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated no significant differences in peak frontal plane joint moments among experience levels during the TSR ($p \geq 0.103$) (Table 4.113).

4.2.17.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level exhibited a significantly greater peak ankle inversion moment during the first ($p = 0.029$) and third ($p < 0.001$) steps, a greater peak ankle eversion moment during the first step ($p = 0.015$), a smaller peak ankle eversion moment during the third step ($p = 0.001$), and a smaller peak knee adduction moment ($p = 0.009$) and greater peak knee ($p = 0.002$) and hip ($p = 0.043$) abduction moments during the first step compared to females. In the recreational level, males displayed a significantly greater peak hip adduction moment during the first step compared to females ($p = 0.011$). Males in the professional level demonstrated a significantly greater peak ankle inversion moment during the third step compared to females ($p = 0.038$) (Table 4.113).

4.2.17.3 Transverse Plane Joint Moments.

4.2.17.3.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSR in the peak ankle internal ($p = 0.017$) and external ($p = 0.013$) rotation moments during the third step, the peak knee external rotation moment during the first ($p = 0.014$) and third ($p = 0.004$) steps, the peak knee internal rotation moment during the third step ($p = 0.021$), and the peak hip external rotation moment during the first ($p < 0.001$) and third ($p < 0.001$) steps (Table 4.114).

Post-hoc comparisons revealed that the professional level displayed significantly greater peak ankle internal ($p = 0.023$) and external ($p = 0.010$) rotation moments compared to the inexperienced level during the third step, a greater peak knee external rotation moment compared to the inexperienced level during the first ($p = 0.014$) and third ($p = 0.004$) steps, a greater peak knee internal rotation moment compared to the inexperienced level during the third step ($p = 0.023$), and a greater peak hip external rotation moment compared to the inexperienced ($p = 0.010$) and recreational ($p < 0.001$) levels during the first step. Peak hip external rotation during the third step was significantly different across all comparisons with the recreational level displaying a greater peak hip external rotation moment than the inexperienced level ($p = 0.008$), and the professional level displaying a greater peak hip external rotation moment than both the inexperienced ($p < 0.001$) and recreational ($p = 0.007$) levels.

4.2.17.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level displayed a significantly greater peak ankle internal rotation moment ($p < 0.001$), a smaller peak ankle external rotation moment ($p = 0.019$), and a greater peak hip internal rotation moment ($p = 0.004$) during the first step compared to females. There were no significant differences in peak transverse plane joint moments during the TSR in the recreational level ($p \geq 0.077$). In the professional level, males exhibited a significantly greater peak hip internal rotation moment ($p = 0.031$) during the first step than females (Table 4.114).

4.2.17.4 Sagittal Plane Joint Angles.

4.2.17.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSR in the peak ankle plantarflexion angle during the first ($p = 0.004$) and third ($p = 0.006$) steps, peak knee flexion angle during the first ($p < 0.001$) and third ($p = 0.034$) steps, peak hip extension angle during the first step ($p < 0.001$) and the peak hip flexion angle during the first ($p < 0.001$) and third ($p < 0.001$) steps (Table 4.115).

Post-hoc comparisons indicated that the inexperienced level displayed significantly greater peak ankle plantarflexion compared to the recreational level during the first ($p = 0.005$) and third ($p = 0.006$) steps, greater peak hip extension compared to both the recreational ($p < 0.001$) and professional ($p = 0.008$) levels during the first step, and less peak hip flexion compared to the recreational and professional levels during the first ($p < 0.001$ for both) and third ($p < 0.001$ for both) steps. The professional level displayed significantly greater peak hip flexion than the inexperienced level during the first ($p < 0.001$) and third ($p = 0.043$) steps.

4.2.17.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males exhibited significantly less peak ankle plantarflexion during the first ($p = 0.006$) and third ($p = 0.026$) steps, greater peak knee extension during the first ($p = 0.001$) and third ($p = 0.002$) steps, and less peak knee flexion during the first ($p = 0.001$) and third ($p = 0.005$) steps compared to females. In the recreational level, males demonstrated significantly less peak knee flexion during the first ($p = 0.014$) and third ($p = 0.003$) steps, and greater peak knee extension ($p = 0.024$) during the third step compared to females. There were no significant differences in peak sagittal plane joint angles between males and females during the TSR in the professional level ($p \geq 0.050$) (Table 4.115).

4.2.17.5 Frontal Plane Joint Angles.

4.2.17.5.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSR in the peak ankle eversion angle during the first ($p = 0.021$) and third ($p = 0.032$) step, peak ankle inversion angle during the third step ($p = 0.011$), peak knee abduction angle during the first ($p < 0.001$) and third ($p < 0.001$) steps, and peak hip abduction angle during the first ($p = 0.030$) and third ($p = 0.004$) steps (Table 4.116).

Post-hoc comparisons illustrated greater peak ankle eversion in the inexperienced level than the recreational level ($p = 0.031$) during the first step. In contrast, differences in peak ankle eversion during the third step were insignificant following post-hoc analyses ($p \geq 0.051$). Peak ankle inversion during the third step was significantly greater in the recreational level compared to the professional level ($p = 0.011$). The professional level demonstrated significantly greater peak knee abduction compared to the inexperienced and recreational levels during the first ($p < 0.001$ for both) and third ($p < 0.001$ for both) steps, and greater peak hip abduction compared to the inexperienced level during the first ($p = 0.033$) and third ($p = 0.003$) steps.

4.2.17.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed significantly less peak ankle eversion ($p = 0.043$), greater peak ankle inversion ($p = 0.033$), and less peak hip abduction ($p = 0.043$) during the first step compared to females. In the recreational level, males demonstrated significantly less peak ankle eversion (p = 0.015), less peak knee adduction (p = 0.003) and peak hip abduction (p = 0.031), and greater peak hip adduction (p = 0.019) during the first step compared to females. There were no significant differences in peak frontal plane joint angles between males and females during the TSR in the professional level ($p \geq 0.190$) (Table 4.116).

4.2.17.6 Transverse Plane Joint Angles.

4.2.17.6.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSR in the peak knee external rotation angle during the first (p = 0.030) and third (p = 0.002) steps, and in the peak knee internal rotation angle during the third step (p = 0.028) (Table 4.117). Differences in peak knee external rotation during the first step and peak knee internal rotation during the third step were insignificant following post-hoc analyses ($p \geq 0.051$). The professional level displayed significantly greater peak knee external rotation compared to the inexperienced (p = 0.005) and recreational (p = 0.010) levels during the third step.

4.2.17.6.2 Comparison Between Genders. Mann-Whitney/independent t-tests illustrated that in the inexperienced level, males displayed significantly greater peak ankle external rotation (p = 0.043) and less peak ankle internal rotation (p = 0.041) during the first step, less peak knee external rotation during the first (p = 0.029) and third (p = 0.019) steps, and greater peak knee internal rotation during the first (p = 0.006) and third (p = 0.007) steps compared to females. Males in the recreational level exhibited less peak ankle internal rotation (p = 0.011), less peak knee external rotation (p = 0.040), and greater peak knee internal rotation (p = 0.048) during the first step, and less peak hip external rotation during the first (p = 0.006) and third (p = 0.034) steps than females. There were no significant differences in peak transverse plane joint angles between males and females during the TSR in the professional level ($p \geq 0.544$) (Table 4.117).

4.2.18 Triple Step Right with Partner (TSRP)

Results for the second step of the TSRP were inaccurate due to participants placing two feet on the same force plate, therefore, results are only presented for the first and third steps.

4.2.18.1 Sagittal Plane Joint Moments.

4.2.18.1.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels during the TSRP in the peak ankle plantarflexion moment during the first step ($p = 0.007$), peak ankle dorsiflexion moment during the third step ($p = 0.008$), peak knee flexion moment during the first ($p < 0.001$) and third ($p < 0.001$) steps, and the peak hip extension moment during the third step ($p < 0.001$) (Table 4.118).

Post-hoc results revealed that the inexperienced level displayed a significantly smaller peak plantarflexion moment compared to the recreational level ($p = 0.006$) during the first step, a greater peak ankle dorsiflexion moment compared to the recreational ($p = 0.028$) and professional ($p = 0.019$) levels during the third step, and a smaller peak knee flexion moment compared to the recreational and professional levels during the first ($p = 0.016$ and $p < 0.001$, respectively) and third ($p = 0.012$ and $p < 0.001$, respectively) steps. The professional level exhibited a significantly greater peak hip extension moment than both the inexperienced ($p < 0.001$) and recreational ($p = 0.038$) levels during the third step.

4.2.18.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level displayed a significantly greater peak ankle dorsiflexion moment ($p = 0.009$), smaller peak hip flexion moment ($p = 0.035$) and greater peak hip extension moment ($p = 0.002$) during the first step, and a greater peak hip extension moment ($p = 0.029$)

during the third step compared to females. In the recreational level, males demonstrated a significantly greater peak ankle plantarflexion moment during the third step than females ($p = 0.023$). In the professional level, males exhibited a significantly greater peak hip extension moment during the third step than females ($p = 0.018$) (Table 4.118).

4.2.18.2 Frontal Plane Joint Moments.

4.2.18.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSRP in the peak ankle eversion moment during the first ($p = 0.019$) and third ($p = 0.028$) steps, and peak knee ($p = 0.040$) and hip ($p = 0.008$) abduction moments during the first step (Table 4.119).

Post-hoc comparisons showed that the professional level displayed a significantly greater peak ankle eversion moment than the recreational level during the first step ($p = 0.015$), a greater peak ankle eversion moment compared to the inexperienced level during the third step ($p = 0.024$), and a greater peak hip abduction moment compared to both the inexperienced ($p = 0.010$) and recreational ($p = 0.037$) levels during the first step. Differences in the peak knee abduction moment during the first step were insignificant following post-hoc analyses ($p \geq 0.078$).

4.2.18.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males exhibited a significantly greater peak ankle inversion moment during the first ($p = 0.003$) and third ($p = 0.003$) steps, a smaller peak ankle eversion moment during the third step ($p = 0.002$), and smaller peak knee adduction ($p = 0.010$) and greater peak knee abduction ($p = 0.004$) moments during the first step compared to females. Males in the recreational level displayed a significantly greater peak ankle inversion moment during the third step compared to females ($p = 0.021$). There were no significant differences in peak frontal plane joint moments between males and females during the TSRP in the professional level ($p \geq 0.077$) (Table 4.119).

4.2.18.3 Transverse Plane Joint Moments.

4.2.18.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSRP in the peak ankle internal rotation moment during the first ($p = 0.003$) and third ($p = 0.002$) steps, peak ankle external rotation moment during the third step ($p = 0.004$), peak knee internal ($p = 0.001$) and external ($p < 0.001$) rotation moments during the third step, the peak hip internal rotation moment during the first step ($p = 0.022$), and the peak hip external rotation moment during the first ($p < 0.001$) and third ($p < 0.001$) steps (Table 4.120).

Post-hoc tests revealed that the professional level displayed a significantly greater peak ankle internal rotation moment compared to the inexperienced ($p = 0.008$) and recreational ($p = 0.008$) levels during the first step, and compared to the inexperienced level ($p = 0.002$) during the third step, and a greater peak knee internal rotation moment compared to the inexperienced ($p = 0.001$) and recreational ($p = 0.025$) levels during the third step. The inexperienced level demonstrated significantly smaller peak ankle and knee external rotation moments compared to both the recreational ($p = 0.038$ and $p = 0.001$, respectively) and professional ($p = 0.005$ and $p < 0.001$, respectively) levels during the third step, a smaller peak hip internal rotation moment compared to the professional level during the first step ($p = 0.045$), and a smaller peak hip external rotation moment compared to both the recreational ($p = 0.005$) and professional ($p = 0.002$) levels during the first step. The peak hip external rotation moment during the third step was observed to be significantly different across all comparisons with the recreational level exhibiting a greater peak hip external rotation moment than the inexperienced level ($p = 0.005$), and the professional level exhibiting a greater peak hip external rotation moment than both the inexperienced ($p < 0.001$) and recreational ($p = 0.020$) levels.

4.2.18.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the inexperienced level, males demonstrated a significantly greater peak ankle internal rotation moment ($p = 0.002$), a smaller peak ankle external rotation moment ($p = 0.043$), and a greater peak hip internal rotation moment ($p = 0.011$) during the first step compared to females. There were no significant differences in peak transverse plane joint moments between males and females during the TSRP in the recreational level ($p \geq 0.200$). Males in the professional level illustrated a significantly greater peak hip internal rotation moment during the first step than females ($p = 0.014$).

4.2.18.4 Sagittal Plane Joint Angles.

4.2.18.4.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results showed significant differences among experience levels during the TSRP in the peak ankle plantarflexion angle during the first ($p = 0.010$) and third ($p = 0.016$) steps, peak knee flexion angle during the first ($p < 0.001$) and third ($p = 0.002$) steps, peak hip extension angle during the first step ($p < 0.001$) and the peak hip flexion angle during the first ($p < 0.001$) and third ($p < 0.001$) steps (Table 4.121).

Post-hoc comparisons revealed that the inexperienced level demonstrated significantly greater peak ankle plantarflexion compared to the recreational level during the first ($p = 0.011$) and third ($p = 0.017$) steps, greater peak hip extension compared to the recreational ($p < 0.001$) and professional ($p = 0.025$) levels during the first step, and less peak hip flexion compared to both the recreational and professional levels during the first ($p < 0.001$ for both) and third ($p < 0.001$ for both) steps. The professional level exhibited significantly greater peak knee flexion compared to the inexperienced ($p < 0.001$) and recreational ($p = 0.027$) levels during the first step, and compared to the inexperienced level ($p = 0.002$) during the third step.

4.2.18.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the inexperienced level exhibited significantly less peak ankle plantarflexion during the first ($p = 0.001$) and third ($p = 0.002$) steps, greater peak knee extension during the first ($p = 0.002$) and third ($p = 0.041$) steps, and less peak knee flexion during the first ($p = 0.011$) and third ($p = 0.009$) steps compared to females. In the recreational level, males demonstrated significantly greater peak knee extension ($p = 0.021$) and less peak knee flexion ($p = 0.002$) during the third step compared to females. Within the professional level, males displayed significantly less peak knee flexion during the first step than females ($p = 0.024$) (Table 4.121).

4.2.18.5 Frontal Plane Joint Angles.

4.2.18.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSRP in the peak ankle inversion angle during the third step ($p = 0.036$), peak knee abduction angle during the first ($p < 0.001$) and third ($p < 0.001$) steps, peak knee adduction angle during the first step ($p = 0.011$), and the peak hip abduction angle during the first ($p = 0.014$) and third ($p = 0.007$) steps (Table 4.122).

Post-hoc results revealed that the professional level demonstrated significantly less peak ankle inversion compared to the recreational level during the third step ($p = 0.030$), greater peak knee abduction compared to the inexperienced and recreational levels during the first ($p < 0.001$ for both) and third ($p < 0.001$ for both) steps, greater peak knee adduction compared to the inexperienced level during the first step ($p = 0.010$), and greater peak hip abduction compared to the inexperienced level during the first ($p = 0.014$) and third ($p = 0.005$) steps.

4.2.18.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males displayed significantly less peak ankle eversion during the first step ($p = 0.029$), greater peak ankle inversion during the first ($p = 0.009$) and third ($p = 0.029$) steps, and less peak hip abduction ($p = 0.035$) during the first step compared to females. In the recreational level, males demonstrated significantly less peak ankle eversion ($p = 0.036$), less peak knee adduction ($p = 0.015$), and less hip abduction ($p = 0.031$) and greater hip adduction ($p = 0.019$) during the first step compared to females. There were no significant differences in the peak frontal plane joint angles between males and females during the TSRP in the professional level ($p \geq 0.354$) (Table 4.122).

4.2.18.6 Transverse Plane Joint Angles.

4.2.18.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels during the TSRP in the peak knee external rotation angle during the first ($p = 0.029$) and third ($p = 0.004$) steps, and in the peak knee internal rotation angle during the third step ($p = 0.044$) (Table 4.123). Post-hoc results revealed significantly greater peak knee external rotation in the professional level compared to the recreational level during the first step ($p = 0.047$), and compared to both the inexperienced ($p = 0.007$) and recreational ($p = 0.016$) levels during the third step. Differences in peak knee internal rotation during the third step were insignificant following post-hoc analyses ($p \geq 0.083$).

4.2.18.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level demonstrated significantly greater peak external rotation during the first ($p = 0.008$) and third ($p = 0.018$) steps, less peak ankle internal rotation during the first step ($p = 0.025$), less peak knee external rotation during the first ($p = 0.039$) and third ($p = 0.025$) steps, and greater peak knee internal rotation during the first ($p = 0.015$) and third ($p =$

0.012) steps compared to females. In the recreational level, males exhibited significantly greater peak ankle external rotation during the first step ($p = 0.035$), less peak ankle internal rotation during the first ($p = 0.016$) and third ($p = 0.038$) steps, and less peak hip external rotation during the first ($p = 0.012$) and third ($p = 0.031$) steps compared to females. There were no significant differences in peak transverse plane joint angles between males and females during the TSRP in the professional level ($p \geq 0.640$) (Table 4.123).

4.3 Tertiary Outcome Variable: Muscle Activity

4.3.1 Backward Step Right (BSR)

4.3.1.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the TA ($p = 0.015$), VL ($p < 0.001$), BF ($p = 0.007$), and GM ($p = 0.026$) muscle activity (Table 4.124). Post-hoc comparisons showed that the inexperienced level displayed significantly less TA activity than the recreational level ($p = 0.012$), less VL activity compared to both the recreational ($p = 0.007$) and professional ($p < 0.001$) levels, and less BF activity compared to the professional level ($p = 0.005$). The professional level displayed significantly less GM activity than the recreational level ($p = 0.023$).

4.3.1.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the BSR in any level ($p \geq 0.097$) (Table 4.124).

4.3.2 Backward Step Right with Partner (BSRP)

4.3.2.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the VL ($p < 0.001$) and BF ($p = 0.029$) muscle activity (Table 4.125). Post-hoc comparisons illustrated that the professional level displayed significantly greater VL activity than both the inexperienced ($p < 0.001$) and recreational ($p = 0.049$) levels, and greater BF activity than the inexperienced level ($p = 0.034$).

4.3.2.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the BSRP in any level ($p \geq 0.081$) (Table 4.125).

4.3.3 Forward Step Left (FSL)

4.3.3.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the TA ($p = 0.017$), VL ($p < 0.001$) and the BF ($p = 0.004$) muscle activity (Table 4.126). Post-hoc results showed that the inexperienced level exhibited significantly less activity in the TA than the professional level ($p = 0.016$), and less activity in the VL than both the recreational ($p = 0.002$) and professional ($p = 0.001$) levels. The professional level displayed significantly greater BF activity than both the inexperienced ($p = 0.004$) and recreational ($p = 0.046$) levels.

4.3.3.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the FSL in the inexperienced or recreational levels ($p \geq 0.133$). Males in the professional level demonstrated significantly greater MG activity compared to females ($p = 0.031$) (Table 4.126).

4.3.4 Forward Step Left with Partner (FSLP)

4.3.4.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the MG ($p = 0.026$), VL ($p = 0.003$), and BF ($p = 0.002$) muscle activity (Table 4.127). Post-hoc comparisons showed that the inexperienced level exhibited significantly less MG activity compared to the recreational level (*p*

= 0.020), less VL activity compared to both the recreational (p = 0.008) and professional (p = 0.014) levels, and less BF activity than the professional level (p = 0.001).

4.3.4.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the FSLP in any level ($p \geq 0.053$) (Table 4.127).

4.3.5 Rock Step Back Right (RSBR)

4.3.5.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the MG muscle activity during the first step (p = 0.010), VL muscle activity during the first ($p < 0.001$) and second ($p < 0.001$) steps, and BF muscle activity during the first (p = 0.002) and second (p = 0.009) steps (Table 4.128). Follow-up tests revealed that the inexperienced level demonstrated significantly less MG activity during the first step compared to the recreational level (p = 0.009), less VL activity during the first and second steps compared to the recreational (p = 0.006 and p = 0.049, respectively), and professional ($p < 0.001$ for both) levels, and less BF activity compared to the professional level during the first (p = 0.001) and second (p = 0.007) steps.

4.3.5.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that males in the recreational level exhibited significantly less BF activity during the first step compared to females (p = 0.004). There were no significant differences in muscle activity observed between males and females during the RSBR in the inexperienced or professional levels ($p \geq 0.075$) (Table 4.128).

4.3.6 Rock Step Back Right with Partner (RSBRP)

4.3.6.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in MG muscle activity during the first step ($p = 0.009$), VL muscle activity during the first ($p < 0.001$) and second ($p < 0.001$) steps, and BF muscle activity during the first ($p = 0.043$) and second ($p = 0.017$) steps (Table 4.129). Post-hoc comparisons revealed that the inexperienced level displayed significantly less MG activity compared to the recreational level during the first step ($p = 0.011$), less VL activity compared to the professional level during the first step ($p < 0.001$), and compared to both the recreational ($p = 0.031$) and professional ($p < 0.001$) levels during the second step, and less BF activity compared to the professional level during both the first ($p = 0.039$) and second ($p = 0.014$) steps.

4.3.6.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests showed that in the inexperienced level, males displayed significantly greater BF activity during the first step than females ($p = 0.035$). In the recreational level, males demonstrated significantly less VL activity during the first step than females ($p = 0.014$). Males in the professional level illustrated significantly less GM activity during the second step than females ($p = 0.029$) (Table 4.129).

4.3.7 Rock Step Forward Left (RSFL)

4.3.7.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in VL muscle activity during the first ($p = 0.001$) and second ($p < 0.001$) steps, and BF muscle activity during the first ($p = 0.005$) and second ($p = 0.011$) steps (Table 4.130). Post-hoc comparisons revealed that the inexperienced level exhibited significantly less VL activity compared to both the recreational and professional levels during the first ($p = 0.010$ and $p = 0.004$, respectively) and second ($p = 0.012$ and $p < 0.001$, respectively) steps, and less BF activity compared to the professional level during the first ($p = 0.004$) and second ($p = 0.009$) steps.

4.3.7.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the RSFL in any level ($p \geq 0.053$) (Table 4.130).

4.3.8 Rock Step Forward Left with Partner (RSFLP)

4.3.8.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in MG muscle activity during the first step ($p = 0.029$), VL muscle activity during the first ($p = 0.008$) and second ($p < 0.001$) steps, and BF muscle activity during the first ($p < 0.001$) and second ($p = 0.034$) steps (Table 4.131). Post-hoc comparisons revealed that the inexperienced level displayed less MG activity during the first step than the recreational level ($p = 0.027$), less VL activity than the professional level during the first ($p = 0.014$) and second ($p < 0.001$) steps, and less BF activity than the professional level during both the first ($p < 0.001$) and second ($p = 0.028$) steps.

4.3.8.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the RSFLP in any level ($p \geq 0.072$) (Table 4.131).

4.3.9 Side Step Left (SSL)

4.3.9.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in VL ($p = 0.003$) and BF ($p = 0.027$) muscle activity (Table 4.132). Post-hoc comparisons showed that the inexperienced level demonstrated significantly less VL ($p = 0.002$) and BF ($p = 0.042$) activity compared to the professional level.

4.3.9.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the recreational level exhibited significantly less TA activity than females ($p = 0.036$).

There were no significant differences in muscle activity between males and females during the SSL in the inexperienced or professional level ($p \geq 0.053$) (Table 4.132).

4.3.10 Side Step Left with Partner (SSLP)

4.3.10.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels in VL ($p = 0.032$), and BF ($p = 0.025$) muscle activity (Table 4.133). Post-hoc comparisons showed that the inexperienced level displayed significantly less VL ($p = 0.032$) and BF ($p = 0.025$) activity compared to the professional level.

4.3.10.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the SSLP in the inexperienced or recreational levels ($p \geq 0.121$). Males in the professional level exhibited significantly greater VL activity than females ($p = 0.010$) (Table 4.133).

4.3.11 Side Step Right (SSR)

4.3.11.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the TA ($p = 0.013$), VL ($p < 0.001$), and BF ($p = 0.004$) muscle activity (Table 4.134). Post-hoc results illustrated that the inexperienced level displayed significantly less TA activity than the recreational level ($p = 0.014$), less VL activity than both the recreational ($p = 0.006$) and professional ($p < 0.001$) levels, and less BF activity than the professional level ($p = 0.003$).

4.3.11.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level exhibited significantly less BF activity than females ($p = 0.023$). There were no significant differences in muscle activity between males and females during the SSR in the recreational or professional levels ($p \geq 0.097$) (Table 4.134).

4.3.12 Side Step Right with Partner (SSRP)

4.3.12.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results illustrated significant differences among experience levels in the TA (p = 0.029), MG (p = 0.034), VL (p = 0.007), and BF (p = 0.042) muscle activity (Table 4.135). Post-hoc tests revealed that the inexperienced level displayed significantly less TA (p = 0.026) and MG (p = 0.037) activity than the recreational level, and less VL (p = 0.007) and BF (p = 0.046) activity than the professional level.

4.3.12.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the SSRP in any level ($p \geq 0.089$) (Table 4.135).

4.3.13 Spot Turn (ST)

4.3.13.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated a significant difference among experience levels in VL muscle activity (p = 0.003) (Table 4.136). Post-hoc results revealed significantly less VL activity in the inexperienced level than the professional level (p = 0.005).

4.3.13.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed no significant differences in muscle activity between males and females during the ST in any level ($p \geq 0.075$) (Table 4.136).

4.3.14 Spot Turn with Partner (STP)

4.3.14.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated a significant difference among experience levels in VL muscle activity (p = 0.009) (Table 4.137). Post-hoc tests revealed significantly less VL activity in the inexperienced level compared to the professional level (p = 0.010).

4.3.14.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that males in the inexperienced level exhibited significantly less TA activity than females (p = 0.019). There were no significant differences in muscle activity between males and females during the STP in the recreational or professional levels ($p \geq 0.121$) (Table 4.137).

4.3.15 Triple Step Left (TSL)

4.3.15.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significant differences among experience levels in the VL muscle activity during the first (p = 0.005) and third (p = 0.016) steps, and BF (p = 0.046) and GM (p = 0.009) muscle activity during the first step (Table 4.138). Post-hoc comparisons showed that the inexperienced level exhibited less VL activity compared to the professional level during the first (p = 0.004) and third (p = 0.013) steps, and less BF (p = 0.041) and GM (p = 0.012) muscle activity during the first step compared to the professional level.

4.3.15.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males displayed less TA activity during the first step (p = 0.009), and less GM activity during the first (p = 0.029) and third (p = 0.019) steps compared to females. Males in the recreational level displayed less TA activity during the third step than females (p = 0.038). There were no significant differences in muscle activity between males and females during the TSL in the professional level ($p \geq 0.210$).

4.3.16 Triple Step Left with Partner (TSLP)

4.3.16.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels in TA muscle activity during the first step (p = 0.027), VL muscle activity during the first (p = 0.004) and third (p = 0.009) steps, BF muscle activity during the third step (p = 0.003), and GM muscle activity during the first step (p =

0.014) (Table 4.139). Post-hoc comparisons showed that the inexperienced level exhibited significantly less TA muscle activity during the first step (p = 0.025), less VL activity during the first (p = 0.004) and second (p = 0.017) steps, less BF activity during the second step (p = 0.002), and less GM muscle activity during the first step (p = 0.020) compared to the professional level.

4.3.16.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that in the inexperienced level, males exhibited significantly greater VL muscle activity during the third step compared to females (p = 0.009). Males in the recreational level demonstrated significantly less VL activity during the third step compared to females (p = 0.026). There were no significant differences in muscle activity observed between males and females during the TSLP in the professional level ($p \geq 0.091$) (Table 4.139).

4.3.17 Triple Step Right (TSR)

4.3.17.1 Comparison Among Experience Levels. Kruskal-Wallis/ANOVA results revealed significant differences among experience levels in the TA muscle activity during the third step (p = 0.045), VL muscle activity during the first ($p < 0.001$) and third ($p < 0.001$) steps, and BF muscle activity during the first (p = 0.011) and third ($p < 0.001$) steps (Table 4.140).

Post-hoc comparisons showed that the inexperienced level displayed significantly less TA activity during the third step than the recreational level (p = 0.039), less VL activity during the first step compared to the recreational (p = 0.026) and professional (p = 0.001) levels, and less BF activity compared to the professional level during the first step (p = 0.008). During the third step, VL activity was significantly different across all comparisons with significantly greater VL activity in the professional level than the inexperienced level ($p < 0.001$), and greater VL activity in the recreational level than both the inexperienced (p = 0.041) and professional (p = 0.046) levels. The professional level exhibited significantly greater BF activity compared to the inexperienced level (*p* = 0.002), and significantly less BF activity compared to the recreational level (*p* = 0.009) during the third step.

4.3.17.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests illustrated that males in the inexperienced level illustrated significantly less TA (*p* = 0.019) and BF (*p* = 0.003) muscle activity during the third step than females. In the recreational level, males exhibited significantly less VL activity during the third step than females (*p* = 0.026). There were no significant differences in muscle activity seen between males and females during the TSR in the professional level (*p* ≥ 0.200) (Table 140).

4.3.18 Triple Step Right with Partner (TSRP)

4.3.18.1 Comparison Among Experience Levels. Results of the Kruskal-Wallis/ANOVA illustrated significance differences among experience levels in TA muscle activity during the third step (*p* = 0.002), MG muscle activity during the third step (*p* = 0.038), VL muscle activity during the first (*p* < 0.001) and third (*p* < 0.001) steps, BF muscle activity during the first (*p* = 0.028) and third (*p* = 0.005) steps, and GM muscle activity during the first step (*p* = 0.038) (Table 4.141).

Post-hoc comparisons revealed that the inexperienced level illustrated significantly less TA activity during the third step compared to the recreational level (*p* = 0.002), less VL activity than both the recreational and professional levels during the first (*p* = 0.011 and *p* < 0.001, respectively) and third (*p* = 0.007 and *p* < 0.001, respectively) steps, less BF activity compared to the professional level during the first (*p* = 0.048) and third (*p* = 0.004) steps, and less GM activity during the first step compared to the professional level (*p* = 0.037). Differences in MG activity during the third step were insignificant following post-hoc comparisons (*p* ≥ 0.090).

4.3.18.2 Comparison Between Genders. Mann-Whitney/independent *t*-tests revealed that in the recreational level, males exhibited significantly less VL activity during the third step than females ($p = 0.038$). There were no significant differences in muscle activity between males and females during the TSRP in the inexperienced or professional levels ($p \geq 0.075$) (Table 4.141).

Table 4.1. Confounded Steps

Table 4.1. Steps within each dance element that were affected by either the partner or the participant's foot placement on the force plates, making the kinetics of the step incorrect, and were excluded from analysis.

Dance elements affected by the partner	Dance elements affected by foot placement
Forward step left with a partner (FSLP)	Second step of spot turn w/ & w/o a partner (ST & STP)
First step of the rock step back right with a partner (RSBRP)	Triple step left w/ & w/o a partner (TSL & TSLP)
Second step of the rock step forward left with a partner (RSFLP)	Triple step right w/ & w/o a partner (TSR & TSRP)

Table 4.2. BSR Loading and Power

Table 4.2. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Adjusted post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.23 ± 0.10	1.06 ± 0.06	1.04 ± 0.02	**<0.001**	**<0.001**	**<0.001**	0.680
	F	1.22 ± 0.09	1.06 ± 0.04	1.04 ± 0.02				
	M	1.23 ± 0.11	1.07 ± 0.07	1.04 ± 0.02				
	p-value	0.739	0.481	0.730				
Loading Rate	F + M	5.51 ± 1.93	3.13 ± 1.73	1.95 ± 0.83	**<0.001**	**<0.001**	**<0.001**	0.083
	F	5.53 ± 2.43	2.70 ± 1.37	1.88 ± 0.71				
	M	5.49 ± 1.40	3.57 ± 2.01	2.01 ± 0.98				
	p-value	0.971	0.340	1.000				
Peak Ankle Power Absorption	F + M	-0.79 ± 0.37	-0.68 ± 0.43	-0.55 ± 0.41	0.134			
	F	-1.03 ± 0.22	-0.66 ± 0.57	-0.53 ± 0.37				
	M	-0.56 ± 0.35	-0.70 ± 0.28	-0.56 ± 0.46				
	p-value	**0.004**	0.605	0.863				
Peak Ankle Power Propulsion	F + M	0.53 ± 0.27	0.47 ± 0.22	0.47 ± 0.21	0.640			
	F	0.61 ± 0.32	0.45 ± 0.23	0.46 ± 0.20				
	M	0.46 ± 0.18	0.49 ± 0.21	0.49 ± 0.24				
	p-value	0.247	0.730	0.931				
Peak Knee Power Absorption	F + M	-0.17 ± 0.12	-0.26 ± 0.15	-0.16 ± 0.08	0.057			
	F	-0.15 ± 0.11	-0.28 ± 0.20	-0.19 ± 0.07				
	M	-0.20 ± 0.13	-0.23 ± 0.07	-0.13 ± 0.08				
	p-value	0.280	1.000	0.222				
Peak Knee Power Propulsion	F + M	0.55 ± 0.59	1.16 ± 0.92	1.68 ± 0.96	**<0.001**	0.055	**<0.001**	0.297
	F	0.20 ± 0.17	1.39 ± 0.92	1.42 ± 0.99				
	M	0.90 ± 0.65	0.93 ± 0.92	1.95 ± 0.92				
	p-value	**0.001**	0.436	0.190				
Peak Hip Power Absorption	F + M	-0.30 ± 0.18	-0.55 ± 0.25	-0.47 ± 0.29	**0.003**	**0.002**	0.115	0.610
	F	-0.22 ± 0.15	-0.50 ± 0.20	-0.30 ± 0.14				
	M	-0.37 ± 0.19	-0.59 ± 0.30	-0.63 ± 0.31				
	p-value	**0.029**	0.666	**0.004**				
Peak Hip Power Propulsion	F + M	0.32 ± 0.32	0.68 ± 0.72	1.08 ± 0.84	0.054			
	F	0.15 ± 0.09	0.86 ± 0.78	1.12 ± 1.01				
	M	0.49 ± 0.38	0.50 ± 0.64	1.03 ± 0.69				
	p-value	**0.015**	0.190	1.000				

Table 4.3. BSRP Loading and Power

Table 4.3. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.19 ± 0.09	1.04 ± 0.06	1.02 ± 0.04	**<0.001**	**<0.001**	**<0.001**	0.929
	F	1.17 ± 0.09	1.03 ± 0.05	1.01 ± 0.04				
	M	1.22 ± 0.09	1.05 ± 0.06	1.03 ± 0.04				
	p-value	0.161	0.388	0.277				
Loading Rate	F + M	5.73 ± 1.92	2.54 ± 1.25	2.02 ± 1.03	**<0.001**	**<0.001**	**<0.001**	0.896
	F	5.35 ± 2.22	2.45 ± 1.47	2.02 ± 1.34				
	M	6.12 ± 1.44	2.68 ± 0.93	2.01 ± 0.63				
	p-value	0.297	0.456	0.743				
Peak Ankle Power Absorption	F + M	-0.73 ± 0.29	-0.50 ± 0.57	-0.63 ± 0.55	0.072			
	F	-0.93 ± 0.17	-0.60 ± 0.69	-0.40 ± 0.32				
	M	-0.53 ± 0.24	-0.34 ± 0.30	-0.89 ± 0.65				
	p-value	**0.001**	1.000	0.093				
Peak Ankle Power Propulsion	F + M	0.52 ± 0.31	0.57 ± 0.27	0.54 ± 0.39	0.934			
	F	0.75 ± 0.20	0.61 ± 0.26	0.47 ± 0.30				
	M	0.29 ± 0.21	0.50 ± 0.30	0.62 ± 0.48				
	p-value	**0.002**	0.328	0.743				
Peak Knee Power Absorption	F + M	-0.18 ± 0.15	-0.28 ± 0.15	-0.18 ± 0.13	0.084			
	F	-0.18 ± 0.16	-0.28 ± 0.19	-0.20 ± 0.16				
	M	-0.18 ± 0.14	-0.27 ± 0.09	-0.16 ± 0.09				
	p-value	0.931	0.864	0.743				
Peak Knee Power Propulsion	F + M	0.75 ± 0.77	1.34 ± 0.97	1.81 ± 1.21	**0.006**	0.134	**0.005**	0.929
	F	0.21 ± 0.18	1.34 ± 1.03	1.63 ± 1.38				
	M	1.29 ± 0.76	1.33 ± 0.97	2.02 ± 1.02				
	p-value	**0.003**	1.000	0.321				
Peak Hip Power Absorption	F + M	-0.26 ± 0.13	-0.54 ± 0.25	-0.46 ± 0.28	**0.002**	**0.002**	**0.040**	0.631
	F	-0.22 ± 0.10	-0.49 ± 0.26	-0.37 ± 0.19				
	M	-0.29 ± 0.15	-0.62 ± 0.25	-0.55 ± 0.35				
	p-value	0.274	0.369	0.186				
Peak Hip Power Propulsion	F + M	0.62 ± 0.62	0.78 ± 0.87	1.17 ± 1.04	0.350			
	F	0.14 ± 0.08	0.91 ± 1.06	1.18 ± 1.04				
	M	1.09 ± 0.54	0.58 ± 0.51	1.16 ± 1.12				
	p-value	**<0.001**	1.000	0.815				

Table 4.4. FSL Loading and Power

Table 4.4. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.01 ± 0.02	1.03 ± 0.02	1.03 ± 0.02	**0.003**	**0.007**	**0.011**	0.997
	F	1.02 ± 0.02	1.04 ± 0.02	1.03 ± 0.02				
	M	1.00 ± 0.01	1.02 ± 0.02	1.03 ± 0.02				
	p-value	**0.014**	0.087	0.433				
Loading Rate	F + M	1.74 ± 1.00	1.72 ± 0.90	1.51 ± 0.53	0.944			
	F	2.28 ± 1.20	1.70 ± 0.76	1.61 ± 0.49				
	M	1.25 ± 0.38	1.75 ± 1.07	1.41 ± 0.58				
	p-value	**0.017**	1.000	0.190				
Peak Ankle Power Absorption	F + M	-0.31 ± 0.13	-0.45 ± 0.17	-0.59 ± 0.28	**<0.001**	**0.034**	**0.001**	0.712
	F	-0.37 ± 0.16	-0.42 ± 0.22	-0.50 ± 0.21				
	M	-0.26 ± 0.08	-0.48 ± 0.12	-0.69 ± 0.33				
	p-value	0.083	0.113	0.222				
Peak Ankle Power Propulsion	F + M	0.04 ± 0.03	0.06 ± 0.06	0.07 ± 0.07	0.563			
	F	0.05 ± 0.04	0.05 ± 0.03	0.04 ± 0.04				
	M	0.04 ± 0.03	0.08 ± 0.07	0.09 ± 0.08				
	p-value	0.905	1.000	0.252				
Peak Knee Power Absorption	F + M	-0.14 ± 0.11	-0.30 ± 0.22	-0.39 ± 0.23	**<0.001**	**0.025**	**<0.001**	0.476
	F	-0.13 ± 0.11	-0.25 ± 0.15	-0.28 ± 0.13				
	M	-0.15 ± 0.11	-0.35 ± 0.28	-0.51 ± 0.27				
	p-value	0.661	0.489	0.113				
Peak Knee Power Propulsion	F + M	0.12 ± 0.06	0.14 ± 0.08	0.12 ± 0.12	0.377			
	F	0.12 ± 0.06	0.12 ± 0.10	0.12 ± 0.11				
	M	0.13 ± 0.07	0.16 ± 0.05	0.12 ± 0.13				
	p-value	0.661	0.077	0.863				
Peak Hip Power Absorption	F + M	-0.11 ± 0.10	-0.29 ± 0.17	-0.35 ± 0.24	**<0.001**	**0.001**	**<0.001**	1.000
	F	-0.13 ± 0.14	-0.31 ± 0.21	-0.47 ± 0.23				
	M	-0.09 ± 0.06	-0.27 ± 0.13	-0.23 ± 0.21				
	p-value	0.905	1.000	**0.014**				
Peak Hip Power Propulsion	F + M	0.22 ± 0.12	0.33 ± 0.18	0.58 ± 0.31	**<0.001**	0.278	**<0.001**	**0.047**
	F	0.26 ± 0.14	0.26 ± 0.15	0.48 ± 0.30				
	M	0.19 ± 0.10	0.40 ± 0.20	0.69 ± 0.29				
	p-value	0.133	0.113	0.063				

Table 4.5. RSBR Loading and Power

Table 4.5. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (R)	F + M	1.24 ± 0.11	1.10 ± 0.09	1.11 ± 0.06	**<0.001**	**<0.001**	**0.001**	1.000
	F	1.26 ± 0.10	1.12 ± 0.11	1.10 ± 0.07				
	M	1.22 ± 0.11	1.08 ± 0.06	1.12 ± 0.05				
	p-value	0.315	0.730	0.605				
Peak Vertical GRF 2 (L)	F + M	1.02 ± 0.04	1.05 ± 0.04	1.03 ± 0.02	**0.016**	**0.013**	0.337	0.642
	F	1.04 ± 0.05	1.05 ± 0.04	1.04 ± 0.02				
	M	1.01 ± 0.03	1.04 ± 0.03	1.02 ± 0.02				
	p-value	**0.043**	0.931	**0.014**				
Loading Rate 1 (R)	F + M	5.57 ± 2.56	3.21 ± 2.04	2.11 ± 0.57	**<0.001**	**0.009**	**<0.001**	0.649
	F	6.32 ± 3.13	2.54 ± 1.87	2.03 ± 0.62				
	M	4.83 ± 1.66	3.88 ± 2.08	2.18 ± 0.54				
	p-value	0.393	0.077	0.489				
Loading Rate 2 (L)	F + M	2.11 ± 1.20	2.43 ± 1.38	1.68 ± 0.70	0.123			
	F	2.36 ± 0.90	2.22 ± 0.99	1.80 ± 0.57				
	M	1.87 ± 1.46	2.63 ± 1.72	1.55 ± 0.82				
	p-value	0.105	0.666	0.113				
Peak Ankle Power Absorption 1 (R)	F + M	-0.79 ± 0.51	-0.97 ± 0.69	-0.90 ± 0.41	0.684			
	F	-1.08 ± 0.46	-0.99 ± 0.89	-0.82 ± 0.41				
	M	-0.49 ± 0.39	-0.95 ± 0.47	-0.98 ± 0.41				
	p-value	**0.009**	0.546	0.605				
Peak Ankle Power Propulsion 1 (R)	F + M	1.15 ± 0.96	1.32 ± 1.11	2.44 ± 1.09	**<0.001**	1.000	**<0.001**	**0.001**
	F	1.64 ± 0.86	1.60 ± 1.58	2.35 ± 0.95				
	M	0.66 ± 0.83	1.08 ± 0.36	2.53 ± 1.25				
	p-value	**0.003**	0.963	0.743				
Peak Ankle Power Absorption 2 (L)	F + M	-0.34 ± 0.29	-0.41 ± 0.19	-0.50 ± 0.27	**0.017**	0.208	**0.016**	1.000
	F	-0.47 ± 0.36	-0.35 ± 0.15	-0.44 ± 0.13				
	M	-0.21 ± 0.11	-0.47 ± 0.22	-0.56 ± 0.35				
	p-value	0.063	0.297	0.931				
Peak Ankle Power Propulsion 2 (L)	F + M	0.03 ± 0.02	0.05 ± 0.07	0.14 ± 0.14	**0.029**	1.000	0.060	0.055
	F	0.03 ± 0.02	0.06 ± 0.07	0.11 ± 0.12				
	M	0.04 ± 0.03	0.04 ± 0.06	0.17 ± 0.17				
	p-value	0.631	0.815	0.607				

Peak Knee Power Absorption 1 (R)	F + M	-0.70 ± 0.67	-0.99 ± 1.06	-1.05 ± 0.83	0.203			
	F	-0.37 ± 0.28	-1.12 ± 1.19	-1.00 ± 0.69				
	M	-1.03 ± 0.79	-0.86 ± 0.99	-1.10 ± 1.00				
	p-value	**0.043**	0.505	0.605				
Peak Knee Power Propulsion 1 (R)	F + M	0.67 ± 0.72	1.34 ± 1.20	1.43 ± 0.86	**0.002**	0.057	**0.002**	0.935
	F	0.30 ± 0.26	1.61 ± 1.28	1.21 ± 0.56				
	M	1.03 ± 0.85	1.08 ± 1.12	1.66 ± 1.07				
	p-value	**0.035**	0.190	0.387				
Peak Knee Power Absorption 2 (L)	F + M	-0.11 ± 0.09	-0.24 ± 0.21	-0.28 ± 0.19	**0.004**	**0.047**	**0.004**	1.000
	F	-0.11 ± 0.08	-0.18 ± 0.11	-0.19 ± 0.10				
	M	-0.12 ± 0.11	-0.30 ± 0.28	-0.36 ± 0.22				
	p-value	0.971	0.546	0.094				
Peak Knee Power Propulsion 2 (L)	F + M	0.11 ± 0.11	0.24 ± 0.18	0.38 ± 0.33	**0.004**	**0.043**	**0.006**	1.000
	F	1.13 ± 0.14	0.31 ± 0.22	0.36 ± 0.42				
	M	0.08 ± 0.07	0.17 ± 0.11	0.39 ± 0.26				
	p-value	0.280	0.161	0.606				
Peak Hip Power Absorption 1 (R)	F + M	-0.45 ± 0.41	-1.18 ± 1.02	-1.97 ± 1.04	**<0.001**	0.053	**<0.001**	0.054
	F	-0.20 ± 0.14	-1.49 ± 1.10	-1.76 ± 0.92				
	M	-0.71 ± 0.44	-0.86 ± 0.87	-2.18 ± 1.16				
	p-value	**<0.001**	0.113	0.340				
Peak Hip Power Propulsion 1 (R)	F + M	0.50 ± 0.38	1.08 ± 1.05	1.99 ± 1.24	**<0.001**	1.000	**<0.001**	**0.011**
	F	0.29 ± 0.16	1.49 ± 1.18	1.71 ± 0.86				
	M	0.70 ± 0.42	0.68 ± 0.75	2.27 ± 1.52				
	p-value	**0.007**	0.077	0.387				
Peak Hip Power Absorption 2 (L)	F + M	-0.12 ± 0.07	-0.27 ± 0.17	-0.52 ± 0.30	**<0.001**	**0.015**	**<0.001**	**0.048**
	F	-0.12 ± 0.06	-0.38 ± 0.18	-0.70 ± 0.31				
	M	-0.11 ± 0.08	-0.15 ± 0.04	-0.34 ± 0.14				
	p-value	0.481	**0.003**	**0.008**				
Peak Hip Power Propulsion 2 (L)	F + M	0.24 ± 0.19	0.27 ± 0.19	0.59 ± 0.35	**<0.001**	1.000	**0.001**	**0.007**
	F	0.29 ± 0.21	0.22 ± 0.08	0.48 ± 0.20				
	M	0.19 ± 0.15	0.32 ± 0.25	0.71 ± 0.44				
	p-value	0.393	0.546	0.387				

Table 4.6. RSBRP Loading and Power

Table 4.6. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (R)	F + M	1.17 ± 0.08	1.05 ± 0.05	1.08 ± 0.05	**<0.001**	**<0.001**	**<0.001**	0.361
	F	1.17 ± 0.09	1.06 ± 0.06	1.06 ± 0.05				
	M	1.17 ± 0.08	1.04 ± 0.03	1.10 ± 0.04				
	p-value	0.720	0.370	**0.024**				
Loading Rate 1 (R)	F + M	4.99 ± 2.04	2.84 ± 1.45	1.94 ± 0.61	**<0.001**	**0.027**	**<0.001**	0.194
	F	5.10 ± 2.52	2.64 ± 1.73	1.89 ± 0.58				
	M	4.89 ± 1.64	3.07 ± 1.15	1.99 ± 0.67				
	p-value	0.720	0.200	0.666				
Peak Ankle Power Absorption 1 (R)	F + M	-0.63 ± 0.29	-0.75 ± 0.44	-0.83 ± 0.41	0.290			
	F	-0.87 ± 0.21	-0.69 ± 0.45	-0.88 ± 0.36				
	M	-0.42 ± 0.16	-0.81 ± 0.45	-0.78 ± 0.47				
	p-value	**<0.001**	0.798	0.730				
Peak Ankle Power Propulsion 1 (R)	F + M	1.05 ± 0.82	1.64 ± 1.43	2.02 ± 1.14	**0.012**	0.411	**0.009**	0.455
	F	1.48 ± 0.74	2.03 ± 1.80	2.25 ± 1.18				
	M	0.66 ± 0.72	1.20 ± 0.74	1.80 ± 1.12				
	p-value	**0.002**	0.541	0.340				
Peak Knee Power Absorption 1 (R)	F + M	-0.90 ± 0.89	-0.88 ± 0.93	-0.84 ± 0.60	0.736			
	F	-0.33 ± 0.17	-1.03 ± 1.01	-0.90 ± 0.65				
	M	-1.41 ± 0.97	-0.72 ± 0.87	-0.78 ± 0.58				
	p-value	**0.008**	0.442	0.666				
Peak Knee Power Propulsion 1 (R)	F + M	0.78 ± 0.97	1.31 ± 1.03	1.51 ± 0.92	**0.011**	0.124	**0.011**	1.000
	F	0.28 ± 0.18	1.66 ± 1.08	1.31 ± 0.99				
	M	1.24 ± 1.17	0.92 ± 0.86	1.71 ± 0.84				
	p-value	**0.017**	0.167	0.258				
Peak Hip Power Absorption 1 (R)	F + M	-0.62 ± 0.48	-1.24 ± 1.01	-2.05 ± 1.12	**<0.001**	0.194	**<0.001**	0.055
	F	-0.21 ± 0.11	-1.54 ± 1.27	-1.54 ± 0.77				
	M	-0.99 ± 0.37	-0.90 ± 0.50	-2.55 ± 1.22				
	p-value	**<0.001**	0.481	0.050				
Peak Hip Power Propulsion 1 (R)	F + M	0.66 ± 0.59	1.19 ± 1.23	2.23 ± 1.34	**<0.001**	0.683	**<0.001**	**0.031**
	F	0.28 ± 0.19	1.78 ± 1.44	1.94 ± 1.29				
	M	1.01 ± 0.62	0.54 ± 0.41	2.52 ± 1.40				
	p-value	**<0.001**	0.114	0.222				

Table 4.7. RSFL Loading and Power

Table 4.7. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (L)	F + M	1.01 ± 0.03	1.06 ± 0.07	1.09 ± 0.05	**<0.001**	**0.006**	**<0.001**	0.297
	F	1.01 ± 0.02	1.08 ± 0.07	1.10 ± 0.06				
	M	1.00 ± 0.03	1.04 ± 0.06	1.07 ± 0.04				
	p-value	0.353	0.136	0.190				
Peak Vertical GRF 2 (R)	F + M	1.21 ± 0.10	1.14 ± 0.09	1.06 ± 0.05	**<0.001**	0.133	**<0.001**	**0.020**
	F	1.24 ± 0.07	1.13 ± 0.07	1.05 ± 0.03				
	M	1.19 ± 0.12	1.14 ± 0.11	1.07 ± 0.07				
	p-value	0.165	0.931	0.730				
Loading Rate 1 (L)	F + M	3.19 ± 1.46	2.78 ± 1.77	1.90 ± 0.34	**0.010**	0.945	**0.008**	0.155
	F	3.35 ± 1.39	2.40 ± 1.20	1.90 ± 0.32				
	M	3.02 ± 1.59	3.16 ± 2.21	1.90 ± 0.38				
	p-value	0.529	0.546	0.605				
Loading Rate 2 (R)	F + M	5.21 ± 2.01	3.84 ± 2.08	2.39 ± 1.34	**<0.001**	0.145	**<0.001**	0.055
	F	5.76 ± 2.12	3.58 ± 1.72	2.03 ± 0.98				
	M	4.66 ± 1.82	4.10 ± 2.46	2.76 ± 1.60				
	p-value	0.228	0.612	0.260				
Peak Ankle Power Absorption 1 (L)	F + M	-0.47 ± 0.29	-0.65 ± 0.39	-0.65 ± 0.31	0.152			
	F	-0.50 ± 0.34	-0.55 ± 0.36	-0.63 ± 0.21				
	M	-0.43 ± 0.24	-0.74 ± 0.42	-0.67 ± 0.40				
	p-value	0.739	0.387	0.796				
Peak Ankle Power Propulsion 1 (L)	F + M	0.57 ± 0.39	0.97 ± 0.49	1.03 ± 0.51	**0.001**	**0.012**	**0.003**	1.000
	F	0.59 ± 0.45	0.97 ± 0.65	1.19 ± 0.62				
	M	0.55 ± 0.33	0.96 ± 0.30	0.87 ± 0.32				
	p-value	0.796	0.605	0.340				
Peak Ankle Power Absorption 2 (R)	F + M	-0.73 ± 0.58	-0.76 ± 0.59	-0.58 ± 0.50	0.600			
	F	-1.03 ± 0.53	-0.80 ± 0.76	-0.47 ± 0.24				
	M	-0.44 ± 0.50	-0.72 ± 0.43	-0.69 ± 0.66				
	p-value	**0.023**	0.888	1.000				
Peak Ankle Power Propulsion 2 (R)	F + M	0.42 ± 0.29	0.48 ± 0.22	0.62 ± 0.51	0.430			
	F	0.45 ± 0.20	0.51 ± 0.21	0.70 ± 0.58				
	M	0.39 ± 0.37	0.44 ± 0.24	0.54 ± 0.44				
	p-value	0.315	0.666	0.489				

Peak Knee Power Absorption 1 (L)	F + M	-0.18 ± 0.11	-0.44 ± 0.29	-0.72 ± 0.32	**<0.001**	**0.017**	**<0.001**	**0.043**
	F	-0.13 ± 0.07	-0.43 ± 0.30	-0.63 ± 0.24				
	M	-0.24 ± 0.13	-0.44 ± 0.30	-0.80 ± 0.38				
	p-value	0.063	0.863	0.489				
Peak Knee Power Propulsion 1 (L)	F + M	0.20 ± 0.11	0.33 ± 0.24	0.53 ± 0.21	**<0.001**	0.199	**<0.001**	**0.024**
	F	0.20 ± 0.13	0.42 ± 0.31	0.50 ± 0.23				
	M	0.21 ± 0.10	0.25 ± 0.12	0.56 ± 0.19				
	p-value	0.739	0.222	0.673				
Peak Knee Power Absorption 2 (R)	F + M	-0.18 ± 0.14	-0.25 ± 0.19	-0.24 ± 0.21	0.506			
	F	-0.14 ± 0.11	-0.23 ± 0.13	-0.26 ± 0.20				
	M	-0.22 ± 0.16	-0.28 ± 0.25	-0.22 ± 0.23				
	p-value	0.393	0.931	0.340				
Peak Knee Power Propulsion 2 (R)	F + M	0.38 ± 0.30	1.08 ± 0.92	2.24 ± 1.20	**<0.001**	**0.014**	**<0.001**	**0.035**
	F	0.20 ± 0.19	1.31 ± 1.16	2.05 ± 1.56				
	M	0.56 ± 0.27	0.84 ± 0.56	2.44 ± 0.74				
	p-value	**0.002**	0.436	0.258				
Peak Hip Power Absorption 1 (L)	F + M	-0.22 ± 0.14	-0.63 ± 0.45	-1.16 ± 0.29	**<0.001**	**0.008**	**<0.001**	**0.006**
	F	-0.21 ± 0.18	-0.82 ± 0.56	-1.25 ± 0.34				
	M	-0.23 ± 0.09	-0.45 ± 0.20	-1.07 ± 0.20				
	p-value	0.315	0.190	0.297				
Peak Hip Power Propulsion 1 (L)	F + M	0.26 ± 0.17	0.50 ± 0.22	1.07 ± 0.43	**<0.001**	**0.014**	**<0.001**	**0.009**
	F	0.31 ± 0.20	0.55 ± 0.26	1.04 ± 0.48				
	M	0.21 ± 0.12	0.44 ± 0.18	1.11 ± 0.39				
	p-value	0.143	0.436	0.666				
Peak Hip Power Absorption 2 (R)	F + M	-0.25 ± 0.15	-0.36 ± 0.21	-0.47 ± 0.36	**0.033**	0.452	**0.027**	0.469
	F	-0.24 ± 0.16	-0.35 ± 0.19	-0.43 ± 0.32				
	M	-0.26 ± 0.14	-0.38 ± 0.23	-0.51 ± 0.41				
	p-value	0.684	0.863	0.666				
Peak Hip Power Propulsion 2 (R)	F + M	0.27 ± 0.23	0.54 ± 0.52	0.89 ± 0.56	**0.004**	0.794	**0.003**	0.096
	F	0.14 ± 0.07	0.66 ± 0.55	0.95 ± 0.68				
	M	0.40 ± 0.27	0.43 ± 0.49	0.82 ± 0.45				
	p-value	**0.011**	0.222	0.605				

Table 4.8. RSFLP Loading and Power

Table 4.8. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 2 (R)	F + M	1.18 ± 0.07	1.08 ± 0.09	1.04 ± 0.06	**<0.001**	**<0.001**	**<0.001**	0.215
	F	1.19 ± 0.04	1.04 ± 0.08	1.00 ± 0.03				
	M	1.18 ± 0.09	1.12 ± 0.09	1.07 ± 0.07				
	p-value	0.604	0.074	**0.024**				
Loading Rate 2 (R)	F + M	4.89 ± 1.42	3.66 ± 1.96	2.41 ± 0.98	**<0.001**	**0.020**	**<0.001**	0.190
	F	5.30 ± 1.52	3.09 ± 1.76	1.98 ± 0.70				
	M	4.51 ± 1.27	4.31 ± 2.08	2.84 ± 1.06				
	p-value	0.156	**0.046**	0.063				
Peak Ankle Power Absorption 2 (R)	F + M	-0.72 ± 0.53	-0.65 ± 0.58	-0.53 ± 0.43	0.454			
	F	-0.98 ± 0.57	-0.86 ± 0.67	-0.46 ± 0.11				
	M	-0.48 ± 0.37	-0.42 ± 0.35	-0.60 ± 0.61				
	p-value	**0.022**	0.139	0.340				
Peak Ankle Power Propulsion 2 (R)	F + M	0.48 ± 0.32	0.71 ± 0.44	0.77 ± 0.45	0.085			
	F	0.56 ± 0.24	0.81 ± 0.38	0.85 ± 0.52				
	M	0.41 ± 0.38	0.61 ± 0.51	0.69 ± 0.40				
	p-value	0.156	0.139	0.863				
Peak Knee Power Absorption 2 (R)	F + M	-0.15 ± 0.08	-0.31 ± 0.23	-0.30 ± 0.17	**0.006**	**0.040**	**0.009**	1.000
	F	-0.15 ± 0.08	-0.33 ± 0.19	-0.32 ± 0.24				
	M	-0.14 ± 0.09	-0.30 ± 0.28	-0.28 ± 0.08				
	p-value	0.549	0.481	0.931				
Peak Knee Power Propulsion 2 (R)	F + M	0.46 ± 0.40	1.13 ± 0.89	1.84 ± 1.00	**<0.001**	**0.030**	**<0.001**	0.097
	F	0.29 ± 0.28	1.29 ± 0.98	1.75 ± 1.00				
	M	0.62 ± 0.44	0.96 ± 0.80	1.93 ± 1.07				
	p-value	**0.043**	0.481	0.796				
Peak Hip Power Absorption 2 (R)	F + M	-0.24 ± 0.13	-0.33 ± 0.24	-0.38 ± 0.30	0.555			
	F	-0.28 ± 0.08	-0.28 ± 0.22	-0.34 ± 0.20				
	M	-0.21 ± 0.16	-0.39 ± 0.27	-0.41 ± 0.39				
	p-value	0.243	0.423	0.863				
Peak Hip Power Propulsion 2 (R)	F + M	0.32 ± 0.27	0.63 ± 0.65	1.16 ± 0.96	**0.029**	1.000	**0.026**	0.273
	F	0.15 ± 0.08	0.83 ± 0.81	1.20 ± 1.20				
	M	0.46 ± 0.30	0.41 ± 0.34	1.11 ± 0.73				
	p-value	**0.017**	0.541	0.796				

Table 4.9. SSL Loading and Power

Table 4.9. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.07 ± 0.09	1.05 ± 0.04	1.03 ± 0.02	0.191			
	F	1.04 ± 0.03	1.04 ± 0.04	1.04 ± 0.02				
	M	1.10 ± 0.12	1.05 ± 0.04	1.02 ± 0.02				
	p-value	0.393	0.796	0.136				
Loading Rate	F + M	3.31 ± 2.15	2.43 ± 1.47	1.56 ± 0.56	**0.013**	0.891	**0.011**	0.202
	F	2.65 ± 1.79	2.09 ± 0.93	1.64 ± 0.58				
	M	3.96 ± 2.37	2.78 ± 1.86	1.48 ± 0.56				
	p-value	0.218	0.605	1.000				
Peak Ankle Power Absorption	F + M	-0.93 ± 0.67	-0.36 ± 0.23	-0.41 ± 0.40	**<0.001**	**0.006**	**0.003**	1.000
	F	-1.04 ± 0.38	-0.23 ± 0.19	-0.40 ± 0.42				
	M	-0.82 ± 0.87	-0.49 ± 0.20	-0.43 ± 0.40				
	p-value	0.063	**0.014**	0.605				
Peak Ankle Power Propulsion	F + M	0.28 ± 0.23	0.22 ± 0.11	0.34 ± 0.30	0.909			
	F	0.22 ± 0.13	0.17 ± 0.10	0.22 ± 0.19				
	M	0.33 ± 0.30	0.27 ± 0.11	0.45 ± 0.34				
	p-value	0.579	0.063	0.161				
Peak Knee Power Absorption	F + M	-0.24 ± 0.20	-0.35 ± 0.27	-0.23 ± 0.14	0.252			
	F	-0.17 ± 0.12	-0.32 ± 0.25	-0.17 ± 0.06				
	M	-0.31 ± 0.24	-0.39 ± 0.31	-0.29 ± 0.17				
	p-value	0.247	0.796	0.113				
Peak Knee Power Propulsion	F + M	0.28 ± 0.24	0.88 ± 0.91	1.18 ± 1.14	**0.013**	0.300	**0.011**	0.643
	F	0.14 ± 0.10	1.13 ± 1.00	0.89 ± 0.65				
	M	0.43 ± 0.26	0.64 ± 0.78	1.48 ± 1.46				
	p-value	**0.002**	0.436	0.546				
Peak Hip Power Absorption	F + M	-0.33 ± 0.17	-0.65 ± 0.39	-0.48 ± 0.30	**0.010**	**0.007**	0.352	0.449
	F	-0.29 ± 0.13	-0.70 ± 0.38	-0.55 ± 0.33				
	M	-0.36 ± 0.20	-0.60 ± 0.42	-0.41 ± 0.28				
	p-value	0.529	0.258	0.297				
Peak Hip Power Propulsion	F + M	0.63 ± 0.63	0.49 ± 0.38	1.19 ± 0.95	0.058			
	F	0.19 ± 0.09	0.40 ± 0.35	1.13 ± 0.81				
	M	1.06 ± 0.64	0.57 ± 0.42	1.25 ± 1.12				
	p-value	**0.003**	0.340	1.000				

Table 4.10. SSLP Loading and Power

Table 4.10. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.04 ± 0.04	1.03 ± 0.03	1.01 ± 0.04	0.137			
	F	1.03 ± 0.04	1.01 ± 0.03	0.99 ± 0.03				
	M	1.05 ± 0.03	1.05 ± 0.02	1.03 ± 0.03				
	p-value	0.063	**0.011**	**0.004**				
Loading Rate	F + M	2.51 ± 1.80	2.16 ± 0.87	1.52 ± 0.58	**0.041**	1.000	0.201	**0.046**
	F	1.93 ± 1.22	2.11 ± 0.79	1.50 ± 0.65				
	M	3.09 ± 2.15	2.21 ± 0.98	1.54 ± 0.54				
	p-value	0.222	0.863	0.796				
Peak Ankle Power Absorption	F + M	-0.79 ± 0.35	-0.31 ± 0.16	-0.38 ± 0.26	**<0.001**	**<0.001**	**0.004**	1.000
	F	-0.95 ± 0.18	-0.25 ± 0.14	-0.39 ± 0.28				
	M	-0.63 ± 0.41	-0.37 ± 0.16	-0.37 ± 0.25				
	p-value	0.143	0.161	0.931				
Peak Ankle Power Propulsion	F + M	0.30 ± 0.18	0.27 ± 0.15	0.39 ± 0.32	0.749			
	F	0.26 ± 0.20	0.27 ± 0.17	0.37 ± 0.38				
	M	0.34 ± 0.17	0.27 ± 0.14	0.41 ± 0.27				
	p-value	0.165	0.863	0.481				
Peak Knee Power Absorption	F + M	-0.20 ± 0.19	-0.28 ± 0.15	-0.24 ± 0.17	0.064			
	F	-0.15 ± 0.09	-0.27 ± 0.16	-0.17 ± 0.06				
	M	-0.25 ± 0.25	-0.30 ± 0.15	-0.31 ± 0.22				
	p-value	0.353	0.730	0.258				
Peak Knee Power Propulsion	F + M	0.47 ± 0.53	0.68 ± 0.67	0.96 ± 0.71	0.057			
	F	0.27 ± 0.36	0.87 ± 0.73	0.82 ± 0.72				
	M	0.68 ± 0.61	0.49 ± 0.59	1.10 ± 0.70				
	p-value	**0.035**	0.387	0.297				
Peak Hip Power Absorption	F + M	-0.44 ± 0.33	-0.69 ± 0.35	-0.50 ± 0.38	**0.049**	0.053	1.000	0.239
	F	-0.35 ± 0.13	-0.75 ± 0.39	-0.62 ± 0.43				
	M	-0.52 ± 0.44	-0.62 ± 0.31	-0.37 ± 0.29				
	p-value	0.631	0.666	0.222				
Peak Hip Power Propulsion	F + M	0.58 ± 0.59	0.48 ± 0.32	1.35 ± 0.97	**0.002**	1.000	**0.004**	**0.011**
	F	0.17 ± 0.11	0.52 ± 0.37	0.99 ± 0.55				
	M	0.99 ± 0.58	0.43 ± 0.27	1.71 ± 1.18				
	p-value	**0.002**	0.666	0.258				

Table 4.11. SSR Loading and Power

Table 4.11. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.02 ± 0.03	1.04 ± 0.04	1.03 ± 0.02	**0.044**	**0.046**	0.247	1.000
	F	1.04 ± 0.04	1.04 ± 0.04	1.03 ± 0.01				
	M	1.01 ± 0.02	1.04 ± 0.03	1.03 ± 0.03				
	p-value	**0.040**	0.863	0.258				
Loading Rate	F + M	2.15 ± 1.41	1.92 ± 0.87	1.49 ± 0.52	0.311			
	F	2.12 ± 1.62	1.95 ± 0.70	1.38 ± 0.40				
	M	2.19 ± 1.24	1.90 ± 1.05	1.60 ± 0.63				
	p-value	0.905	0.666	0.730				
Peak Ankle Power Absorption	F + M	-0.87 ± 0.48	-0.42 ± 0.21	-0.51 ± 0.35	**0.002**	**0.004**	**0.014**	1.000
	F	-0.80 ± 0.33	-0.33 ± 0.14	-0.33 ± 0.12				
	M	-0.94 ± 0.61	-0.51 ± 0.23	-0.69 ± 0.42				
	p-value	0.853	0.094	**0.031**				
Peak Ankle Power Propulsion	F + M	0.15 ± 0.10	0.24 ± 0.22	0.21 ± 0.18	0.602			
	F	0.14 ± 0.11	0.22 ± 0.26	0.09 ± 0.07				
	M	0.17 ± 0.09	0.26 ± 0.17	0.33 ± 0.18				
	p-value	0.393	0.436	**0.002**				
Peak Knee Power Absorption	F + M	-0.10 ± 0.09	-0.34 ± 0.24	-0.38 ± 0.23	**<0.001**	**<0.001**	**<0.001**	1.000
	F	-0.10 ± 0.07	-0.30 ± 0.15	-0.35 ± 0.16				
	M	-0.10 ± 0.11	-0.39 ± 0.32	-0.41 ± 0.29				
	p-value	0.912	0.931	0.666				
Peak Knee Power Propulsion	F + M	0.16 ± 0.11	0.30 ± 0.23	0.33 ± 0.27	**0.032**	0.086	0.063	1.000
	F	0.14 ± 0.13	0.28 ± 0.29	0.19 ± 0.10				
	M	0.17 ± 0.10	0.32 ± 0.16	0.49 ± 0.31				
	p-value	0.353	0.190	**0.036**				
Peak Hip Power Absorption	F + M	-0.23 ± 0.11	-0.51 ± 0.24	-0.57 ± 0.28	**<0.001**	**<0.001**	**<0.001**	0.772
	F	-0.29 ± 0.08	-0.55 ± 0.21	-0.62 ± 0.35				
	M	-0.17 ± 0.11	-0.47 ± 0.28	-0.53 ± 0.19				
	p-value	0.052	0.297	0.931				
Peak Hip Power Propulsion	F + M	0.17 ± 0.09	0.37 ± 0.27	0.39 ± 0.17	**<0.001**	**0.014**	**<0.001**	0.604
	F	0.15 ± 0.09	0.32 ± 0.28	0.36 ± 0.13				
	M	0.19 ± 0.09	0.41 ± 0.26	0.42 ± 0.21				
	p-value	0.353	0.258	0.730				

Table 4.12. SSRP Loading and Power

Table 4.12. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	1.02 ± 0.03	1.03 ± 0.03	1.01 ± 0.04	0.454			
	F	1.02 ± 0.03	1.01 ± 0.03	0.99 ± 0.03				
	M	1.03 ± 0.03	1.04 ± 0.02	1.04 ± 0.04				
	p-value	0.684	**0.008**	**0.014**				
Loading Rate	F + M	3.40 ± 2.12	1.65 ± 0.72	1.32 ± 0.31	**0.002**	**0.038**	**0.002**	1.000
	F	2.89 ± 1.82	1.71 ± 0.63	1.34 ± 0.27				
	M	3.91 ± 2.36	1.60 ± 0.84	1.31 ± 0.35				
	p-value	0.684	0.546	0.546				
Peak Ankle Power Absorption	F + M	-0.94 ± 0.49	-0.47 ± 0.23	-0.64 ± 0.39	**0.004**	**0.003**	0.118	0.672
	F	-1.00 ± 0.33	-0.50 ± 0.28	-0.49 ± 0.20				
	M	-0.89 ± 0.62	-0.45 ± 0.16	-0.80 ± 0.48				
	p-value	0.579	0.546	0.297				
Peak Ankle Power Propulsion	F + M	0.21 ± 0.17	0.23 ± 0.14	0.20 ± 0.20	0.409			
	F	0.19 ± 0.17	0.18 ± 0.12	0.12 ± 0.09				
	M	0.22 ± 0.17	0.28 ± 0.14	0.28 ± 0.25				
	p-value	0.579	0.161	0.063				
Peak Knee Power Absorption	F + M	-0.15 ± 0.15	-0.41 ± 0.15	-0.41 ± 0.20	**<0.001**	**<0.001**	**<0.001**	1.000
	F	-0.10 ± 0.06	-0.39 ± 0.11	-0.36 ± 0.12				
	M	-0.20 ± 0.19	-0.43 ± 0.18	-0.45 ± 0.25				
	p-value	0.136	0.495	0.346				
Peak Knee Power Propulsion	F + M	0.22 ± 0.14	0.25 ± 0.11	0.26 ± 0.25	0.494			
	F	0.16 ± 0.10	0.21 ± 0.12	0.18 ± 0.10				
	M	0.28 ± 0.14	0.30 ± 0.07	0.36 ± 0.34				
	p-value	0.075	0.113	0.423				
Peak Hip Power Absorption	F + M	-0.29 ± 0.18	-0.55 ± 0.26	-0.53 ± 0.27	**0.002**	**0.005**	**0.009**	1.000
	F	-0.36 ± 0.23	-0.66 ± 0.21	-0.65 ± 0.24				
	M	-0.23 ± 0.08	-0.44 ± 0.27	-0.40 ± 0.24				
	p-value	0.481	0.094	0.113				
Peak Hip Power Propulsion	F + M	0.19 ± 0.12	0.44 ± 0.21	0.54 ± 0.25	**<0.001**	**0.001**	**<0.001**	0.770
	F	0.18 ± 0.12	0.45 ± 0.26	0.42 ± 0.15				
	M	0.20 ± 0.14	0.42 ± 0.16	0.65 ± 0.29				
	p-value	0.796	0.863	0.063				

Table 4.13. ST Loading and Power

Table 4.13. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	0.91 ± 0.12	1.03 ± 0.08	1.02 ± 0.05	**<0.001**	**0.001**	**0.003**	1.000
	F	0.95 ± 0.10	1.02 ± 0.08	1.04 ± 0.05				
	M	0.87 ± 0.14	1.04 ± 0.08	1.00 ± 0.04				
	p-value	0.579	0.258	**0.040**				
Loading Rate	F + M	1.88 ± 0.62	1.69 ± 0.41	1.75 ± 0.47	0.506			
	F	2.01 ± 0.73	1.52 ± 0.40	1.71 ± 0.59				
	M	1.75 ± 0.48	1.86 ± 0.37	1.78 ± 0.34				
	p-value	0.280	0.077	0.436				
Peak Ankle Power Absorption	F + M	-0.57 ± 0.46	-0.75 ± 0.32	-0.87 ± 0.33	**0.002**	0.071	**0.002**	0.816
	F	-0.68 ± 0.47	-0.58 ± 0.20	-0.75 ± 0.24				
	M	-0.46 ± 0.44	-0.93 ± 0.33	-0.99 ± 0.38				
	p-value	0.089	**0.019**	0.136				
Peak Ankle Power Propulsion	F + M	2.76 ± 1.23	3.40 ± 1.27	2.65 ± 0.79	0.102			
	F	3.54 ± 1.23	2.97 ± 0.85	2.64 ± 0.78				
	M	1.99 ± 0.59	3.84 ± 1.50	2.66 ± 0.84				
	p-value	**<0.001**	0.222	0.931				
Peak Knee Power Absorption	F + M	-0.33 ± 0.24	-0.73 ± 0.44	-0.79 ± 0.41	**<0.001**	**0.005**	**0.001**	1.000
	F	-0.35 ± 0.17	-0.62 ± 0.23	-0.77 ± 0.50				
	M	-0.32 ± 0.30	-0.84 ± 0.58	-0.82 ± 0.32				
	p-value	0.353	0.546	0.489				
Peak Knee Power Propulsion	F + M	0.90 ± 0.50	0.64 ± 0.42	1.22 ± 1.00	0.133			
	F	0.66 ± 0.35	0.60 ± 0.36	0.73 ± 0.55				
	M	1.13 ± 0.53	0.68 ± 0.48	1.71 ± 1.13				
	p-value	**0.023**	0.730	**0.019**				
Peak Hip Power Absorption	F + M	-0.28 ± 0.16	-0.29 ± 0.16	-0.49 ± 0.25	**0.008**	1.000	**0.013**	**0.034**
	F	-0.22 ± 0.11	-0.23 ± 0.14	-0.35 ± 0.14				
	M	-0.34 ± 0.19	-0.34 ± 0.16	-0.63 ± 0.27				
	p-value	0.143	0.077	**0.014**				
Peak Hip Power Propulsion	F + M	0.69 ± 0.45	1.07 ± 0.62	1.49 ± 0.78	**<0.001**	**0.043**	**<0.001**	0.347
	F	0.75 ± 0.51	0.80 ± 0.42	1.51 ± 1.03				
	M	0.64 ± 0.41	1.34 ± 0.69	1.46 ± 0.47				
	p-value	0.579	**0.031**	0.863				

Table 4.14. STP Loading and Power

Table 4.14. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF	F + M	0.95 ± 0.07	1.03 ± 0.10	1.02 ± 0.05	**0.002**	**0.005**	**0.011**	0.987
	F	0.95 ± 0.05	1.02 ± 0.10	1.02 ± 0.03				
	M	0.95 ± 0.09	1.04 ± 0.10	1.02 ± 0.06				
	p-value	0.954	0.623	0.844				
Loading Rate	F + M	1.73 ± 0.58	1.82 ± 0.41	1.60 ± 0.49	0.200			
	F	1.57 ± 0.43	1.60 ± 0.38	1.54 ± 0.44				
	M	1.89 ± 0.69	2.06 ± 0.30	1.67 ± 0.55				
	p-value	0.393	**0.021**	0.666				
Peak Ankle Power Absorption	F + M	-0.52 ± 0.37	-0.86 ± 0.43	-0.76 ± 0.27	**0.009**	**0.014**	**0.045**	1.000
	F	-0.44 ± 0.22	-0.55 ± 0.24	-0.63 ± 0.21				
	M	-0.61 ± 0.47	-1.17 ± 0.35	-0.88 ± 0.28				
	p-value	0.313	**<0.001**	0.051				
Peak Ankle Power Propulsion	F + M	3.26 ± 1.07	3.70 ± 1.48	3.82 ± 1.10	0.328			
	F	3.80 ± 0.94	3.43 ± 0.96	3.53 ± 0.76				
	M	2.71 ± 0.92	3.97 ± 1.89	4.12 ± 1.34				
	p-value	**0.018**	0.457	0.269				
Peak Knee Power Absorption	F + M	-0.41 ± 0.21	-0.94 ± 0.43	-0.90 ± 0.39	**<0.001**	**<0.001**	**<0.001**	0.976
	F	-0.47 ± 0.17	-0.98 ± 0.51	-0.83 ± 0.44				
	M	-0.34 ± 0.24	-0.90 ± 0.36	-0.97 ± 0.35				
	p-value	0.063	0.796	0.546				
Peak Knee Power Propulsion	F + M	0.87 ± 0.55	0.45 ± 0.35	0.75 ± 0.62	**0.035**	**0.030**	1.000	0.361
	F	0.63 ± 0.49	0.48 ± 0.40	0.57 ± 0.54				
	M	1.10 ± 0.52	0.41 ± 0.31	0.96 ± 0.66				
	p-value	**0.043**	0.605	0.167				
Peak Hip Power Absorption	F + M	-0.32 ± 0.19	-0.35 ± 0.19	-0.37 ± 0.19	0.787			
	F	-0.37 ± 0.24	-0.32 ± 0.17	-0.34 ± 0.12				
	M	-0.27 ± 0.13	-0.38 ± 0.21	-0.39 ± 0.25				
	p-value	0.393	0.666	1.000				
Peak Hip Power Propulsion	F + M	0.63 ± 0.32	1.28 ± 0.65	1.18 ± 0.48	**<0.001**	**0.001**	**0.001**	1.000
	F	0.68 ± 0.31	1.00 ± 0.51	1.02 ± 0.58				
	M	0.58 ± 0.34	1.57 ± 0.68	1.35 ± 0.29				
	p-value	0.579	0.050	**0.019**				

Table 4.15. TSL Loading and Power

Table 4.15. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (L)	F + M	1.20 ± 0.10	1.11 ± 0.10	1.10 ± 0.12	**0.007**	**0.034**	**0.011**	0.971
	F	1.26 ± 0.12	1.15 ± 0.07	1.13 ± 0.11				
	M	1.15 ± 0.05	1.07 ± 0.11	1.07 ± 0.12				
	p-value	**0.016**	0.089	0.216				
Peak Vertical GRF 3 (L)	F + M	1.13 ± 0.11	1.07 ± 0.07	1.05 ± 0.04	**0.044**	0.156	0.062	1.000
	F	1.15 ± 0.08	1.08 ± 0.08	1.06 ± 0.03				
	M	1.11 ± 0.13	1.06 ± 0.05	1.05 ± 0.05				
	p-value	0.243	0.605	0.489				
Loading Rate 1 (L)	F + M	3.40 ± 1.82	4.34 ± 1.75	3.43 ± 1.61	0.090			
	F	3.73 ± 1.91	4.06 ± 1.94	3.75 ± 2.13				
	M	3.08 ± 1.75	4.62 ± 1.59	3.10 ± 0.85				
	p-value	0.190	0.387	0.666				
Loading Rate 3 (L)	F + M	6.74 ± 3.29	3.70 ± 3.22	3.04 ± 2.40	**0.004**	**0.045**	**0.006**	1.000
	F	7.61 ± 2.61	3.70 ± 3.74	2.75 ± 1.73				
	M	5.87 ± 3.78	3.70 ± 2.83	3.33 ± 3.01				
	p-value	0.315	0.666	0.863				
Peak Ankle Power Absorption 1 (L)	F + M	-0.97 ± 0.39	-0.78 ± 0.47	-0.94 ± 0.34	0.125			
	F	-1.03 ± 0.50	-0.66 ± 0.31	-0.94 ± 0.32				
	M	-0.91 ± 0.24	-0.91 ± 0.59	-0.93 ± 0.38				
	p-value	0.684	0.546	0.796				
Peak Ankle Power Propulsion 1 (L)	F + M	1.24 ± 1.81	1.06 ± 1.17	1.25 ± 1.48	0.683			
	F	1.74 ± 2.37	0.77 ± 1.08	1.62 ± 2.05				
	M	0.74 ± 0.83	1.35 ± 1.25	0.89 ± 0.43				
	p-value	0.853	0.063	0.489				
Peak Ankle Power Absorption 3 (L)	F + M	-1.07 ± 0.65	-0.52 ± 0.35	-0.66 ± 0.46	**0.013**	**0.015**	0.092	1.000
	F	-1.39 ± 0.56	-0.46 ± 0.33	-0.58 ± 0.24				
	M	-0.74 ± 0.59	-0.58 ± 0.37	-0.74 ± 0.62				
	p-value	**0.043**	0.340	0.931				
Peak Ankle Power Propulsion 3 (L)	F + M	0.26 ± 0.19	0.26 ± 0.10	0.34 ± 0.19	0.219			
	F	0.18 ± 0.10	0.26 ± 0.09	0.36 ± 0.21				
	M	0.33 ± 0.24	0.25 ± 0.11	0.32 ± 0.16				
	p-value	0.190	0.666	0.888				

Peak Knee Power Absorption 1 (L)	F + M	-0.54 ± 0.40	-1.49 ± 1.30	-1.46 ± 1.20	**0.006**	**0.022**	**0.017**	1.000
	F	-0.42 ± 0.31	-1.68 ± 1.64	-1.94 ± 1.47				
	M	-0.66 ± 0.45	-1.29 ± 0.91	-1.04 ± 0.74				
	p-value	0.218	0.931	0.277				
Peak Knee Power Propulsion 1 (L)	F + M	0.40 ± 0.54	0.44 ± 0.37	1.16 ± 0.88	**0.002**	1.000	**0.001**	**0.036**
	F	0.59 ± 0.73	0.49 ± 0.42	1.14 ± 0.83				
	M	0.21 ± 0.10	0.40 ± 0.34	1.17 ± 0.97				
	p-value	0.393	0.489	1.000				
Peak Knee Power Absorption 3 (L)	F + M	-0.24 ± 0.16	-0.58 ± 0.34	-0.54 ± 0.42	**<0.001**	**0.001**	**0.008**	1.000
	F	-0.21 ± 0.16	-0.45 ± 0.21	-0.51 ± 0.34				
	M	-0.26 ± 0.17	-0.70 ± 0.41	-0.58 ± 0.51				
	p-value	0.436	0.161	0.815				
Peak Knee Power Propulsion 3 (L)	F + M	0.42 ± 0.46	0.84 ± 0.83	1.12 ± 0.69	**0.007**	0.675	**0.005**	0.191
	F	0.25 ± 0.22	0.97 ± 0.69	1.07 ± 0.69				
	M	0.59 ± 0.57	0.70 ± 0.97	1.16 ± 0.73				
	p-value	0.089	0.436	0.796				
Peak Hip Power Absorption 1 (L)	F + M	-0.62 ± 0.24	-0.87 ± 0.59	-1.35 ± 0.74	**0.003**	0.851	**0.002**	0.069
	F	-0.76 ± 0.22	-1.06 ± 0.70	-1.22 ± 0.57				
	M	-0.48 ± 0.19	-0.69 ± 0.41	-1.47 ± 0.89				
	p-value	**0.009**	0.258	0.666				
Peak Hip Power Propulsion 1 (L)	F + M	0.28 ± 0.21	0.95 ± 0.77	1.33 ± 0.80	**<0.001**	**0.003**	**<0.001**	0.462
	F	0.24 ± 0.12	1.14 ± 1.00	1.46 ± 0.91				
	M	0.33 ± 0.28	0.75 ± 0.42	1.20 ± 0.71				
	p-value	0.353	0.666	0.605				
Peak Hip Power Absorption 3 (L)	F + M	-0.46 ± 0.34	-0.64 ± 0.43	-0.64 ± 0.36	0.218			
	F	-0.43 ± 0.33	-0.79 ± 0.45	-0.65 ± 0.39				
	M	-0.49 ± 0.35	-0.49 ± 0.38	-0.64 ± 0.35				
	p-value	0.673	0.139	0.944				
Peak Hip Power Propulsion 3 (L)	F + M	0.50 ± 0.41	0.75 ± 0.55	1.23 ± 0.79	**0.003**	0.447	**0.002**	0.180
	F	0.26 ± 0.16	0.58 ± 0.38	1.08 ± 0.70				
	M	0.75 ± 0.44	0.93 ± 0.65	1.37 ± 0.89				
	p-value	**0.007**	0.222	0.340				

Table 4.16. TSLP Loading and Power

Table 4.16. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (L)	F + M	1.18 ± 0.12	1.10 ± 0.11	1.06 ± 0.11	**0.003**	**0.046**	**0.004**	1.000
	F	1.21 ± 0.15	1.08 ± 0.05	1.01 ± 0.11				
	M	1.16 ± 0.07	1.13 ± 0.15	1.11 ± 0.09				
	p-value	0.529	0.796	0.050				
Peak Vertical GRF 3 (L)	F + M	1.09 ± 0.08	1.06 ± 0.06	1.02 ± 0.04	**0.008**	1.000	**0.010**	0.066
	F	1.08 ± 0.06	1.04 ± 0.06	0.99 ± 0.03				
	M	1.09 ± 0.10	1.09 ± 0.06	1.04 ± 0.03				
	p-value	0.436	0.113	**0.004**				
Loading Rate 1 (L)	F + M	3.18 ± 1.55	3.58 ± 1.30	3.09 ± 1.31	0.329			
	F	3.49 ± 1.61	3.39 ± 1.36	3.44 ± 1.67				
	M	2.88 ± 1.50	3.79 ± 1.27	2.73 ± 0.78				
	p-value	0.315	0.541	0.387				
Loading Rate 3 (L)	F + M	5.84 ± 3.25	4.39 ± 2.51	2.00 ± 1.06	**<0.001**	0.780	**<0.001**	**0.005**
	F	6.02 ± 2.94	3.73 ± 1.83	2.10 ± 1.13				
	M	5.66 ± 3.70	5.06 ± 3.01	1.90 ± 1.05				
	p-value	0.684	0.436	0.666				
Peak Ankle Power Absorption 1 (L)	F + M	-0.88 ± 0.28	-0.83 ± 0.43	-0.86 ± 0.37	0.910			
	F	-0.87 ± 0.30	-0.78 ± 0.34	-0.83 ± 0.39				
	M	-0.89 ± 0.27	-0.88 ± 0.52	-0.89 ± 0.36				
	p-value	0.854	0.629	0.764				
Peak Ankle Power Propulsion 1 (L)	F + M	0.68 ± 0.84	0.65 ± 0.39	0.97 ± 0.78	**0.040**	0.273	**0.041**	1.000
	F	0.84 ± 1.00	0.59 ± 0.19	0.93 ± 0.95				
	M	0.55 ± 0.70	0.72 ± 0.54	1.00 ± 0.64				
	p-value	0.400	1.000	0.340				
Peak Ankle Power Absorption 3 (L)	F + M	-0.89 ± 0.60	-0.51 ± 0.39	-0.46 ± 0.32	**0.047**	0.126	0.082	1.000
	F	-1.07 ± 0.55	-0.48 ± 0.33	-0.51 ± 0.28				
	M	-0.71 ± 0.63	-0.54 ± 0.46	-0.41 ± 0.37				
	p-value	0.105	0.931	0.190				
Peak Ankle Power Propulsion 3 (L)	F + M	0.29 ± 0.19	0.31 ± 0.15	0.35 ± 0.23	0.622			
	F	0.21 ± 0.10	0.31 ± 0.16	0.37 ± 0.27				
	M	0.37 ± 0.23	0.30 ± 0.14	0.33 ± 0.19				
	p-value	0.123	1.000	1.000				

Peak Knee Power Absorption 1 (L)	F + M	-0.69 ± 0.52	-1.79 ± 1.55	-1.76 ± 1.40	**0.008**	**0.016**	**0.035**	1.000
	F	-0.55 ± 0.50	-2.12 ± 1.83	-2.04 ± 1.56				
	M	-0.83 ± 0.53	-1.46 ± 1.22	-1.49 ± 1.26				
	p-value	0.315	0.297	0.489				
Peak Knee Power Propulsion 1 (L)	F + M	0.36 ± 0.53	0.50 ± 0.50	0.93 ± 0.64	**0.002**	0.469	**0.001**	0.123
	F	0.50 ± 0.72	0.57 ± 0.44	1.02 ± 0.64				
	M	0.22 ± 0.15	0.43 ± 0.56	0.84 ± 0.66				
	p-value	0.315	0.222	0.605				
Peak Knee Power Absorption 3 (L)	F + M	-0.23 ± 0.15	-0.59 ± 0.32	-0.53 ± 0.38	**<0.001**	**<0.001**	**0.018**	0.843
	F	-0.19 ± 0.14	-0.44 ± 0.23	-0.37 ± 0.17				
	M	-0.27 ± 0.15	-0.74 ± 0.33	-0.69 ± 0.47				
	p-value	0.280	0.077	0.222				
Peak Knee Power Propulsion 3 (L)	F + M	0.44 ± 0.50	0.92 ± 0.96	1.19 ± 0.85	**0.010**	0.853	**0.008**	0.176
	F	0.20 ± 0.13	1.28 ± 1.08	1.26 ± 0.91				
	M	0.68 ± 0.61	0.56 ± 0.71	1.13 ± 0.84				
	p-value	**0.009**	0.258	0.796				
Peak Hip Power Absorption 1 (L)	F + M	-0.66 ± 0.45	-0.94 ± 0.54	-1.65 ± 0.82	**<0.001**	0.272	**<0.001**	**0.030**
	F	-0.84 ± 0.56	-1.19 ± 0.60	-1.45 ± 0.65				
	M	-0.49 ± 0.23	-0.68 ± 0.33	-1.86 ± 0.96				
	p-value	0.063	0.077	0.546				
Peak Hip Power Propulsion 1 (L)	F + M	0.35 ± 0.25	1.04 ± 0.80	1.34 ± 0.63	**<0.001**	**0.002**	**<0.001**	0.471
	F	0.30 ± 0.26	1.06 ± 0.89	1.37 ± 0.59				
	M	0.41 ± 0.25	1.03 ± 0.76	1.31 ± 0.69				
	p-value	0.247	0.815	0.931				
Peak Hip Power Absorption 3 (L)	F + M	-0.47 ± 0.31	-0.83 ± 0.47	-0.69 ± 0.38	**0.017**	**0.016**	0.177	1.000
	F	-0.42 ± 0.21	-1.10 ± 0.54	-0.88 ± 0.39				
	M	-0.52 ± 0.39	-0.57 ± 0.19	-0.49 ± 0.28				
	p-value	0.684	0.063	**0.040**				
Peak Hip Power Propulsion 3 (L)	F + M	0.62 ± 0.66	0.79 ± 0.41	1.13 ± 0.82	**0.031**	0.244	**0.030**	1.000
	F	0.20 ± 0.12	0.67 ± 0.39	0.70 ± 0.35				
	M	1.05 ± 0.70	0.91 ± 0.41	1.55 ± 0.96				
	p-value	**0.002**	0.190	0.050				

Table 4.17. TSR Loading and Power

Table 4.17. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (R)	F + M	1.26 ± 0.16	1.11 ± 0.09	1.10 ± 0.10	**<0.001**	**0.003**	**0.001**	0.969
	F	1.31 ± 0.18	1.15 ± 0.11	1.08 ± 0.13				
	M	1.21 ± 0.13	1.08 ± 0.07	1.11 ± 0.06				
	p-value	0.123	0.190	0.605				
Peak Vertical GRF 3 (R)	F + M	1.14 ± 0.14	1.08 ± 0.07	1.03 ± 0.03	**0.012**	1.000	**0.011**	0.117
	F	1.17 ± 0.11	1.08 ± 0.07	1.04 ± 0.02				
	M	1.12 ± 0.17	1.07 ± 0.07	1.02 ± 0.03				
	p-value	**0.035**	0.546	0.190				
Loading Rate 1 (R)	F + M	3.85 ± 2.52	4.47 ± 2.02	3.77 ± 1.61	0.225			
	F	4.39 ± 2.59	4.55 ± 2.20	3.95 ± 2.03				
	M	3.31 ± 2.46	4.39 ± 1.95	3.58 ± 1.15				
	p-value	0.218	1.000	0.796				
Loading Rate 3 (R)	F + M	6.44 ± 3.61	3.43 ± 2.71	2.14 ± 0.86	**<0.001**	**0.020**	**<0.001**	0.906
	F	6.93 ± 2.65	3.40 ± 2.89	1.84 ± 0.60				
	M	5.94 ± 4.47	3.45 ± 2.68	2.43 ± 1.00				
	p-value	0.436	0.730	0.340				
Peak Ankle Power Absorption 1 (R)	F + M	-0.92 ± 0.64	-0.99 ± 1.10	-0.91 ± 0.70	0.918			
	F	-1.40 ± 0.50	-1.26 ± 1.45	-0.78 ± 0.41				
	M	-0.43 ± 0.29	-0.72 ± 0.57	-1.04 ± 0.91				
	p-value	**<0.001**	0.546	0.796				
Peak Ankle Power Propulsion 1 (R)	F + M	1.25 ± 1.84	1.12 ± 1.12	1.02 ± 0.70	0.195			
	F	1.67 ± 2.44	1.20 ± 1.16	1.26 ± 0.84				
	M	0.83 ± 0.91	1.05 ± 1.14	0.79 ± 0.48				
	p-value	0.497	0.666	0.297				
Peak Ankle Power Absorption 3 (R)	F + M	-1.21 ± 0.65	-0.73 ± 0.49	-0.75 ± 0.38	**0.014**	**0.026**	0.053	1.000
	F	-1.38 ± 0.83	-0.65 ± 0.45	-0.67 ± 0.22				
	M	-1.04 ± 0.38	-0.81 ± 0.55	-0.83 ± 0.50				
	p-value	0.543	0.513	0.397				
Peak Ankle Power Propulsion 3 (R)	F + M	0.17 ± 0.11	0.25 ± 0.16	0.23 ± 0.15	0.273			
	F	0.15 ± 0.12	0.25 ± 0.20	0.19 ± 0.15				
	M	0.20 ± 0.09	0.25 ± 0.13	0.27 ± 0.15				
	p-value	0.165	0.730	0.387				

Peak Knee Power Absorption 1 (R)	F + M	-0.47 ± 0.35	-1.42 ± 2.18	-3.11 ± 4.24	**0.002**	0.057	**0.002**	0.753
	F	-0.40 ± 0.35	-2.02 ± 2.97	-2.26 ± 2.45				
	M	-0.55 ± 0.36	-0.82 ± 0.67	-3.97 ± 5.53				
	p-value	0.353	0.370	1.000				
Peak Knee Power Propulsion 1 (R)	F + M	0.58 ± 0.87	0.85 ± 0.64	1.25 ± 1.07	**0.017**	0.173	**0.017**	1.000
	F	0.75 ± 1.20	1.11 ± 0.72	1.36 ± 1.17				
	M	0.40 ± 0.28	0.59 ± 0.45	1.14 ± 1.02				
	p-value	0.684	0.136	0.796				
Peak Knee Power Absorption 3 (R)	F + M	-0.19 ± 0.15	-0.63 ± 0.42	-0.86 ± 0.44	**<0.001**	**<0.001**	**<0.001**	0.423
	F	-0.17 ± 0.10	-0.58 ± 0.44	-0.77 ± 0.48				
	M	-0.20 ± 0.19	-0.67 ± 0.42	-0.95 ± 0.40				
	p-value	0.796	0.730	0.190				
Peak Knee Power Propulsion 3 (R)	F + M	0.23 ± 0.14	0.41 ± 0.34	0.54 ± 0.66	0.162			
	F	0.21 ± 0.11	0.51 ± 0.42	0.33 ± 0.22				
	M	0.26 ± 0.17	0.31 ± 0.19	0.75 ± 0.88				
	p-value	0.481	0.436	0.370				
Peak Hip Power Absorption 1 (R)	F + M	-0.59 ± 0.34	-0.71 ± 0.65	-1.03 ± 0.78	0.174			
	F	-0.78 ± 0.27	-0.82 ± 0.85	-0.70 ± 0.56				
	M	-0.40 ± 0.29	-0.60 ± 0.39	-1.36 ± 0.84				
	p-value	**0.007**	1.000	0.063				
Peak Hip Power Propulsion 1 (R)	F + M	0.40 ± 0.36	1.47 ± 1.85	2.88 ± 2.89	**<0.001**	**0.010**	**<0.001**	0.136
	F	0.28 ± 0.17	1.96 ± 2.54	2.15 ± 1.35				
	M	0.51 ± 0.47	0.99 ± 0.55	3.61 ± 3.84				
	p-value	0.353	0.606	0.470				
Peak Hip Power Absorption 3 (R)	F + M	-0.30 ± 0.23	-0.52 ± 0.23	-0.71 ± 0.31	**<0.001**	**0.022**	**<0.001**	0.326
	F	-0.42 ± 0.28	-0.60 ± 0.23	-0.81 ± 0.37				
	M	-0.18 ± 0.10	-0.44 ± 0.22	-0.61 ± 0.21				
	p-value	**0.020**	0.156	0.185				
Peak Hip Power Propulsion 3 (R)	F + M	0.21 ± 0.11	0.55 ± 0.36	0.88 ± 0.49	**<0.001**	**0.003**	**<0.001**	**0.042**
	F	0.21 ± 0.14	0.51 ± 0.40	0.93 ± 0.63				
	M	0.20 ± 0.09	0.58 ± 0.34	0.83 ± 0.33				
	p-value	1.000	0.730	0.606				

Table 4.18. TSRP Loading and Power

Table 4.18. Comparisons of GRF (BW), loading rate (BW/s) and joint powers (watts) (in mean ± standard deviation) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Vertical GRF 1 (R)	F + M	1.20 ± 0.12	1.09 ± 0.09	1.07 ± 0.14	**0.003**	**0.008**	**0.017**	1.000
	F	1.22 ± 0.16	1.07 ± 0.09	1.01 ± 0.16				
	M	1.19 ± 0.09	1.11 ± 0.09	1.13 ± 0.09				
	p-value	0.602	0.460	0.085				
Peak Vertical GRF 3 (R)	F + M	1.09 ± 0.09	1.04 ± 0.05	1.03 ± 0.05	0.051			
	F	1.12 ± 0.11	1.03 ± 0.06	1.01 ± 0.02				
	M	1.06 ± 0.05	1.05 ± 0.04	1.05 ± 0.05				
	p-value	0.280	0.222	0.050				
Loading Rate 1 (R)	F + M	3.40 ± 1.90	3.97 ± 1.37	3.35 ± 1.24	0.109			
	F	3.55 ± 2.25	4.09 ± 1.36	3.33 ± 1.59				
	M	3.24 ± 1.59	3.84 ± 1.45	3.37 ± 0.85				
	p-value	1.000	0.423	0.387				
Loading Rate 3 (R)	F + M	6.58 ± 3.68	3.69 ± 3.02	2.63 ± 1.91	**0.001**	**0.037**	**0.001**	0.878
	F	6.56 ± 2.86	3.14 ± 2.29	2.37 ± 1.70				
	M	6.61 ± 4.52	4.25 ± 3.66	2.89 ± 2.16				
	p-value	0.684	0.489	0.546				
Peak Ankle Power Absorption 1 (R)	F + M	-0.78 ± 0.47	-0.98 ± 0.76	-0.89 ± 0.68	0.803			
	F	-1.10 ± 0.34	-1.03 ± 0.84	-0.77 ± 0.66				
	M	-0.45 ± 0.32	-0.93 ± 0.71	-1.00 ± 0.72				
	p-value	**<0.001**	0.863	0.436				
Peak Ankle Power Propulsion 1 (R)	F + M	0.70 ± 0.90	0.89 ± 0.79	0.75 ± 0.57	0.195			
	F	0.83 ± 1.21	0.99 ± 0.98	0.77 ± 0.63				
	M	0.59 ± 0.52	0.77 ± 0.54	0.74 ± 0.54				
	p-value	0.447	0.963	0.605				
Peak Ankle Power Absorption 3 (R)	F + M	-1.02 ± 0.69	-0.57 ± 0.38	-0.75 ± 0.51	0.069			
	F	-1.27 ± 0.81	-0.55 ± 0.39	-0.61 ± 0.29				
	M	-0.77 ± 0.47	-0.60 ± 0.38	-0.89 ± 0.65				
	p-value	0.165	0.796	0.297				
Peak Ankle Power Propulsion 3 (R)	F + M	0.19 ± 0.13	0.27 ± 0.16	0.22 ± 0.14	0.299			
	F	0.16 ± 0.14	0.23 ± 0.12	0.17 ± 0.14				
	M	0.22 ± 0.13	0.31 ± 0.18	0.26 ± 0.12				
	p-value	0.165	0.258	0.161				

Peak Knee Power Absorption 1 (R)	F + M	-0.72 ± 0.57	-1.22 ± 0.75	-1.46 ± 1.03	**0.013**	0.081	**0.019**	1.000
	F	-0.62 ± 0.49	-1.26 ± 0.56	-1.24 ± 0.62				
	M	-0.82 ± 0.65	-1.20 ± 0.93	-1.65 ± 1.31				
	p-value	0.579	0.673	0.963				
Peak Knee Power Propulsion 1 (R)	F + M	0.50 ± 0.53	0.64 ± 0.43	0.85 ± 0.65	**0.049**	0.337	**0.048**	1.000
	F	0.63 ± 0.66	0.78 ± 0.38	0.96 ± 0.76				
	M	0.38 ± 0.34	0.50 ± 0.44	0.73 ± 0.54				
	p-value	0.315	0.136	0.605				
Peak Knee Power Absorption 3 (R)	F + M	-0.25 ± 0.21	-0.57 ± 0.29	-0.84 ± 0.38	**<0.001**	**0.003**	**<0.001**	0.200
	F	-0.22 ± 0.13	-0.47 ± 0.13	-0.70 ± 0.23				
	M	-0.27 ± 0.28	-0.67 ± 0.38	-0.98 ± 0.46				
	p-value	0.590	0.149	0.129				
Peak Knee Power Propulsion 3 (R)	F + M	0.24 ± 0.16	0.23 ± 0.21	0.26 ± 0.19	0.943			
	F	0.23 ± 0.18	0.28 ± 0.27	0.24 ± 0.19				
	M	0.25 ± 0.14	0.18 ± 0.10	0.27 ± 0.21				
	p-value	0.393	0.340	0.730				
Peak Hip Power Absorption 1 (R)	F + M	-0.67 ± 0.41	-0.75 ± 0.45	-1.04 ± 0.67	0.185			
	F	-0.86 ± 0.47	-0.91 ± 0.32	-0.94 ± 0.66				
	M	-0.47 ± 0.23	-0.60 ± 0.53	-1.13 ± 0.69				
	p-value	**0.035**	0.063	0.730				
Peak Hip Power Propulsion 1 (R)	F + M	0.45 ± 0.32	1.49 ± 1.05	2.17 ± 1.42	**<0.001**	**<0.001**	**<0.001**	0.583
	F	0.34 ± 0.14	1.80 ± 1.32	2.10 ± 1.53				
	M	0.56 ± 0.42	1.18 ± 0.60	2.24 ± 1.39				
	p-value	0.353	0.436	0.666				
Peak Hip Power Absorption 3 (R)	F + M	-0.32 ± 0.22	-0.52 ± 0.29	-0.60 ± 0.30	**0.003**	0.053	**0.003**	1.000
	F	-0.39 ± 0.26	-0.68 ± 0.30	-0.65 ± 0.36				
	M	-0.24 ± 0.16	-0.36 ± 0.16	-0.55 ± 0.24				
	p-value	0.247	**0.008**	0.436				
Peak Hip Power Propulsion 3 (R)	F + M	0.22 ± 0.10	0.58 ± 0.42	0.79 ± 0.42	**<0.001**	**0.003**	**<0.001**	0.361
	F	0.22 ± 0.10	0.57 ± 0.46	0.73 ± 0.27				
	M	0.23 ± 0.11	0.59 ± 0.40	0.85 ± 0.54				
	p-value	1.000	0.931	0.489				

Table 4.19. BSR Sagittal Plane Mom

Table 4.19. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.08 ± 0.15	-0.09 ± 0.16	-0.19 ± 0.25	0.418			
	F	-0.01 ± 0.02	-0.12 ± 0.20	-0.13 ± 0.22				
	M	-0.17 ± 0.20	-0.06 ± 0.11	-0.26 ± 0.27				
	p-value	**0.002**	0.541	0.161				
Peak Ankle Plantar-flexion	F + M	0.82 ± 0.52	0.78 ± 0.49	0.54 ± 0.49	0.202			
	F	1.11 ± 0.14	0.63 ± 0.45	0.64 ± 0.46				
	M	0.53 ± 0.60	0.93 ± 0.51	0.43 ± 0.52				
	p-value	0.143	0.161	0.436				
Peak Knee Flexion	F + M	-0.10 ± 0.20	-0.19 ± 0.24	-0.19 ± 0.25	0.282			
	F	-0.10 ± 0.14	-0.18 ± 0.26	-0.27 ± 0.30				
	M	-0.09 ± 0.26	-0.20 ± 0.23	-0.11 ± 0.17				
	p-value	0.353	0.931	0.258				
Peak Knee Extension	F + M	0.84 ± 0.75	0.61 ± 0.68	0.61 ± 0.53	0.493			
	F	0.33 ± 0.17	0.50 ± 0.45	0.37 ± 0.41				
	M	1.35 ± 0.77	0.72 ± 0.86	0.85 ± 0.55				
	p-value	**0.009**	0.931	**0.031**				
Peak Hip Flexion	F + M	-1.07 ± 1.03	-0.84 ± 0.75	-1.04 ± 0.59	0.240			
	F	-0.38 ± 0.10	-0.83 ± 0.68	-0.90 ± 0.55				
	M	-1.77 ± 1.09	-0.85 ± 0.85	-1.18 ± 0.62				
	p-value	**0.015**	0.796	0.340				
Peak Hip Extension	F + M	0.14 ± 0.19	0.15 ± 0.21	0.12 ± 0.21	0.730			
	F	0.12 ± 0.12	0.17 ± 0.21	0.17 ± 0.25				
	M	0.16 ± 0.25	0.14 ± 0.21	0.07 ± 0.15				
	p-value	0.853	0.605	0.546				

Table 4.20. BSR Frontal Plane Joint Mom

Table 4.20. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.11 ± 0.16	-0.42 ± 0.47	-0.67 ± 0.56	**0.005**	0.079	**0.005**	1.000
	F	-0.05 ± 0.05	-0.62 ± 0.58	-0.69 ± 0.64				
	M	-0.19 ± 0.21	-0.22 ± 0.21	-0.65 ± 0.50				
	p-value	0.146	0.387	0.863				
Peak Ankle Eversion	F + M	0.26 ± 0.36	0.13 ± 0.17	0.12 ± 0.15	0.521			
	F	0.13 ± 0.07	0.08 ± 0.09	0.08 ± 0.15				
	M	0.40 ± 0.49	0.19 ± 0.21	0.16 ± 0.14				
	p-value	0.400	0.258	0.236				
Peak Knee Adduction	F + M	-0.45 ± 0.56	-0.72 ± 0.76	-1.17 ± 0.72	**0.004**	1.000	**0.003**	0.050
	F	-0.10 ± 0.06	-0.99 ± 0.86	-1.10 ± 0.76				
	M	-0.81 ± 0.61	-0.45 ± 0.57	-1.25 ± 0.72				
	p-value	**0.011**	0.094	0.863				
Peak Knee Abduction	F + M	0.50 ± 0.33	0.38 ± 0.26	0.39 ± 0.33	0.449			
	F	0.42 ± 0.18	0.25 ± 0.28	0.26 ± 0.26				
	M	0.58 ± 0.44	0.52 ± 0.15	0.51 ± 0.36				
	p-value	0.720	0.050	0.113				
Peak Hip Adduction	F + M	-0.42 ± 0.53	-0.80 ± 0.89	-1.35 ± 0.89	**0.004**	1.000	**0.003**	0.075
	F	-0.08 ± 0.06	-1.05 ± 0.96	-1.33 ± 1.00				
	M	-0.76 ± 0.58	-0.55 ± 0.78	-1.36 ± 0.83				
	p-value	**0.011**	0.136	0.931				
Peak Hip Abduction	F + M	0.99 ± 0.42	0.78 ± 0.24	0.72 ± 0.59	0.181			
	F	0.78 ± 0.25	0.71 ± 0.32	0.56 ± 0.59				
	M	1.21 ± 0.46	0.83 ± 0.16	0.89 ± 0.57				
	p-value	0.052	0.606	0.297				

Table 4.21. BSR Transverse Plane Mom

Table 4.21. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.07 ± 0.06	-0.07 ± 0.05	-0.15 ± 0.08	**0.001**	1.000	**0.003**	**0.004**
	F	-0.05 ± 0.05	-0.08 ± 0.04	-0.16 ± 0.09				
	M	-0.10 ± 0.06	-0.06 ± 0.06	-0.14 ± 0.06				
	p-value	0.105	0.297	0.730				
Peak Ankle External Rotation	F + M	0.10 ± 0.06	0.11 ± 0.05	0.09 ± 0.06	0.410			
	F	0.07 ± 0.04	0.08 ± 0.03	0.10 ± 0.07				
	M	0.12 ± 0.08	0.14 ± 0.04	0.08 ± 0.06				
	p-value	0.122	**0.004**	0.642				
Peak Knee Internal Rotation	F + M	-0.04 ± 0.06	-0.14 ± 0.17	-0.26 ± 0.19	**<0.001**	0.113	**<0.001**	0.103
	F	-0.02 ± 0.01	-0.20 ± 0.20	-0.26 ± 0.18				
	M	-0.07 ± 0.08	-0.08 ± 0.10	-0.26 ± 0.21				
	p-value	0.243	0.222	0.931				
Peak Knee External Rotation	F + M	0.11 ± 0.07	0.10 ± 0.08	0.06 ± 0.07	0.124			
	F	0.10 ± 0.05	0.04 ± 0.05	0.06 ± 0.06				
	M	0.13 ± 0.10	0.16 ± 0.06	0.07 ± 0.07				
	p-value	0.549	**<0.001**	0.679				
Peak Hip Internal Rotation	F + M	-0.07 ± 0.05	-0.07 ± 0.06	-0.09 ± 0.07	0.467			
	F	-0.05 ± 0.03	-0.08 ± 0.05	-0.09 ± 0.09				
	M	-0.09 ± 0.06	-0.07 ± 0.07	-0.09 ± 0.05				
	p-value	0.218	0.546	0.796				
Peak Hip External Rotation	F + M	0.10 ± 0.08	0.14 ± 0.13	0.18 ± 0.15	0.191			
	F	0.05 ± 0.02	0.13 ± 0.14	0.13 ± 0.12				
	M	0.15 ± 0.08	0.15 ± 0.13	0.23 ± 0.17				
	p-value	**0.002**	0.546	0.161				

Table 4.22. BSR Sagittal Plane Angle

Table 4.22. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	5.83 ± 3.25	6.43 ± 4.06	2.93 ± 4.78	**0.034**	1.000	0.114	**0.049**
	F	5.14 ± 3.66	5.80 ± 3.60	3.96 ± 3.53				
	M	6.53 ± 2.79	6.99 ± 4.57	1.90 ± 5.80				
	p-value	0.739	0.743	0.489				
Peak Ankle Dorsiflex-ion	F + M	21.30 ± 4.71	21.62 ± 7.32	20.93 ± 5.97	0.929			
	F	21.99 ± 5.68	22.05 ± 9.31	19.66 ± 5.33				
	M	20.61 ± 3.68	21.20 ± 5.18	22.21 ± 6.61				
	p-value	0.528	0.812	0.381				
Peak Knee Extension	F + M	6.27 ± 7.30	5.45 ± 8.84	5.02 ± 6.89	0.970			
	F	10.67 ± 7.50	11.98 ± 6.59	6.10 ± 9.49				
	M	1.88 ± 3.64	-1.09 ± 5.16	4.05 ± 3.75				
	p-value	**0.004**	**<0.001**	0.557				
Peak Knee Flexion	F + M	14.24 ± 9.06	16.12 ± 8.84	18.63 ± 10.14	0.358			
	F	20.33 ± 8.02	22.83 ± 6.61	18.27 ± 11.92				
	M	8.14 ± 5.16	9.41 ± 4.58	18.98 ± 8.72				
	p-value	**0.001**	**<0.001**	0.887				
Peak Hip Extension	F + M	5.02 ± 4.51	6.44 ± 6.17	2.06 ± 6.44	0.074			
	F	5.32 ± 4.51	5.67 ± 5.37	0.59 ± 6.77				
	M	4.72 ± 4.72	7.20 ± 7.12	3.54 ± 6.13				
	p-value	0.579	0.605	0.546				
Peak Hip Flexion	F + M	22.93 ± 7.34	40.19 ± 9.72	44.00 ± 15.47	**<0.001**	**<0.001**	**<0.001**	0.672
	F	23.24 ± 8.35	41.28 ± 11.98	38.67 ± 11.64				
	M	22.62 ± 6.63	39.09 ± 7.39	49.33 ± 17.59				
	p-value	0.856	0.646	0.149				

Table 4.23. BSR Frontal Plane Angle

Table 4.23. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-3.27 ± 2.98	-1.73 ± 1.96	-4.54 ± 3.97	0.065			
	F	-4.82 ± 2.48	-2.57 ± 1.89	-4.13 ± 4.26				
	M	-1.73 ± 2.71	-0.97 ± 1.78	-4.95 ± 3.87				
	p-value	**0.029**	0.139	0.605				
Peak Ankle Inversion	F + M	-0.77 ± 2.71	0.66 ± 1.95	-1.10 ± 2.31	0.079			
	F	-2.24 ± 1.79	-0.25 ± 1.43	-0.80 ± 1.47				
	M	0.71 ± 2.74	1.46 ± 2.07	-1.37 ± 2.94				
	p-value	**0.011**	0.070	0.629				
Peak Knee Abduction	F + M	-4.71 ± 4.69	-9.58 ± 7.28	-17.08 ± 7.96	**<0.001**	0.111	**<0.001**	**0.039**
	F	-5.67 ± 4.32	-10.01 ± 8.68	-14.12 ± 4.98				
	M	-3.76 ± 5.09	-9.14 ± 6.08	-20.04 ± 9.48				
	p-value	0.353	0.931	0.136				
Peak Knee Adduction	F + M	1.42 ± 4.18	4.43 ± 4.21	8.18 ± 5.54	**<0.001**	0.149	**<0.001**	0.057
	F	0.76 ± 5.22	5.12 ± 3.68	8.20 ± 6.55				
	M	2.09 ± 2.93	3.73 ± 4.80	8.16 ± 4.74				
	p-value	0.493	0.501	0.990				
Peak Hip Abduction	F + M	-2.00 ± 4.41	-0.25 ± 5.28	-4.84 ± 6.70	**0.038**	0.300	1.000	**0.034**
	F	-3.38 ± 3.99	-1.41 ± 4.22	-5.09 ± 7.63				
	M	-0.63 ± 4.57	0.77 ± 6.14	-4.59 ± 6.09				
	p-value	0.105	0.074	0.796				
Peak Hip Adduction	F + M	1.88 ± 4.39	7.70 ± 10.07	5.66 ± 5.43	**0.046**	**0.044**	0.289	0.765
	F	1.23 ± 3.32	3.28 ± 7.41	4.72 ± 4.10				
	M	2.61 ± 5.46	12.13 ± 10.79	6.60 ± 6.62				
	p-value	0.842	**0.040**	0.297				

Table 4.24. BSR Transverse Plane Angle

Table 4.24. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	3.23 ± 15.81	-4.45 ± 10.45	6.46 ± 13.42	0.060			
	F	11.51 ± 9.15	0.17 ± 9.51	7.21 ± 14.19				
	M	-5.05 ± 17.07	-8.55 ± 9.95	5.70 ± 13.42				
	p-value	**0.015**	0.086	0.819				
Peak Ankle Internal Rotation	F + M	17.12 ± 15.16	11.44 ± 11.47	24.16 ± 13.61	**0.027**	0.504	0.308	**0.023**
	F	24.82 ± 10.22	15.84 ± 10.07	21.84 ± 12.96				
	M	9.42 ± 15.77	7.52 ± 11.73	26.49 ± 14.61				
	p-value	**0.018**	0.140	0.486				
Peak Knee External Rotation	F + M	-4.52 ± 11.56	-9.13 ± 17.32	-26.03 ± 17.31	**<0.001**	0.704	**<0.001**	**0.006**
	F	-10.82 ± 6.33	-14.44 ± 15.62	-26.48 ± 15.28				
	M	1.77 ± 12.42	-3.81 ± 18.16	-25.59 ± 20.07				
	p-value	**0.011**	0.202	0.918				
Peak Knee Internal Rotation	F + M	3.51 ± 11.72	0.93 ± 15.16	-12.33 ± 16.26	**0.003**	0.926	**0.004**	**0.024**
	F	-3.57 ± 6.91	-6.03 ± 14.81	-12.94 ± 16.80				
	M	10.60 ± 11.41	7.88 ± 12.66	-11.72 ± 16.70				
	p-value	**0.005**	0.240	0.666				
Peak Hip External Rotation	F + M	-21.72 ± 6.52	-25.91 ± 8.64	-27.87 ± 14.52	0.183			
	F	-21.37 ± 5.87	-30.79 ± 6.94	-28.10 ± 15.27				
	M	-22.08 ± 7.42	-20.41 ± 7.09	-27.63 ± 14.65				
	p-value	0.912	**0.004**	0.931				
Peak Hip Internal Rotation	F + M	-12.91 ± 8.05	-14.64 ± 12.54	-17.51 ± 14.22	0.486			
	F	-14.22 ± 6.04	-20.74 ± 10.39	-18.42 ± 15.24				
	M	-11.60 ± 9.82	-8.55 ± 11.94	-16.60 ± 13.99				
	p-value	0.482	**0.035**	0.795				

Table 4.25. BSRP Sagittal Plane Mom

Table 4.25. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.18 ± 0.28	-0.08 ± 0.12	-0.27 ± 0.35	0.354			
	F	-0.01 ± 0.02	-0.08 ± 0.15	-0.16 ± 0.27				
	M	-0.37 ± 0.32	-0.08 ± 0.09	-0.38 ± 0.41				
	p-value	**0.004**	0.776	0.321				
Peak Ankle Plantar-flexion	F + M	0.69 ± 0.55	0.79 ± 0.54	0.54 ± 0.52	0.328			
	F	1.14 ± 0.13	0.75 ± 0.45	0.58 ± 0.46				
	M	0.25 ± 0.42	0.85 ± 0.69	0.50 ± 0.61				
	p-value	**0.002**	0.529	0.673				
Peak Knee Flexion	F + M	-0.05 ± 0.13	-0.35 ± 0.32	-0.29 ± 0.31	**0.011**	**0.014**	0.082	1.000
	F	-0.13 ± 0.14	-0.40 ± 0.30	-0.35 ± 0.28				
	M	0.02 ± 0.06	-0.28 ± 0.37	-0.21 ± 0.35				
	p-value	**0.006**	0.529	0.370				
Peak Knee Extension	F + M	1.02 ± 0.97	0.46 ± 0.46	0.61 ± 0.56	0.192			
	F	0.26 ± 0.18	0.32 ± 0.36	0.39 ± 0.42				
	M	1.78 ± 0.83	0.66 ± 0.56	0.85 ± 0.62				
	p-value	**0.001**	0.388	0.200				
Peak Hip Flexion	F + M	-1.29 ± 1.17	-0.84 ± 0.62	-0.92 ± 0.62	0.651			
	F	-0.31 ± 0.13	-0.77 ± 0.58	-0.81 ± 0.56				
	M	-2.27 ± 0.86	-0.95 ± 0.71	-1.05 ± 0.71				
	p-value	**<0.001**	0.607	0.541				
Peak Hip Extension	F + M	0.10 ± 0.13	0.20 ± 0.24	0.15 ± 0.23	0.322			
	F	0.17 ± 0.12	0.23 ± 0.20	0.18 ± 0.21				
	M	0.02 ± 0.10	0.16 ± 0.32	0.12 ± 0.26				
	p-value	**0.011**	0.328	0.423				

Table 4.26. BSRP Frontal Plane Mom

Table 4.26. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.48 ± 0.65	-0.75 ± 0.82	-0.63 ± 0.64	0.503			
	F	-0.03 ± 0.02	-0.80 ± 0.87	-0.58 ± 0.60				
	M	-0.94 ± 0.66	-0.68 ± 0.82	-0.68 ± 0.71				
	p-value	**<0.001**	0.864	0.606				
Peak Ankle Eversion	F + M	0.12 ± 0.19	0.05 ± 0.10	0.16 ± 0.24	0.609			
	F	0.11 ± 0.05	0.05 ± 0.11	0.11 ± 0.18				
	M	0.13 ± 0.28	0.04 ± 0.09	0.23 ± 0.29				
	p-value	0.093	1.000	0.606				
Peak Knee Adduction	F + M	-0.70 ± 0.80	-1.01 ± 0.96	-1.08 ± 0.72	0.224			
	F	-0.09 ± 0.03	-1.08 ± 0.99	-0.96 ± 0.72				
	M	-1.31 ± 0.72	-0.90 ± 0.99	-1.23 ± 0.73				
	p-value	**0.003**	0.529	0.606				
Peak Knee Abduction	F + M	0.42 ± 0.39	0.23 ± 0.28	0.40 ± 0.37	0.201			
	F	0.42 ± 0.17	0.24 ± 0.33	0.37 ± 0.39				
	M	0.42 ± 0.54	0.21 ± 0.18	0.44 ± 0.38				
	p-value	0.387	1.000	0.606				
Peak Hip Adduction	F + M	-0.66 ± 0.77	-1.15 ± 1.10	-1.25 ± 0.92	0.096			
	F	-0.07 ± 0.04	-1.21 ± 1.10	-1.17 ± 0.97				
	M	-1.25 ± 0.71	-1.04 ± 1.19	-1.33 ± 0.92				
	p-value	**0.004**	0.776	0.815				
Peak Hip Abduction	F + M	0.72 ± 0.47	0.45 ± 0.39	0.69 ± 0.55	0.241			
	F	0.76 ± 0.25	0.45 ± 0.47	0.55 ± 0.52				
	M	0.68 ± 0.63	0.45 ± 0.28	0.84 ± 0.58				
	p-value	0.736	0.978	0.290				

Table 4.27. BSRP Transverse Plane Mom

Table 4.27. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.06 ± 0.07	-0.10 ± 0.10	-0.15 ± 0.08	**0.002**	0.498	**0.001**	0.137
	F	-0.05 ± 0.07	-0.11 ± 0.11	-0.16 ± 0.10				
	M	-0.08 ± 0.07	-0.10 ± 0.09	-0.14 ± 0.04				
	p-value	0.136	1.000	0.888				
Peak Ankle External Rotation	F + M	0.10 ± 0.07	0.12 ± 0.06	0.12 ± 0.07	0.292			
	F	0.08 ± 0.04	0.13 ± 0.04	0.09 ± 0.03				
	M	0.13 ± 0.09	0.11 ± 0.09	0.15 ± 0.08				
	p-value	0.173	0.566	0.055				
Peak Knee Internal Rotation	F + M	-0.13 ± 0.15	-0.25 ± 0.30	-0.23 ± 0.21	0.059			
	F	-0.01 ± 0.02	-0.26 ± 0.34	-0.21 ± 0.17				
	M	-0.24 ± 0.15	-0.23 ± 0.26	-0.26 ± 0.26				
	p-value	**0.006**	1.000	0.673				
Peak Knee External Rotation	F + M	0.09 ± 0.07	0.08 ± 0.08	0.08 ± 0.09	0.963			
	F	0.11 ± 0.05	0.08 ± 0.07	0.05 ± 0.05				
	M	0.06 ± 0.08	0.09 ± 0.11	0.12 ± 0.11				
	p-value	0.222	0.864	0.236				
Peak Hip Internal Rotation	F + M	-0.07 ± 0.08	-0.07 ± 0.06	-0.09 ± 0.06	0.400			
	F	-0.04 ± 0.04	-0.07 ± 0.06	-0.09 ± 0.08				
	M	-0.10 ± 0.10	-0.07 ± 0.07	-0.09 ± 0.03				
	p-value	0.161	0.776	0.743				
Peak Hip External Rotation	F + M	0.11 ± 0.09	0.14 ± 0.14	0.16 ± 0.12	0.337			
	F	0.04 ± 0.03	0.15 ± 0.16	0.11 ± 0.09				
	M	0.17 ± 0.09	0.13 ± 0.10	0.22 ± 0.12				
	p-value	**0.004**	1.000	0.059				

Table 4.28. BSRP Sagittal Plane Angle

Table 4.28. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	6.35 ± 3.47	3.54 ± 7.43	0.71 ± 6.05	**0.021**	0.425	**0.017**	0.429
	F	6.09 ± 3.02	0.26 ± 7.01	-0.34 ± 5.36				
	M	6.60 ± 4.04	8.46 ± 5.26	1.89 ± 6.92				
	p-value	0.931	**0.026**	0.277				
Peak Ankle Dorsiflex-ion	F + M	21.34 ± 4.89	19.54 ± 6.74	20.67 ± 6.54	0.457			
	F	22.48 ± 5.13	19.43 ± 8.40	17.62 ± 4.53				
	M	20.20 ± 4.66	19.72 ± 3.78	24.09 ± 7.01				
	p-value	0.387	0.388	**0.036**				
Peak Knee Extension	F + M	7.21 ± 7.74	8.79 ± 9.28	7.53 ± 7.60	0.363			
	F	10.77 ± 9.28	14.24 ± 5.48	8.43 ± 10.17				
	M	3.64 ± 3.54	0.62 ± 7.72	6.51 ± 3.41				
	p-value	0.113	**<0.001**	0.370				
Peak Knee Flexion	F + M	15.21 ± 7.85	18.31 ± 8.47	21.36 ± 8.10	0.074			
	F	19.47 ± 8.57	23.68 ± 4.62	21.49 ± 9.01				
	M	10.95 ± 4.08	10.24 ± 6.04	21.21 ± 7.55				
	p-value	**0.016**	**<0.001**	0.946				
Peak Hip Extension	F + M	5.79 ± 5.01	5.01 ± 7.22	1.44 ± 6.54	0.106			
	F	4.95 ± 4.74	3.13 ± 5.65	-1.64 ± 5.76				
	M	6.63 ± 5.41	7.83 ± 8.88	4.90 ± 5.81				
	p-value	0.493	0.230	**0.034**				
Peak Hip Flexion	F + M	24.89 ± 8.00	41.74 ± 10.66	43.42 ± 15.33	**<0.001**	**0.001**	**<0.001**	1.000
	F	25.99 ± 8.45	41.82 ± 10.66	39.46 ± 9.83				
	M	23.78 ± 7.86	41.62 ± 12.42	47.88 ± 19.60				
	p-value	0.573	0.974	0.272				

Table 4.29. BSRP Frontal Plane Angle

Table 4.29. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-2.85 ± 2.78	-1.70 ± 2.25	-3.92 ± 2.90	0.183			
	F	-3.98 ± 2.89	-2.99 ± 1.35	-3.17 ± 1.87				
	M	-1.71 ± 2.26	0.04 ± 2.09	-4.67 ± 3.65				
	p-value	0.077	**0.005**	0.574				
Peak Ankle Inversion	F + M	-0.72 ± 2.61	0.44 ± 2.45	-1.73 ± 2.75	0.081			
	F	-1.86 ± 2.37	-0.61 ± 2.19	-1.89 ± 2.04				
	M	0.40 ± 2.46	1.84 ± 2.18	-1.55 ± 3.53				
	p-value	0.065	0.060	0.808				
Peak Knee Abduction	F + M	-4.86 ± 3.95	-10.00 ± 7.38	-16.57 ± 7.76	**<0.001**	0.083	**<0.001**	**0.019**
	F	-7.29 ± 2.97	-10.59 ± 7.31	-15.14 ± 6.96				
	M	-2.44 ± 3.33	-9.13 ± 8.09	-18.19 ± 8.76				
	p-value	**0.006**	0.776	0.541				
Peak Knee Adduction	F + M	1.14 ± 3.69	3.87 ± 5.01	6.78 ± 4.69	**0.002**	0.235	**0.002**	0.198
	F	-0.36 ± 3.77	4.06 ± 6.37	6.25 ± 4.90				
	M	2.64 ± 3.11	3.58 ± 2.30	7.38 ± 4.70				
	p-value	0.084	0.863	0.635				
Peak Hip Abduction	F + M	-1.32 ± 4.93	-0.69 ± 4.11	-5.86 ± 6.85	**0.019**	0.984	0.053	**0.036**
	F	-3.08 ± 4.21	-1.38 ± 3.30	-6.19 ± 8.24				
	M	0.44 ± 5.20	0.22 ± 5.18	-5.50 ± 5.44				
	p-value	0.136	0.345	1.000				
Peak Hip Adduction	F + M	3.34 ± 5.06	6.69 ± 10.63	4.66 ± 4.87	0.451			
	F	2.06 ± 3.15	3.11 ± 8.52	4.79 ± 4.12				
	M	4.62 ± 6.39	12.07 ± 11.94	4.51 ± 5.90				
	p-value	0.730	0.328	0.963				

Table 4.30. BSRP Transverse Plane Angle

Table 4.30. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	3.11 ± 14.02	1.09 ± 20.41	8.35 ± 12.52	0.220			
	F	9.15 ± 10.70	8.65 ± 22.53	9.95 ± 10.01				
	M	-2.93 ± 14.87	-10.24 ± 9.89	6.54 ± 15.39				
	p-value	0.066	0.078	0.593				
Peak Ankle Internal Rotation	F + M	15.44 ± 12.85	15.69 ± 19.93	24.74 ± 13.28	0.070			
	F	20.73 ± 12.44	25.11 ± 18.66	24.47 ± 13.19				
	M	10.14 ± 11.53	1.55 ± 12.46	25.04 ± 14.29				
	p-value	0.050	**0.008**	0.963				
Peak Knee External Rotation	F + M	-6.69 ± 9.13	-12.01 ± 18.57	-26.12 ± 17.91	**0.002**	0.699	**0.002**	**0.040**
	F	-10.33 ± 7.01	-15.25 ± 16.82	-25.28 ± 15.41				
	M	-3.05 ± 9.91	-7.14 ± 21.58	-27.08 ± 21.45				
	p-value	0.161	0.328	0.815				
Peak Knee Internal Rotation	F + M	2.18 ± 10.98	-2.58 ± 16.79	-15.73 ± 17.28	**0.003**	0.750	**0.003**	0.053
	F	-3.13 ± 6.75	-7.78 ± 16.48	-15.19 ± 15.02				
	M	7.48 ± 12.14	5.23 ± 15.28	-16.34 ± 20.59				
	p-value	0.077	0.272	0.743				
Peak Hip External Rotation	F + M	-22.28 ± 7.24	-24.47 ± 12.35	-24.02 ± 12.36	0.823			
	F	-21.50 ± 5.86	-29.67 ± 8.15	-23.75 ± 11.68				
	M	-23.07 ± 8.69	-16.68 ± 14.13	-24.29 ± 13.82				
	p-value	0.660	**0.041**	0.933				
Peak Hip Internal Rotation	F + M	-12.91 ± 8.75	-13.96 ± 12.33	-17.10 ± 12.78	0.534			
	F	-13.76 ± 6.02	-19.53 ± 10.55	-17.77 ± 13.34				
	M	-12.07 ± 11.18	-5.62 ± 10.42	-16.35 ± 12.99				
	p-value	0.695	**0.026**	0.828				

Table 4.31. FSL Sagittal Plane Mom

Table 4.31. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.06 ± 0.05	-0.03 ± 0.03	-0.01 ± 0.01	**<0.001**	**0.018**	**<0.001**	0.852
	F	-0.05 ± 0.05	-0.03 ± 0.03	-0.01 ± 0.01				
	M	-0.07 ± 0.05	-0.02 ± 0.03	-0.01 ± 0.01				
	p-value	0.460	0.387	0.863				
Peak Ankle Plantar-flexion	F + M	0.84 ± 0.23	0.88 ± 0.19	0.89 ± 0.19	0.816			
	F	0.78 ± 0.20	0.84 ± 0.18	0.81 ± 0.17				
	M	0.90 ± 0.24	0.91 ± 0.21	0.97 ± 0.18				
	p-value	0.276	0.513	0.062				
Peak Knee Flexion	F + M	-0.26 ± 0.19	-0.28 ± 0.16	-0.32 ± 0.20	0.418			
	F	-0.16 ± 0.11	-0.27 ± 0.16	-0.20 ± 0.12				
	M	-0.35 ± 0.21	-0.28 ± 0.17	-0.44 ± 0.19				
	p-value	**0.010**	0.931	**0.006**				
Peak Knee Extension	F + M	0.18 ± 0.20	0.26 ± 0.27	0.24 ± 0.23	0.686			
	F	0.27 ± 0.24	0.26 ± 0.33	0.38 ± 0.23				
	M	0.10 ± 0.13	0.25 ± 0.20	0.10 ± 0.13				
	p-value	0.095	1.000	**0.006**				
Peak Hip Flexion	F + M	-0.10 ± 0.12	-0.20 ± 0.24	-0.36 ± 0.36	**0.039**	1.000	**0.035**	0.338
	F	-0.15 ± 0.13	-0.27 ± 0.22	-0.62 ± 0.33				
	M	-0.05 ± 0.09	-0.12 ± 0.24	-0.10 ± 0.15				
	p-value	0.065	0.094	**<0.001**				
Peak Hip Extension	F + M	0.39 ± 0.17	0.36 ± 0.14	0.43 ± 0.23	0.579			
	F	0.30 ± 0.13	0.29 ± 0.14	0.26 ± 0.16				
	M	0.47 ± 0.17	0.43 ± 0.10	0.59 ± 0.16				
	p-value	**0.022**	**0.028**	**<0.001**				

Table 4.32. FSL Frontal Plane Mom

Table 4.32. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.05 ± 0.05	-0.06 ± 0.05	-0.04 ± 0.05	0.422			
	F	-0.03 ± 0.05	-0.03 ± 0.03	-0.01 ± 0.02				
	M	-0.06 ± 0.06	-0.09 ± 0.06	-0.07 ± 0.05				
	p-value	0.497	0.063	**0.008**				
Peak Ankle Eversion	F + M	0.11 ± 0.07	0.11 ± 0.06	0.14 ± 0.07	0.296			
	F	0.12 ± 0.08	0.12 ± 0.05	0.17 ± 0.05				
	M	0.11 ± 0.06	0.11 ± 0.07	0.11 ± 0.07				
	p-value	0.686	0.635	**0.049**				
Peak Knee Adduction	F + M	-0.01 ± 0.03	-0.04 ± 0.06	-0.02 ± 0.07	0.200			
	F	-0.01 ± 0.04	-0.04 ± 0.06	-0.02 ± 0.09				
	M	-0.01 ± 0.03	-0.04 ± 0.07	-0.02 ± 0.05				
	p-value	0.497	0.730	0.605				
Peak Knee Abduction	F + M	0.42 ± 0.15	0.52 ± 0.16	0.54 ± 0.19	0.068			
	F	0.45 ± 0.12	0.49 ± 0.20	0.50 ± 0.17				
	M	0.39 ± 0.17	0.55 ± 0.11	0.58 ± 0.20				
	p-value	0.604	0.436	0.436				
Peak Hip Adduction	F + M	-0.03 ± 0.05	-0.04 ± 0.06	-0.07 ± 0.10	0.253			
	F	-0.02 ± 0.05	-0.02 ± 0.05	0.00 ± 0.05				
	M	-0.04 ± 0.05	-0.06 ± 0.06	-0.14 ± 0.09				
	p-value	0.576	0.083	**0.001**				
Peak Hip Abduction	F + M	0.73 ± 0.24	0.82 ± 0.17	0.78 ± 0.24	0.465			
	F	0.80 ± 0.17	0.83 ± 0.21	0.75 ± 0.26				
	M	0.66 ± 0.29	0.80 ± 0.14	0.82 ± 0.22				
	p-value	0.239	0.714	0.556				

Table 4.33. FSL Transverse Plane Mom

Table 4.33. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.01 ± 0.01	-0.01 ± 0.02	-0.02 ± 0.02	0.519			
	F	0.00 ± 0.01	-0.01 ± 0.02	-0.01 ± 0.02				
	M	-0.01 ± 0.01	-0.01 ± 0.01	-0.02 ± 0.02				
	p-value	1.000	0.387	0.546				
Peak Ankle External Rotation	F + M	0.11 ± 0.04	0.13 ± 0.04	0.13 ± 0.06	0.467			
	F	0.12 ± 0.03	0.12 ± 0.04	0.14 ± 0.06				
	M	0.10 ± 0.05	0.14 ± 0.05	0.13 ± 0.06				
	p-value	0.331	0.463	0.736				
Peak Knee Internal Rotation	F + M	0.00 ± 0.01	-0.01 ± 0.02	-0.01 ± 0.02	0.316			
	F	0.00 ± 0.01	-0.01 ± 0.02	-0.02 ± 0.03				
	M	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01				
	p-value	0.156	0.161	0.436				
Peak Knee External Rotation	F + M	0.10 ± 0.03	0.12 ± 0.03	0.13 ± 0.05	0.123			
	F	0.11 ± 0.02	0.12 ± 0.03	0.12 ± 0.04				
	M	0.09 ± 0.03	0.13 ± 0.03	0.13 ± 0.05				
	p-value	0.241	0.360	0.720				
Peak Hip Internal Rotation	F + M	-0.03 ± 0.04	-0.06 ± 0.04	-0.05 ± 0.02	**0.024**	**0.027**	0.149	1.000
	F	-0.04 ± 0.05	-0.05 ± 0.05	-0.04 ± 0.03				
	M	-0.02 ± 0.02	-0.06 ± 0.03	-0.05 ± 0.01				
	p-value	0.604	0.387	0.297				
Peak Hip External Rotation	F + M	0.06 ± 0.04	0.07 ± 0.05	0.10 ± 0.04	**0.015**	1.000	**0.031**	**0.039**
	F	0.05 ± 0.03	0.08 ± 0.06	0.10 ± 0.03				
	M	0.07 ± 0.04	0.05 ± 0.04	0.11 ± 0.04				
	p-value	0.264	0.304	0.520				

Table 4.34. FSL Sagittal Plane Angle

Table 4.34. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-12.48 ± 7.04	-14.11 ± 5.29	-17.43 ± 9.52	0.135			
	F	-15.90 ± 8.31	-14.44 ± 4.47	-22.34 ± 10.34				
	M	-9.41 ± 3.93	-13.77 ± 6.26	-12.51 ± 5.90				
	p-value	**0.041**	0.799	**0.023**				
Peak Ankle Dorsiflex-ion	F + M	5.14 ± 2.89	8.68 ± 4.22	6.56 ± 4.95	**0.038**	**0.033**	0.646	0.328
	F	6.93 ± 2.07	8.35 ± 4.40	7.64 ± 6.11				
	M	3.52 ± 2.62	9.01 ± 4.27	5.47 ± 3.47				
	p-value	**0.006**	0.750	0.369				
Peak Knee Extension	F + M	1.84 ± 5.32	4.45 ± 7.38	-0.57 ± 5.39	0.056			
	F	3.07 ± 4.92	1.97 ± 7.21	1.00 ± 5.62				
	M	0.73 ± 5.67	6.92 ± 7.08	02.13 ± 4.96				
	p-value	0.353	0.161	0.228				
Peak Knee Flexion	F + M	11.41 ± 7.76	19.17 ± 11.67	26.10 ± 12.50	**<0.001**	0.061	**<0.001**	0.379
	F	14.13 ± 9.12	19.05 ± 15.27	23.79 ± 12.34				
	M	8.97 ± 5.71	19.29 ± 7.51	28.42 ± 12.95				
	p-value	0.153	0.966	0.448				
Peak Hip Extension	F + M	17.16 ± 9.79	16.19 ± 9.33	17.72 ± 7.30	0.872			
	F	20.44 ± 8.70	20.19 ± 9.71	20.51 ± 6.94				
	M	14.20 ± 10.20	12.19 ± 7.40	14.94 ± 6.89				
	p-value	0.172	0.067	0.107				
Peak Hip Flexion	F + M	35.41 ± 8.62	44.37 ± 9.64	54.49 ± 10.14	**<0.001**	**0.017**	**<0.001**	**0.007**
	F	41.13 ± 6.37	49.68 ± 9.97	57.89 ± 10.35				
	M	30.26 ± 7.09	39.05 ± 5.87	51.09 ± 9.24				
	p-value	**0.003**	**0.014**	0.161				

Table 4.35. FSL Frontal Plane Angle

Table 4.35. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-2.09 ± 2.74	-2.31 ± 3.34	-2.90 ± 3.75	0.857			
	F	-2.59 ± 1.11	-3.08 ± 2.57	-4.96 ± 4.27				
	M	-1.64 ± 3.67	-1.54 ± 3.96	-1.07 ± 2.03				
	p-value	0.065	0.136	**0.027**				
Peak Ankle Inversion	F + M	-0.16 ± 1.80	0.57 ± 2.62	-0.05 ± 3.50	0.680			
	F	-0.83 ± 0.94	-0.04 ± 2.68	-2.27 ± 2.70				
	M	0.44 ± 2.20	1.18 ± 2.55	2.17 ± 2.76				
	p-value	0.127	0.336	**0.003**				
Peak Knee Abduction	F + M	-0.37 ± 3.65	0.96 ± 4.89	-2.59 ± 6.06	0.114			
	F	-0.99 ± 3.40	-1.28 ± 4.82	-6.59 ± 5.97				
	M	0.18 ± 3.95	3.19 ± 4.06	1.41 ± 2.51				
	p-value	0.604	0.050	**0.024**				
Peak Knee Adduction	F + M	2.97 ± 3.72	8.10 ± 8.51	8.66 ± 8.74	**0.040**	0.107	0.063	0.994
	F	1.79 ± 3.56	3.82 ± 6.08	2.44 ± 4.57				
	M	4.03 ± 3.72	12.39 ± 8.70	14.87 ± 7.37				
	p-value	0.197	**0.028**	**0.001**				
Peak Hip Abduction	F + M	-4.61 ± 5.35	-11.53 ± 10.68	-22.14 ± 8.57	**<0.001**	**0.047**	**<0.001**	**0.001**
	F	-4.69 ± 4.13	-13.83 ± 13.06	-22.99 ± 7.34				
	M	-4.53 ± 6.48	-9.22 ± 7.74	-21.29 ± 10.04				
	p-value	0.780	0.605	0.863				
Peak Hip Adduction	F + M	0.16 ± 5.43	4.44 ± 4.48	4.58 ± 9.61	0.092			
	F	0.64 ± 4.23	4.78 ± 5.47	6.44 ± 8.52				
	M	-0.26 ± 6.64	4.09 ± 3.53	2.72 ± 10.77				
	p-value	0.730	0.754	0.428				

Table 4.36. FSL Transverse Plane Angle

Table 4.36. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-0.19 ± 12.97	-6.15 ± 17.58	-2.65 ± 18.97	0.394			
	F	5.12 ± 6.11	-0.87 ± 18.09	9.42 ± 13.18				
	M	-4.96 ± 15.80	-11.43 ± 16.32	-14.73 ± 16.21				
	p-value	0.091	0.212	**0.003**				
Peak Ankle Internal Rotation	F + M	11.50 ± 15.83	12.27 ± 17.23	17.24 ± 19.55	0.783			
	F	17.08 ± 7.76	18.04 ± 15.84	28.83 ± 18.61				
	M	6.49 ± 19.71	6.49 ± 17.47	5.64 ± 12.80				
	p-value	0.150	0.161	**0.007**				
Peak Knee External Rotation	F + M	-25.04 ± 11.35	-23.74 ± 11.47	-25.58 ± 11.07	0.881			
	F	-22.52 ± 8.24	-29.36 ± 11.73	-27.36 ± 13.55				
	M	-27.32 ± 13.61	-18.12 ± 8.41	-23.81 ± 8.35				
	p-value	0.372	**0.033**	0.513				
Peak Knee Internal Rotation	F + M	-16.02 ± 9.62	-12.25 ± 11.24	-11.67 ± 11.81	0.365			
	F	-13.33 ± 8.36	-17.72 ± 12.52	-13.62 ± 14.60				
	M	-18.43 ± 10.45	-6.78 ± 6.65	-9.72 ± 8.65				
	p-value	0.260	**0.034**	0.499				
Peak Hip External Rotation	F + M	3.44 ± 12.43	-3.73 ± 19.69	-23.53 ± 25.65	**<0.001**	0.619	**<0.001**	**0.013**
	F	-4.21 ± 10.02	-10.07 ± 21.28	-39.45 ± 22.29				
	M	10.32 ± 10.42	2.61 ± 16.76	-7.61 ± 18.19				
	p-value	**0.010**	0.190	**0.008**				
Peak Hip Internal Rotation	F + M	10.48 ± 10.23	9.79 ± 19.71	-7.55 ± 24.58	**0.008**	0.999	**0.017**	**0.025**
	F	4.25 ± 8.11	4.35 ± 17.03	-21.54 ± 21.18				
	M	16.09 ± 8.79	15.23 ± 21.67	6.43 ± 19.88				
	p-value	**0.007**	0.253	**0.011**				

Table 4.37. FSLP Sagittal Plane Angle

Table 4.37. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the FSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-12.84 ± 7.34	-14.81 ± 6.42	-19.85 ± 11.37	**0.045**	0.860	**0.045**	0.232
	F	-14.53 ± 8.45	-14.86 ± 7.61	-24.96 ± 13.39				
	M	-11.16 ± 6.02	-14.77 ± 5.46	-14.73 ± 6.04				
	p-value	0.436	0.796	0.258				
Peak Ankle Dorsiflex-ion	F + M	4.57 ± 3.39	7.40 ± 3.82	4.89 ± 5.65	0.107			
	F	5.94 ± 2.58	6.72 ± 4.53	6.27 ± 7.15				
	M	3.21 ± 3.67	8.09 ± 3.06	3.50 ± 3.52				
	p-value	0.071	0.463	0.312				
Peak Knee Extension	F + M	1.52 ± 5.10	3.14 ± 7.64	-0.21 ± 5.21	0.263			
	F	2.17 ± 3.84	0.85 ± 8.52	0.74 ± 5.82				
	M	0.88 ± 6.26	5.43 ± 6.30	-1.15 ± 4.67				
	p-value	0.584	0.213	0.458				
Peak Knee Flexion	F + M	10.92 ± 7.64	17.19 ± 8.71	19.88 ± 11.80	**0.016**	0.132	**0.016**	0.779
	F	11.90 ± 8.40	17.94 ± 11.84	17.83 ± 11.76				
	M	9.94 ± 7.09	16.45 ± 4.43	21.93 ± 12.18				
	p-value	0.579	0.727	0.479				
Peak Hip Extension	F + M	14.50 ± 9.33	14.28 ± 10.54	19.60 ± 5.97	0.130			
	F	17.29 ± 10.12	19.16 ± 11.09	21.30 ± 6.27				
	M	11.72 ± 8.00	9.40 ± 7.71	17.90 ± 5.47				
	p-value	0.189	**0.046**	0.239				
Peak Hip Flexion	F + M	35.58 ± 8.91	40.02 ± 10.19	51.66 ± 10.25	**<0.001**	0.419	**<0.001**	**0.002**
	F	41.08 ± 7.02	46.46 ± 10.51	55.05 ± 11.42				
	M	30.07 ± 7.12	33.57 ± 4.09	48.27 ± 8.18				
	p-value	**0.003**	**0.003**	0.167				

Table 4.38. FSLP Frontal Plane Angle

Table 4.38. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the FSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-2.09 ± 2.43	-1.99 ± 3.07	-3.30 ± 4.39	0.431			
	F	-2.56 ± 1.30	-2.42 ± 2.64	-5.77 ± 4.60				
	M	-1.63 ± 3.22	-1.56 ± 3.55	-0.83 ± 2.45				
	p-value	0.190	0.190	**0.011**				
Peak Ankle Inversion	F + M	-0.02 ± 1.56	0.29 ± 2.47	-0.46 ± 3.30	0.670			
	F	-0.64 ± 1.03	-0.27 ± 2.69	-2.45 ± 2.78				
	M	0.61 ± 1.79	0.85 ± 2.24	1.53 ± 2.55				
	p-value	0.073	0.352	**0.006**				
Peak Knee Abduction	F + M	-0.71 ± 3.18	0.96 ± 4.31	-0.78 ± 4.42	0.184			
	F	-1.15 ± 3.23	-0.44 ± 4.85	-3.85 ± 4.54				
	M	-0.27 ± 3.24	2.36 ± 3.41	1.95 ± 1.82				
	p-value	0.853	0.546	**0.015**				
Peak Knee Adduction	F + M	3.40 ± 3.23	6.81 ± 6.40	7.08 ± 6.97	0.092			
	F	2.58 ± 3.46	4.28 ± 6.01	3.46 ± 4.43				
	M	4.22 ± 2.94	9.34 ± 6.04	10.71 ± 7.36				
	p-value	0.481	0.113	**0.031**				
Peak Hip Abduction	F + M	-4.62 ± 4.94	-9.33 ± 11.00	-20.87 ± 9.58	**<0.001**	0.710	**<0.001**	**0.002**
	F	-5.38 ± 4.41	-13.98 ± 13.61	-23.85 ± 9.27				
	M	-3.85 ± 5.55	-4.67 ± 4.79	-17.89 ± 9.45				
	p-value	0.579	0.190	0.222				
Peak Hip Adduction	F + M	1.52 ± 4.60	5.69 ± 4.19	4.77 ± 9.48	0.122			
	F	1.63 ± 3.53	5.94 ± 4.78	6.70 ± 9.01				
	M	1.41 ± 5.67	5.43 ± 3.78	2.85 ± 10.08				
	p-value	0.918	0.802	0.406				

Table 4.39. FSLP Transverse Plane Angle

Table 4.39. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the FSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-0.87 ± 11.64	-4.52 ± 16.88	-0.08 ± 17.86	0.574			
	F	3.64 ± 6.56	0.42 ± 18.15	10.67 ± 13.97				
	M	-5.39 ± 14.07	-9.47 ± 14.88	-10.83 ± 14.93				
	p-value	0.082	0.224	**0.006**				
Peak Ankle Internal Rotation	F + M	12.04 ± 14.70	10.67 ± 16.81	15.44 ± 19.76	0.691			
	F	16.63 ± 9.38	14.25 ± 17.21	27.49 ± 15.80				
	M	7.46 ± 17.93	7.09 ± 16.59	3.40 ± 15.93				
	p-value	0.169	0.382	**0.005**				
Peak Knee External Rotation	F + M	-23.59 ± 10.82	-23.17 ± 10.19	-23.94 ± 10.52	0.996			
	F	-20.60 ± 8.47	-29.12 ± 8.79	-26.36 ± 13.06				
	M	-26.58 ± 12.48	-17.21 ± 7.97	-21.51 ± 7.17				
	p-value	0.226	**0.008**	0.343				
Peak Knee Internal Rotation	F + M	-14.50 ± 10.18	-12.13 ± 10.71	-14.37 ± 10.89	0.774			
	F	-11.21 ± 9.65	-20.02 ± 8.50	-16.83 ± 13.72				
	M	-17.79 ± 10.07	-4.24 ± 5.62	-11.92 ± 7.08				
	p-value	0.153	**<0.001**	0.354				
Peak Hip External Rotation	F + M	1.51 ± 13.98	-5.33 ± 18.11	-21.88 ± 27.18	**0.003**	0.659	**0.002**	0.052
	F	-7.50 ± 10.98	-11.47 ± 16.92	-38.62 ± 22.52				
	M	10.52 ± 10.57	0.81 ± 18.04	-5.13 ± 20.79				
	p-value	**0.005**	0.113	**0.011**				
Peak Hip Internal Rotation	F + M	10.61 ± 12.14	6.99 ± 19.27	-9.31 ± 24.67	**0.006**	0.915	**0.041**	**0.040**
	F	2.17 ± 8.41	0.37 ± 15.52	-23.60 ± 21.53				
	M	19.04 ± 9.06	13.60 ± 21.22	4.97 ± 19.25				
	p-value	**<0.001**	0.151	**0.009**				

Table 4.40. RSBR Sagittal Plane Mom

Table 4.40. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (R)	F + M	-0.20 ± 0.39	-0.14 ± 0.21	-0.05 ± 0.13	0.314			
	F	-0.01 ± 0.03	-0.16 ± 0.24	-0.02 ± 0.06				
	M	-0.40 ± 0.49	-0.12 ± 0.18	-0.07 ± 0.17				
	p-value	0.489	0.863	**0.002**				
Peak Ankle Plantarflexion 1 (R)	F + M	0.74 ± 0.65	0.92 ± 0.67	1.30 ± 0.72	0.099			
	F	1.17 ± 0.24	0.85 ± 0.66	1.28 ± 0.56				
	M	0.31 ± 0.65	0.98 ± 0.72	1.33 ± 0.89				
	p-value	0.796	0.546	**0.011**				
Peak Ankle Dorsiflexion 2 (L)	F + M	-0.05 ± 0.05	-0.01 ± 0.02	-0.01 ± 0.03	**0.012**	**0.021**	0.054	1.000
	F	-0.05 ± 0.06	-0.01 ± 0.02	-0.02 ± 0.04				
	M	-0.05 ± 0.03	-0.02 ± 0.02	-0.01 ± 0.00				
	p-value	0.258	**0.019**	0.529				
Peak Ankle Plantarflexion 2 (L)	F + M	0.76 ± 0.26	0.88 ± 0.24	0.76 ± 0.20	0.215			
	F	0.76 ± 0.21	0.80 ± 0.23	0.66 ± 0.18				
	M	0.77 ± 0.31	0.96 ± 0.22	0.86 ± 0.18				
	p-value	0.935	0.152	**0.027**				
Peak Knee Flexion 1 (R)	F + M	-0.10 ± 0.16	-0.38 ± 0.49	-0.72 ± 0.53	**<0.001**	0.121	**<0.001**	0.087
	F	-0.18 ± 0.15	-0.50 ± 0.64	-0.82 ± 0.63				
	M	-0.02 ± 0.12	-0.26 ± 0.27	-0.62 ± 0.41				
	p-value	0.541	0.796	**0.002**				
Peak Knee Extension 1 (R)	F + M	0.89 ± 0.71	0.44 ± 0.49	0.33 ± 0.33	**0.014**	0.099	**0.018**	1.000
	F	0.40 ± 0.20	0.43 ± 0.47	0.28 ± 0.26				
	M	1.39 ± 0.69	0.44 ± 0.56	0.39 ± 0.39				
	p-value	0.796	0.918	**0.011**				
Peak Knee Flexion 2 (L)	F + M	-0.25 ± 0.23	-0.23 ± 0.20	-0.22 ± 0.17	0.993			
	F	-0.19 ± 0.20	-0.23 ± 0.19	-0.13 ± 0.09				
	M	-0.30 ± 0.26	-0.24 ± 0.22	-0.32 ± 0.18				
	p-value	**0.011**	1.000	0.280				
Peak Knee Extension 2 (L)	F + M	0.20 ± 0.18	0.28 ± 0.26	0.31 ± 0.24	0.330			
	F	0.26 ± 0.18	0.37 ± 0.33	0.42 ± 0.28				
	M	0.14 ± 0.16	0.19 ± 0.14	0.19 ± 0.13				
	p-value	**0.024**	0.340	0.143				

Peak Hip Flexion 1 (R)	F + M	-1.34 ± 1.34	-1.11 ± 1.25	-0.80 ± 0.61	0.789			
	F	-0.37 ± 0.17	-1.07 ± 1.14	-0.72 ± 0.52				
	M	-2.32 ± 1.28	-1.14 ± 1.43	-0.88 ± 0.72				
	p-value	0.796	0.436	**0.003**				
Peak Hip Extension 1 (R)	F + M	0.15 ± 0.18	0.11 ± 0.20	0.28 ± 0.21	0.061			
	F	0.23 ± 0.17	0.12 ± 0.21	0.29 ± 0.19				
	M	0.07 ± 0.15	0.10 ± 0.20	0.27 ± 0.23				
	p-value	**0.044**	0.843	0.852				
Peak Hip Flexion 2 (L)	F + M	-0.18 ± 0.09	-0.24 ± 0.17	-0.40 ± 0.24	**0.003**	1.000	**0.003**	0.059
	F	-0.23 ± 0.09	-0.31 ± 0.17	-0.55 ± 0.25				
	M	-0.14 ± 0.06	-0.18 ± 0.16	-0.26 ± 0.12				
	p-value	**0.006**	0.063	**0.029**				
Peak Hip Extension 2 (L)	F + M	0.40 ± 0.23	0.36 ± 0.23	0.34 ± 0.19	0.637			
	F	0.31 ± 0.21	0.29 ± 0.22	0.21 ± 0.14				
	M	0.49 ± 0.23	0.43 ± 0.24	0.46 ± 0.15				
	p-value	**0.002**	0.258	0.105				

Table 4.41. RSBR Frontal Plane Mom

Table 4.41. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (R)	F + M	-0.41 ± 0.54	-0.75 ± 0.86	-0.97 ± 0.74	0.174			
	F	-0.03 ± 0.03	-1.00 ± 0.97	-0.82 ± 0.82				
	M	-0.78 ± 0.56	-0.51 ± 0.72	-1.11 ± 0.67				
	p-value	**<0.001**	0.436	0.546				
Peak Ankle Eversion 1 (R)	F + M	0.13 ± 0.16	0.06 ± 0.09	0.06 ± 0.09	0.268			
	F	0.13 ± 0.07	0.03 ± 0.10	0.08 ± 0.10				
	M	0.14 ± 0.23	0.08 ± 0.07	0.05 ± 0.08				
	p-value	0.400	0.161	0.481				
Peak Ankle Inversion 2 (L)	F + M	-0.03 ± 0.05	-0.05 ± 0.06	-0.04 ± 0.03	0.556			
	F	-0.02 ± 0.03	-0.04 ± 0.06	-0.02 ± 0.02				
	M	-0.05 ± 0.06	-0.06 ± 0.06	-0.06 ± 0.02				
	p-value	0.436	0.436	**<0.001**				
Peak Ankle Eversion 2 (L)	F + M	0.11 ± 0.06	0.13 ± 0.08	0.12 ± 0.06	0.643			
	F	0.12 ± 0.07	0.14 ± 0.07	0.16 ± 0.06				
	M	0.10 ± 0.05	0.12 ± 0.09	0.09 ± 0.05				
	p-value	0.394	0.628	**0.015**				
Peak Knee Adduction 1 (R)	F + M	-0.80 ± 0.99	-1.12 ± 1.28	-1.44 ± 0.98	0.098			
	F	-0.08 ± 0.05	-1.43 ± 1.35	-1.20 ± 0.98				
	M	-1.52 ± 0.95	-0.81 ± 1.20	-1.67 ± 0.98				
	p-value	**0.009**	0.161	0.546				
Peak Knee Abduction 1 (R)	F + M	0.26 ± 0.22	0.25 ± 0.26	0.29 ± 0.46	0.715			
	F	0.41 ± 0.16	0.20 ± 0.30	0.38 ± 0.57				
	M	0.11 ± 0.17	0.29 ± 0.21	0.19 ± 0.34				
	p-value	**0.001**	0.297	0.546				
Peak Knee Adduction 2 (L)	F + M	-0.01 ± 0.03	-0.04 ± 0.04	-0.05 ± 0.05	**0.002**	**0.012**	**0.004**	1.000
	F	-1.01 ± 0.02	-0.04 ± 0.05	-0.04 ± 0.05				
	M	-0.01 ± 0.04	-0.04 ± 0.04	-0.05 ± 0.05				
	p-value	0.796	0.605	0.481				
Peak Knee Abduction 2 (L)	F + M	0.42 ± 0.14	0.50 ± 0.19	0.51 ± 0.16	0.189			
	F	0.45 ± 0.12	0.45 ± 0.25	0.47 ± 0.18				
	M	0.38 ± 0.15	0.54 ± 0.11	0.55 ± 0.14				
	p-value	0.277	0.358	0.316				

Peak Hip Adduction 1 (R)	F + M	-0.79 ± 1.01	-1.27 ± 1.49	-2.04 ± 1.35	**0.003**	0.795	**0.002**	0.089
	F	-0.06 ± 0.06	-1.53 ± 1.47	-1.85 ± 1.43				
	M	-1.52 ± 0.98	-1.00 ± 1.55	-2.23 ± 1.32				
	p-value	**0.005**	0.222	0.931				
Peak Hip Abduction 1 (R)	F + M	0.54 ± 0.36	0.48 ± 0.42	0.38 ± 0.57	0.205			
	F	0.80 ± 0.19	0.45 ± 0.53	0.39 ± 0.54				
	M	0.29 ± 0.30	0.52 ± 0.30	0.36 ± 0.63				
	p-value	**0.002**	0.546	0.730				
Peak Hip Adduction 2 (L)	F + M	-0.01 ± 0.06	-0.04 ± 0.05	-0.10 ± 0.08	**<0.001**	0.570	**<0.001**	**0.015**
	F	-0.01 ± 0.06	-0.03 ± 0.06	-0.07 ± 0.05				
	M	-0.02 ± 0.07	-0.05 ± 0.04	-0.12 ± 0.09				
	p-value	0.883	0.363	0.165				
Peak Hip Abduction 2 (L)	F + M	0.71 ± 0.23	0.85 ± 0.17	0.81 ± 0.21	0.093			
	F	0.76 ± 0.17	0.91 ± 0.20	0.80 ± 0.27				
	M	0.65 ± 0.28	0.79 ± 0.11	0.83 ± 0.16				
	p-value	0.321	0.130	0.806				

Table 4.42. RSBR Transverse Plane Mom

Table 4.42. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (R)	F + M	-0.07 ± 0.06	-0.17 ± 0.20	-0.35 ± 0.25	**<0.001**	0.713	**<0.001**	**0.035**
	F	-0.05 ± 0.05	-0.22 ± 0.21	-0.37 ± 0.31				
	M	-0.09 ± 0.07	-0.13 ± 0.19	-0.33 ± 0.20				
	p-value	0.315	0.297	0.796				
Peak Ankle External Rotation 1 (R)	F + M	0.14 ± 0.13	0.13 ± 0.08	0.07 ± 0.10	0.051			
	F	0.09 ± 0.07	0.16 ± 0.08	0.07 ± 0.08				
	M	0.19 ± 0.17	0.09 ± 0.06	0.07 ± 0.12				
	p-value	0.280	0.161	0.796				
Peak Ankle Internal Rotation 2 (L)	F + M	0.00 ± 0.01	-0.01 ± 0.01	-0.02 ± 0.02	**0.017**	0.507	**0.013**	0.448
	F	0.00 ± 0.01	-0.01 ± 0.02	-0.02 ± 0.02				
	M	0.00 ± 0.01	-0.01 ± 0.01	-0.03 ± 0.02				
	p-value	0.631	0.605	0.222				
Peak Ankle External Rotation 2 (L)	F + M	0.11 ± 0.04	0.13 ± 0.05	0.14 ± 0.06	0.104			
	F	0.12 ± 0.03	0.12 ± 0.04	0.14 ± 0.06				
	M	0.09 ± 0.05	0.15 ± 0.05	0.14 ± 0.05				
	p-value	0.108	0.157	0.844				
Peak Knee Internal Rotation 1 (R)	F + M	-0.09 ± 0.12	-0.30 ± 0.36	-0.50 ± 0.34	**<0.001**	0.503	**0.001**	0.066
	F	-0.02 ± 0.02	-0.36 ± 0.35	-0.43 ± 0.37				
	M	-0.17 ± 0.13	-0.23 ± 0.37	-0.56 ± 0.32				
	p-value	**0.009**	0.297	0.546				
Peak Knee External Rotation 1 (R)	F + M	0.10 ± 0.06	0.06 ± 0.08	0.05 ± 0.08	0.089			
	F	0.11 ± 0.05	0.04 ± 0.09	0.04 ± 0.08				
	M	0.09 ± 0.07	0.09 ± 0.06	0.06 ± 0.09				
	p-value	0.739	0.190	0.436				
Peak Knee Internal Rotation 2 (L)	F + M	0.00 ± 0.01	0.00 ± 0.01	-0.01 ± 0.01	0.079			
	F	0.00 ± 0.01	0.00 ± 0.01	-0.01 ± 0.02				
	M	0.00 ± 0.01	0.00 ± 0.01	-0.01 ± 0.01				
	p-value	0.393	0.673	1.000				
Peak Knee External Rotation 2 (L)	F + M	0.10 ± 0.03	0.13 ± 0.04	0.13 ± 0.04	**0.017**	**0.018**	0.121	0.835
	F	0.11 ± 0.03	0.12 ± 0.04	0.12 ± 0.04				
	M	0.09 ± 0.04	0.15 ± 0.03	0.14 ± 0.04				
	p-value	0.329	0.262	0.343				

Peak Hip Internal Rotation 1 (R)	F + M	-0.05 ± 0.04	-0.07 ± 0.08	-0.17 ± 0.11	**<0.001**	1.000	**<0.001**	**0.004**
	F	-0.05 ± 0.04	-0.11 ± 0.10	-0.17 ± 0.12				
	M	-0.04 ± 0.03	-0.04 ± 0.02	-0.17 ± 0.09				
	p-value	1.000	0.077	0.931				
Peak Hip External Rotation 1 (R)	F + M	0.11 ± 0.12	0.18 ± 0.16	0.14 ± 0.14	0.287			
	F	0.04 ± 0.03	0.19 ± 0.16	0.08 ± 0.10				
	M	0.17 ± 0.14	0.17 ± 0.17	0.20 ± 0.15				
	p-value	**0.005**	0.730	**0.019**				
Peak Hip Internal Rotation 2 (L)	F + M	-0.04 ± 0.04	-0.07 ± 0.05	-0.05 ± 0.04	0.081			
	F	-0.04 ± 0.04	-0.07 ± 0.06	-0.05 ± 0.05				
	M	-0.03 ± 0.04	-0.07 ± 0.04	-0.05 ± 0.03				
	p-value	0.796	0.436	0.436				
Peak Hip External Rotation 2 (L)	F + M	0.06 ± 0.05	0.06 ± 0.05	0.10 ± 0.05	**0.027**	1.000	**0.036**	0.104
	F	0.05 ± 0.04	0.07 ± 0.06	0.08 ± 0.03				
	M	0.07 ± 0.05	0.06 ± 0.04	0.11 ± 0.05				
	p-value	0.528	0.535	0.171				

Table 4.43. RSBR Sagittal Plane Angle

Table 4.43. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (R)	F + M	0.19 ± 0.98	-0.38 ± 15.03	-16.13 ± 14.75	**<0.001**	0.097	**0.001**	0.361
	F	-0.51 ± 12.27	-18.02 ± 16.81	-23.92 ± 15.77				
	M	0.89 ± 6.49	-0.74 ± 5.45	-8.35 ± 8.80				
	p-value	0.755	**0.010**	**0.020**				
Peak Ankle Dorsiflex-ion 1 (R)	F + M	20.62 ± 5.70	21.72 ± 6.48	23.28 ± 6.17	0.412			
	F	20.64 ± 7.55	21.32 ± 7.42	21.92 ± 4.52				
	M	20.61 ± 3.43	22.10 ± 5.82	24.64 ± 7.51				
	p-value	0.991	0.806	0.366				
Peak Ankle Plantar-flexion 2 (L)	F + M	-11.03 ± 6.05	-9.32 ± 5.86	-15.27 ± 9.79	0.054			
	F	-14.15 ± 6.80	-10.04 ± 6.16	-16.98 ± 10.28				
	M	-7.90 ± 3.07	-8.60 ± 5.81	-13.56 ± 9.58				
	p-value	**0.016**	0.618	0.476				
Peak Ankle Dorsiflex-ion 2 (L)	F + M	4.27 ± 3.17	9.35 ± 3.76	7.01 ± 3.85	**<0.001**	**<0.001**	0.065	0.156
	F	5.29 ± 2.95	9.80 ± 3.48	7.09 ± 4.84				
	M	3.25 ± 3.19	8.91 ± 4.18	6.94 ± 2.83				
	p-value	0.156	0.631	0.935				
Peak Knee Extension 1 (R)	F + M	3.03 ± 8.13	2.98 ± 8.65	4.12 ± 6.91	0.886			
	F	7.91 ± 8.04	9.48 ± 5.94	5.90 ± 8.12				
	M	-1.84 ± 4.68	-3.52 ± 5.36	2.35 ± 5.33				
	p-value	**0.004**	**<0.001**	0.289				
Peak Knee Flexion 1 (R)	F + M	11.47 ± 8.74	14.24 ± 10.14	19.22 ± 7.89	**0.034**	0.716	**0.030**	0.272
	F	17.05 ± 8.20	22.33 ± 6.20	19.16 ± 9.60				
	M	5.89 ± 4.98	6.15 ± 5.71	19.27 ± 6.34				
	p-value	**0.002**	**<0.001**	0.977				
Peak Knee Extension 2 (L)	F + M	3.02 ± 5.60	5.43 ± 7.22	1.12 ± 5.17	0.111			
	F	4.75 ± 4.68	4.93 ± 8.96	2.87 ± 5.66				
	M	1.29 ± 6.14	5.92 ± 5.46	-0.62 ± 4.23				
	p-value	0.174	0.781	0.158				
Peak Knee Flexion 2 (L)	F + M	10.98 ± 7.86	23.21 ± 13.54	34.39 ± 16.20	**<0.001**	**0.015**	**<0.001**	**0.035**
	F	12.78 ± 8.77	27.38 ± 17.94	34.64 ± 16.71				
	M	9.18 ± 6.80	19.04 ± 5.33	34.14 ± 16.68				
	p-value	0.481	0.190	0.796				

Peak Hip Extension 1 (R)	F + M	6.33 ± 4.01	7.69 ± 7.45	4.03 ± 6.44	0.197			
	F	7.17 ± 4.81	6.36 ± 4.97	2.80 ± 5.77				
	M	5.49 ± 3.04	9.02 ± 9.45	5.25 ± 7.17				
	p-value	0.361	0.466	0.436				
Peak Hip Flexion 1 (R)	F + M	24.28 ± 6.54	39.45 ± 9.13	45.20 ± 12.97	**<0.001**	**<0.001**	**<0.001**	0.253
	F	25.44 ± 7.69	43.89 ± 8.42	41.86 ± 11.59				
	M	23.13 ± 5.31	35.02 ± 7.87	48.55 ± 14.08				
	p-value	0.444	**0.035**	0.287				
Peak Hip Extension 2 (L)	F + M	20.05 ± 8.89	15.55 ± 9.95	17.62 ± 7.48	0.299			
	F	23.07 ± 8.40	20.81 ± 9.55	20.52 ± 7.36				
	M	17.03 ± 8.73	10.30 ± 7.56	14.71 ± 6.77				
	p-value	0.132	**0.020**	0.100				
Peak Hip Flexion 2 (L)	F + M	37.40 ± 9.46	43.55 ± 11.80	57.51 ± 10.38	**<0.001**	0.215	**<0.001**	**<0.001**
	F	42.86 ± 7.49	51.18 ± 9.18	62.44 ± 8.66				
	M	31.94 ± 8.16	35.92 ± 8.98	52.57 ± 9.95				
	p-value	**0.006**	**0.003**	**0.039**				

Table 4.44. RSBR Frontal Plane Angle

Table 4.44. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (R)	F + M	-3.27 ± 2.91	-3.50 ± 5.51	-5.56 ± 4.54	0.154			
	F	-4.62 ± 2.47	-6.07 ± 6.74	-5.18 ± 4.51				
	M	-1.93 ± 2.80	-0.93 ± 2.06	-5.95 ± 4.81				
	p-value	0.063	**0.004**	0.796				
Peak Ankle Inversion 1 (R)	F + M	-0.95 ± 2.83	0.57 ± 2.09	-1.25 ± 2.70	0.166			
	F	-2.08 ± 2.38	-0.13 ± 1.76	-1.14 ± 2.81				
	M	0.19 ± 2.88	1.19 ± 2.27	-1.37 ± 2.76				
	p-value	0.075	0.423	1.000				
Peak Ankle Eversion 2 (L)	F + M	-1.45 ± 2.20	-1.52 ± 2.74	-3.31 ± 4.34	0.289			
	F	-2.02 ± 1.09	-2.48 ± 2.64	-5.59 ± 4.54				
	M	-0.88 ± 2.89	-0.56 ± 2.63	-1.02 ± 2.77				
	p-value	0.089	0.136	**0.024**				
Peak Ankle Inversion 2 (L)	F + M	0.08 ± 1.65	1.37 ± 2.46	0.35 ± 3.34	0.275			
	F	-0.71 ± 0.99	0.72 ± 2.92	-1.86 ± 2.66				
	M	0.88 ± 1.83	2.02 ± 1.83	2.55 ± 2.38				
	p-value	**0.027**	0.275	**0.002**				
Peak Knee Abduction 1 (R)	F + M	-6.67 ± 4.51	-9.41 ± 5.54	-15.24 ± 7.82	**0.001**	0.619	**0.001**	0.072
	F	-6.87 ± 3.89	-10.56 ± 7.21	-12.95 ± 6.99				
	M	-6.48 ± 5.28	-8.26 ± 3.20	-17.54 ± 8.32				
	p-value	0.796	0.931	0.190				
Peak Knee Adduction 1 (R)	F + M	0.21 ± 4.10	4.97 ± 5.58	11.84 ± 5.26	**<0.001**	**0.014**	**<0.001**	**<0.001**
	F	0.02 ± 4.45	8.17 ± 4.74	11.60 ± 5.42				
	M	0.39 ± 3.95	1.77 ± 4.54	12.08 ± 5.41				
	p-value	0.847	**0.010**	0.854				
Peak Knee Abduction 2 (L)	F + M	0.22 ± 3.87	1.14 ± 4.40	-0.98 ± 5.02	0.209			
	F	-0.06 ± 3.49	-0.48 ± 5.25	-4.30 ± 5.64				
	M	0.50 ± 4.39	2.76 ± 2.78	1.60 ± 2.51				
	p-value	0.912	**0.040**	**0.016**				
Peak Knee Adduction 2 (L)	F + M	3.66 ± 4.05	11.47 ± 10.83	11.11 ± 11.84	**0.020**	**0.040**	0.053	0.999
	F	2.46 ± 3.71	7.39 ± 10.27	2.64 ± 5.40				
	M	4.86 ± 4.20	15.54 ± 10.31	19.57 ± 10.36				
	p-value	0.353	0.136	**0.001**				

Peak Hip Abduction 1 (R)	F + M	-1.10 ± 4.52	0.35 ± 5.27	-5.24 ± 6.89	**0.013**	0.819	0.079	**0.014**
	F	-2.65 ± 4.17	-0.40 ± 3.29	-4.45 ± 7.38				
	M	0.45 ± 4.51	1.02 ± 6.71	-6.03 ± 6.71				
	p-value	0.123	0.277	0.387				
Peak Hip Adduction 1 (R)	F + M	4.01 ± 7.35	9.40 ± 10.21	6.42 ± 6.58	**0.025**	**0.021**	0.358	0.796
	F	2.15 ± 4.08	6.15 ± 8.51	5.91 ± 3.67				
	M	5.87 ± 9.46	12.64 ± 11.21	6.92 ± 8.83				
	p-value	0.268	0.186	0.756				
Peak Hip Abduction 2 (L)	F + M	-4.23 ± 4.73	-9.46 ± 12.46	-23.34 ± 11.74	**<0.001**	1.000	**<0.001**	**0.002**
	F	-5.05 ± 4.04	-13.73 ± 14.79	-23.72 ± 7.32				
	M	-3.42 ± 5.42	-5.19 ± 8.37	-22.96 ± 15.46				
	p-value	0.684	0.222	0.730				
Peak Hip Adduction 2 (L)	F + M	0.82 ± 5.10	5.23 ± 4.38	5.19 ± 7.83	**0.036**	0.076	0.079	1.000
	F	0.54 ± 4.20	6.00 ± 5.45	6.73 ± 8.47				
	M	1.10 ± 6.10	4.46 ± 3.13	3.66 ± 7.29				
	p-value	0.811	0.471	0.422				

Table 4.45. RSBR Transverse Plane Angle

Table 4.45. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (R)	F + M	4.34 ± 15.51	-1.31 ± 16.31	4.77 ± 13.82	0.166			
	F	10.23 ± 11.97	4.18 ± 19.29	3.45 ± 15.16				
	M	-1.55 ± 16.95	-6.79 ± 11.21	6.09 ± 13.12				
	p-value	0.089	0.160	0.698				
Peak Ankle Internal Rotation 1 (R)	F + M	17.47 ± 14.43	18.13 ± 17.68	27.73 ± 13.38	0.083			
	F	23.85 ± 10.57	28.75 ± 16.47	26.79 ± 12.84				
	M	11.09 ± 15.41	7.50 ± 11.80	28.67 ± 14.62				
	p-value	0.075	**0.003**	0.796				
Peak Ankle External Rotation 2 (L)	F + M	-1.94 ± 12.20	-10.84 ± 17.42	-5.84 ± 18.49	0.161			
	F	3.82 ± 6.45	-5.32 ± 19.45	6.21 ± 12.42				
	M	-7.71 ± 14.10	-16.35 ± 14.08	-17.88 ± 15.67				
	p-value	**0.030**	0.187	**0.002**				
Peak Ankle Internal Rotation 2 (L)	F + M	7.55 ± 13.95	7.86 ± 15.89	15.91 ± 19.68	0.318			
	F	12.41 ± 6.88	14.14 ± 16.13	27.06 ± 16.34				
	M	2.68 ± 17.63	1.58 ± 13.69	4.76 ± 16.61				
	p-value	0.121	0.094	**0.011**				
Peak Knee External Rotation 1 (R)	F + M	-7.59 ± 12.11	-9.93 ± 16.59	-26.26 ± 16.61	**<0.001**	0.951	**0.001**	**0.006**
	F	-13.99 ± 6.23	-15.09 ± 15.73	-26.61 ± 13.87				
	M	-1.19 ± 13.41	-4.76 ± 16.67	-25.92 ± 19.84				
	p-value	**0.029**	0.063	0.931				
Peak Knee Internal Rotation 1 (R)	F + M	1.69 ± 12.16	0.03 ± 14.78	-10.29 ± 18.02	**0.040**	0.981	0.052	0.128
	F	-3.30 ± 9.29	-5.61 ± 14.01	-9.40 ± 15.00				
	M	6.68 ± 13.06	5.66 ± 14.01	-11.18 ± 21.53				
	p-value	0.089	0.063	0.666				
Peak Knee External Rotation 2 (L)	F + M	-25.27 ± 12.12	-24.44 ± 12.33	-23.81 ± 10.51	0.862			
	F	-21.75 ± 8.89	-29.64 ± 12.52	-25.61 ± 12.85				
	M	-28.79 ± 14.28	-19.24 ± 10.26	-22.01 ± 7.90				
	p-value	0.202	0.072	0.485				
Peak Knee Internal Rotation 2 (L)	F + M	-15.52 ± 10.07	-11.66 ± 11.76	-12.48 ± 12.87	0.438			
	F	-12.79 ± 9.50	-16.61 ± 12.43	-13.82 ± 15.21				
	M	-18.26 ± 10.35	-6.71 ± 9.19	-11.14 ± 10.80				
	p-value	0.165	0.063	0.730				

Peak Hip External Rotation 1 (R)	F + M	-23.70 ± 7.60	-24.98 ± 11.56	-28.48 ± 15.09	0.440			
	F	-23.70 ± 6.54	-31.09 ± 6.76	-29.16 ± 16.64				
	M	-24.32 ± 8.86	-18.86 ± 12.43	-27.79 ± 14.36				
	p-value	0.724	**0.020**	0.854				
Peak Hip Internal Rotation 1 (R)	F + M	-15.10 ± 8.07	-14.65 ± 12.43	-16.51 ± 12.16	0.868			
	F	-15.58 ± 6.39	-19.98 ± 9.33	-16.85 ± 13.91				
	M	-14.62 ± 9.80	-9.32 ± 13.31	-16.17 ± 10.98				
	p-value	0.798	0.067	0.910				
Peak Hip External Rotation 2 (L)	F + M	3.84 ± 12.39	-3.37 ± 19.77	-21.39 ± 24.63	**<0.001**	0.584	**<0.001**	**0.022**
	F	-3.98 ± 9.02	-9.31 ± 21.83	-36.99 ± 20.44				
	M	11.67 ± 10.33	2.57 ± 16.56	-5.79 ± 18.00				
	p-value	**0.002**	0.212	**0.003**				
Peak Hip Internal Rotation 2 (L)	F + M	10.64 ± 11.79	11.37 ± 17.87	-5.74 ± 22.97	**0.008**	0.999	**0.020**	**0.018**
	F	2.89 ± 8.68	4.77 ± 17.01	-20.34 ± 18.63				
	M	18.40 ± 9.19	17.96 ± 17.07	8.87 ± 17.14				
	p-value	**0.001**	0.120	**0.003**				

Table 4.46. RSBRP Sagittal Plane Mom

Table 4.46. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion 1 (R)	F + M	-0.12 ± 0.18	-0.07 ± 0.14	-0.03 ± 0.12	0.179			
	F	0.00 ± 0.02	-0.09 ± 0.17	-0.01 ± 0.07				
	M	-0.24 ± 0.19	-0.05 ± 0.10	-0.06 ± 0.15				
	p-value	**0.003**	0.888	0.258				
Peak Ankle Plantar-flexion 1 (R)	F + M	0.75 ± 0.62	1.02 ± 0.53	1.29 ± 0.66	0.050			
	F	1.19 ± 0.21	0.87 ± 0.37	1.31 ± 0.62				
	M	0.36 ± 0.61	1.18 ± 0.64	1.26 ± 0.74				
	p-value	0.243	0.139	0.863				
Peak Knee Flexion 1 (R)	F + M	-0.09 ± 0.16	-0.61 ± 0.64	-0.87 ± 0.74	**<0.001**	**0.003**	**<0.001**	1.000
	F	-0.14 ± 0.14	-0.87 ± 0.75	-0.98 ± 0.82				
	M	-0.04 ± 0.18	-0.30 ± 0.30	-0.74 ± 0.67				
	p-value	**0.001**	0.093	0.606				
Peak Knee Extension 1 (R)	F + M	0.87 ± 0.74	0.45 ± 0.60	0.25 ± 0.27	**0.016**	0.218	**0.013**	0.965
	F	0.32 ± 0.19	0.28 ± 0.34	0.20 ± 0.24				
	M	1.37 ± 0.70	0.63 ± 0.78	0.30 ± 0.30				
	p-value	0.211	0.481	0.730				
Peak Hip Flexion 1 (R)	F + M	-1.31 ± 1.29	-0.86 ± 0.88	-0.68 ± 0.53	0.653			
	F	-0.32 ± 0.19	-0.90 ± 0.86	-0.59 ± 0.38				
	M	-2.21 ± 1.19	-0.82 ± 0.96	-0.76 ± 0.65				
	p-value	**0.010**	0.815	0.730				
Peak Hip Extension 1 (R)	F + M	0.11 ± 0.14	0.29 ± 0.35	0.46 ± 0.48	**0.011**	0.207	**0.009**	0.848
	F	0.13 ± 0.11	0.34 ± 0.42	0.64 ± 0.52				
	M	0.10 ± 0.17	0.24 ± 0.28	0.27 ± 0.36				
	p-value	**<0.001**	0.798	**0.046**				

Table 4.47. RSBRP Frontal Plane Mom

Table 4.47. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion R	F + M	-0.53 ± 0.71	-0.91 ± 1.08	-1.02 ± 0.94	0.199			
	F	-0.03 ± 0.03	-1.17 ± 1.20	-0.70 ± 0.81				
	M	-0.98 ± 0.72	-0.63 ± 0.93	-1.33 ± 1.00				
	p-value	**0.001**	0.423	0.222				
Peak Ankle Eversion R	F + M	0.14 ± 0.18	0.04 ± 0.09	0.11 ± 0.21	0.192			
	F	0.14 ± 0.05	0.02 ± 0.08	0.14 ± 0.18				
	M	0.14 ± 0.25	0.06 ± 0.09	0.07 ± 0.23				
	p-value	0.211	0.321	0.258				
Peak Knee Adduction R	F + M	-0.85 ± 1.01	-1.16 ± 1.30	-1.32 ± 0.98	0.257			
	F	-0.08 ± 0.06	-1.46 ± 1.39	-0.96 ± 0.80				
	M	-1.54 ± 0.97	-0.84 ± 1.19	-1.67 ± 1.05				
	p-value	**0.010**	0.167	0.094				
Peak Knee Abduction R	F + M	0.23 ± 0.21	0.27 ± 0.30	0.36 ± 0.38	0.805			
	F	0.38 ± 0.18	0.26 ± 0.35	0.45 ± 0.33				
	M	0.10 ± 0.14	0.29 ± 0.26	0.28 ± 0.42				
	p-value	**<0.001**	0.743	0.436				
Peak Hip Adduction R	F + M	-0.76 ± 0.90	-1.38 ± 1.57	-1.91 ± 1.25	**0.011**	0.595	**0.008**	0.293
	F	-0.06 ± 0.04	-1.62 ± 1.62	-1.65 ± 1.20				
	M	-1.39 ± 0.83	-1.10 ± 1.58	-2.17 ± 1.32				
	p-value	**0.010**	0.423	0.340				
Peak Hip Abduction R	F + M	0.50 ± 0.37	0.46 ± 0.46	0.38 ± 0.61	0.243			
	F	0.77 ± 0.23	0.42 ± 0.56	0.36 ± 0.58				
	M	0.26 ± 0.29	0.50 ± 0.35	0.40 ± 0.68				
	p-value	**0.003**	0.743	0.666				

Table 4.48 RSBRP Transverse Plane Mom

Table 4.48. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation R	F + M	-0.07 ± 0.08	-0.25 ± 0.29	-0.31 ± 0.23	**0.003**	0.516	**0.002**	0.164
	F	-0.05 ± 0.06	-0.27 ± 0.29	-0.34 ± 0.26				
	M	-0.09 ± 0.09	-0.23 ± 0.31	-0.28 ± 0.21				
	p-value	0.356	0.743	0.863				
Peak Ankle External Rotation R	F + M	0.12 ± 0.11	0.12 ± 0.07	0.11 ± 0.12	0.434			
	F	0.08 ± 0.04	0.15 ± 0.03	0.09 ± 0.12				
	M	0.16 ± 0.14	0.09 ± 0.10	0.12 ± 0.13				
	p-value	0.182	0.370	0.605				
Peak Knee Internal Rotation R	F + M	-0.14 ± 0.20	-0.42 ± 0.48	-0.47 ± 0.32	**0.009**	0.376	**0.007**	0.429
	F	-0.02 ± 0.02	-0.47 ± 0.47	-0.40 ± 0.29				
	M	-0.25 ± 0.22	-0.37 ± 0.52	-0.53 ± 0.35				
	p-value	**0.006**	0.541	0.436				
Peak Knee External Rotation R	F + M	0.08 ± 0.08	0.07 ± 0.09	0.04 ± 0.08	0.344			
	F	0.11 ± 0.05	0.06 ± 0.10	0.04 ± 0.09				
	M	0.06 ± 0.09	0.08 ± 0.10	0.04 ± 0.08				
	p-value	0.065	0.606	1.000				
Peak Hip Internal Rotation R	F + M	-0.06 ± 0.05	-0.08 ± 0.09	-0.22 ± 0.16	**<0.001**	1.000	**0.002**	**0.005**
	F	-0.05 ± 0.03	-0.11 ± 0.10	-0.24 ± 0.18				
	M	-0.06 ± 0.06	-0.04 ± 0.05	-0.20 ± 0.14				
	p-value	0.720	0.114	0.666				
Peak Hip External Rotation R	F + M	0.11 ± 0.12	0.15 ± 0.11	0.13 ± 0.13	0.238			
	F	0.04 ± 0.03	0.16 ± 0.08	0.08 ± 0.10				
	M	0.18 ± 0.13	0.15 ± 0.14	0.18 ± 0.15				
	p-value	**0.002**	0.423	0.190				

Table 4.49. RSBRP Sagittal Plane Angle

Table 4.49. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (R)	F + M	3.29 ± 6.96	-8.40 ± 17.16	-8.69 ± 13.87	**0.008**	0.050	**0.011**	1.000
	F	0.78 ± 7.20	-17.16 ± 20.44	-19.15 ± 10.72				
	M	5.56 ± 6.23	1.46 ± 3.24	1.77 ± 6.92				
	p-value	0.139	**0.023**	**<0.001**				
Peak Ankle Dorsiflex-ion 1 (R)	F + M	21.13 ± 4.44	19.38 ± 6.73	21.56 ± 6.31	0.512			
	F	21.81 ± 5.18	19.74 ± 8.41	19.10 ± 3.57				
	M	20.52 ± 3.84	18.97 ± 4.74	24.03 ± 7.62				
	p-value	0.542	0.822	0.098				
Peak Ankle Plantar-flexion 2 (L)	F + M	-13.05 ± 7.42	-12.26 ± 7.99	-18.59 ± 10.94	0.083			
	F	-15.61 ± 9.31	-14.69 ± 8.81	-23.21 ± 12.60				
	M	-10.75 ± 4.54	-9.52 ± 6.41	-13.96 ± 6.88				
	p-value	0.400	0.236	0.161				
Peak Ankle Dorsiflex-ion 2 (L)	F + M	3.85 ± 3.17	7.59 ± 3.87	4.08 ± 5.57	**0.021**	**0.036**	0.998	0.057
	F	5.13 ± 2.90	7.29 ± 3.69	4.14 ± 7.36				
	M	2.70 ± 3.07	7.93 ± 4.29	4.01 ± 3.43				
	p-value	0.095	0.747	0.960				
Peak Knee Extension 1 (R)	F + M	3.66 ± 8.72	4.50 ± 8.82	5.38 ± 6.48	0.811			
	F	8.25 ± 9.05	10.19 ± 5.69	6.99 ± 8.32				
	M	-0.47 ± 6.26	-1.89 ± 7.25	3.77 ± 3.76				
	p-value	**0.025**	**0.002**	0.305				
Peak Knee Flexion 1 (R)	F + M	11.79 ± 8.28	14.38 ± 9.66	19.34 ± 7.96	**0.034**	0.748	**0.031**	0.257
	F	15.80 ± 8.44	20.82 ± 7.06	19.17 ± 9.94				
	M	8.18 ± 6.57	7.14 ± 6.57	19.52 ± 5.96				
	p-value	**0.041**	**0.001**	0.928				
Peak Knee Extension 2 (L)	F + M	2.00 ± 5.71	5.19 ± 8.22	-0.24 ± 5.46	0.056			
	F	2.77 ± 4.65	3.33 ± 9.04	0.60 ± 6.34				
	M	1.30 ± 6.70	7.29 ± 7.17	-1.09 ± 4.64				
	p-value	0.590	0.337	0.528				
Peak Knee Flexion 2 (L)	F + M	10.05 ± 8.69	21.89 ± 7.85	31.01 ± 14.05	**<0.001**	**0.007**	**<0.001**	0.385
	F	12.14 ± 9.27	22.99 ± 10.83	32.35 ± 14.67				
	M	8.18 ± 8.15	20.64 ± 1.88	29.66 ± 14.15				
	p-value	0.243	0.481	0.863				

Peak Hip Extension 1 (R)	F + M	5.84 ± 3.68	6.52 ± 8.85	2.67 ± 7.60	0.202			
	F	5.69 ± 3.03	3.16 ± 5.04	0.33 ± 6.34				
	M	5.97 ± 4.35	10.31 ± 10.90	5.01 ± 8.37				
	p-value	0.968	0.236	0.387				
Peak Hip Flexion 1 (R)	F + M	27.23 ± 7.89	40.12 ± 9.20	46.37 ± 12.65	**<0.001**	**0.002**	**<0.001**	0.722
	F	29.85 ± 8.72	43.58 ± 9.45	43.57 ± 11.52				
	M	24.88 ± 6.52	36.24 ± 7.65	49.17 ± 13.78				
	p-value	0.177	0.101	0.364				
Peak Hip Extension 2 (L)	F + M	16.33 ± 8.92	17.11 ± 9.90	17.77 ± 6.09	0.873			
	F	18.90 ± 8.54	19.75 ± 10.32	20.46 ± 6.58				
	M	14.01 ± 9.03	14.13 ± 9.13	15.08 ± 4.39				
	p-value	0.243	0.255	0.058				
Peak Hip Flexion 2 (L)	F + M	34.62 ± 9.53	44.89 ± 11.11	56.56 ± 10.49	**<0.001**	**0.014**	**<0.001**	**0.005**
	F	39.91 ± 7.97	51.72 ± 8.22	63.21 ± 8.17				
	M	29.85 ± 8.49	37.21 ± 8.81	49.90 ± 8.21				
	p-value	**0.017**	**0.003**	**0.003**				

Table 4.50. RSBRP Frontal Plane Angle

Table 4.50. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (R)	F + M	-2.99 ± 3.08	-2.25 ± 3.02	-4.85 ± 3.30	0.058			
	F	-3.99 ± 2.90	-4.23 ± 2.53	-4.36 ± 2.71				
	M	-2.09 ± 3.09	-0.26 ± 2.02	-5.29 ± 3.87				
	p-value	0.356	**0.010**	0.888				
Peak Ankle Inversion 1 (R)	F + M	-0.63 ± 3.06	0.63 ± 2.30	-1.06 ± 2.49	0.174			
	F	-2.01 ± 2.54	-0.32 ± 2.07	-1.36 ± 2.55				
	M	0.62 ± 3.06	1.57 ± 2.25	-0.75 ± 2.53				
	p-value	0.060	0.103	0.616				
Peak Ankle Eversion 2 (L)	F + M	-1.39 ± 2.08	-1.40 ± 3.12	-2.92 ± 3.24	0.228			
	F	-1.82 ± 1.10	-1.86 ± 2.40	-4.68 ± 3.42				
	M	-1.00 ± 2.69	-0.89 ± 3.89	-1.35 ± 2.23				
	p-value	0.156	0.167	0.093				
Peak Ankle Inversion 2 (L)	F + M	0.18 ± 1.76	1.57 ± 2.44	0.24 ± 2.83	0.160			
	F	-0.49 ± 0.89	1.11 ± 3.25	-1.50 ± 2.35				
	M	0.79 ± 2.15	2.08 ± 0.98	1.98 ± 2.18				
	p-value	0.113	0.431	**0.005**				
Peak Knee Abduction 1 (R)	F + M	-7.17 ± 4.12	-9.48 ± 5.94	-16.95 ± 6.33	**<0.001**	1.000	**<0.001**	**0.004**
	F	-9.04 ± 3.40	-11.02 ± 6.88	-15.81 ± 6.40				
	M	-5.47 ± 4.11	-7.74 ± 4.45	-18.10 ± 6.43				
	p-value	0.095	0.423	0.489				
Peak Knee Adduction 1 (R)	F + M	0.47 ± 3.77	6.68 ± 4.60	12.38 ± 4.13	**<0.001**	**<0.001**	**<0.001**	**<0.001**
	F	-1.42 ± 3.61	7.96 ± 4.67	11.71 ± 3.94				
	M	2.16 ± 3.18	5.23 ± 4.34	13.05 ± 4.44				
	p-value	**0.035**	0.232	0.508				
Peak Knee Abduction 2 (L)	F + M	0.15 ± 3.05	1.63 ± 4.52	0.14 ± 3.64	0.422			
	F	-0.09 ± 2.81	0.27 ± 4.67	-2.35 ± 3.59				
	M	0.37 ± 3.38	3.16 ± 4.09	1.80 ± 2.72				
	p-value	0.750	0.197	**0.024**				
Peak Knee Adduction 2 (L)	F + M	3.58 ± 2.65	11.29 ± 9.41	10.87 ± 9.35	**0.005**	**0.013**	**0.017**	0.998
	F	2.57 ± 2.06	8.93 ± 9.64	5.72 ± 8.28				
	M	4.49 ± 2.88	13.95 ± 8.99	16.02 ± 7.59				
	p-value	0.182	0.236	**0.014**				

Peak Hip Abduction 1 (R)	F + M	-0.83 ± 5.20	0.67 ± 4.58	-5.54 ± 7.37	**0.023**	0.866	**0.020**	0.248
	F	-2.52 ± 4.63	-0.59 ± 3.75	-6.01 ± 8.45				
	M	0.70 ± 5.44	1.93 ± 5.23	-5.07 ± 6.61				
	p-value	0.278	0.161	1.000				
Peak Hip Adduction 1 (R)	F + M	5.21 ± 8.09	9.08 ± 9.42	7.05 ± 6.43	0.126			
	F	2.75 ± 4.14	5.84 ± 8.93	8.11 ± 4.71				
	M	7.42 ± 10.20	12.73 ± 9.10	5.98 ± 7.95				
	p-value	0.218	0.136	0.499				
Peak Hip Abduction 2 (L)	F + M	-3.21 ± 4.13	-8.78 ± 13.04	-24.30 ± 10.45	**<0.001**	0.809	**<0.001**	**0.001**
	F	-3.55 ± 4.20	-14.13 ± 15.50	-27.32 ± 8.37				
	M	-2.92 ± 4.27	-2.77 ± 6.00	-21.29 ± 11.90				
	p-value	0.780	0.074	0.258				
Peak Hip Adduction 2 (L)	F + M	1.66 ± 4.60	7.26 ± 4.48	7.20 ± 7.44	**0.005**	**0.012**	**0.022**	1.000
	F	1.21 ± 3.35	7.85 ± 4.85	6.47 ± 8.43				
	M	2.07 ± 5.65	6.60 ± 4.26	7.92 ± 6.73				
	p-value	0.696	0.583	0.691				

Table 4.51. RSBRP Transverse Plane Angle

Table 4.51. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (R)	F + M	2.54 ± 17.32	-1.03 ± 18.42	4.31 ± 12.93	0.331			
	F	10.34 ± 12.59	6.13 ± 21.63	5.16 ± 14.29				
	M	-4.47 ± 18.53	-9.08 ± 10.06	3.46 ± 12.24				
	p-value	0.060	0.089	0.790				
Peak Ankle Internal Rotation 1 (R)	F + M	16.02 ± 15.38	17.55 ± 20.11	28.32 ± 12.48	0.053			
	F	20.86 ± 12.17	30.00 ± 18.10	29.57 ± 13.68				
	M	11.67 ± 17.23	3.54 ± 11.25	27.06 ± 11.84				
	p-value	0.202	**0.003**	0.682				
Peak Ankle External Rotation 2 (L)	F + M	-2.42 ± 12.93	-12.30 ± 16.73	-5.26 ± 15.39	0.074			
	F	2.90 ± 5.31	-7.32 ± 20.84	3.73 ± 11.44				
	M	-7.21 ± 15.99	-17.91 ± 8.72	-14.25 ± 13.82				
	p-value	0.089	0.202	**0.008**				
Peak Ankle Internal Rotation 2 (L)	F + M	8.15 ± 13.50	7.05 ± 16.91	17.96 ± 18.71	0.102			
	F	12.15 ± 7.20	11.08 ± 16.43	28.94 ± 16.95				
	M	4.55 ± 16.97	2.51 ± 17.36	6.97 ± 13.60				
	p-value	0.230	0.313	**0.008**				
Peak Knee External Rotation 1 (R)	F + M	-8.03 ± 12.33	-10.05 ± 17.43	-26.25 ± 17.73	**0.002**	1.000	**0.003**	**0.012**
	F	-13.66 ± 5.99	-15.03 ± 16.54	-25.83 ± 15.69				
	M	-2.96 ± 14.55	-4.45 ± 17.72	-26.68 ± 20.52				
	p-value	0.079	0.114	0.931				
Peak Knee Internal Rotation 1 (R)	F + M	0.08 ± 12.59	-0.99 ± 15.88	-10.46 ± 18.21	0.094			
	F	-6.92 ± 6.85	-6.08 ± 15.67	-9.05 ± 16.23				
	M	6.38 ± 13.49	4.74 ± 14.99	-11.86 ± 20.90				
	p-value	**0.022**	0.139	0.796				
Peak Knee External Rotation 2 (L)	F + M	-26.56 ± 12.76	-24.81 ± 12.14	-25.54 ± 10.79	0.891			
	F	-23.99 ± 9.50	-30.22 ± 13.26	-28.73 ± 13.50				
	M	-28.87 ± 15.26	-18.72 ± 7.48	-22.36 ± 6.49				
	p-value	0.420	**0.047**	0.220				
Peak Knee Internal Rotation 2 (L)	F + M	-15.40 ± 10.12	-12.08 ± 10.97	-13.40 ± 10.48	0.672			
	F	-13.35 ± 9.69	-18.36 ± 9.50	-15.57 ± 11.96				
	M	-17.25 ± 10.64	-5.02 ± 8.02	-11.23 ± 8.94				
	p-value	0.416	**0.007**	0.396				

Peak Hip External Rotation 1 (R)	F + M	-24.18 ± 8.33	-25.75 ± 12.17	-29.19 ± 15.77	0.462			
	F	-23.06 ± 6.84	-31.46 ± 8.05	-28.96 ± 17.17				
	M	-25.18 ± 9.74	-19.32 ± 13.23	-29.43 ± 15.28				
	p-value	0.593	**0.035**	0.952				
Peak Hip Internal Rotation 1 (R)	F + M	-14.80 ± 9.79	-14.97 ± 11.24	-16.61 ± 12.32	0.865			
	F	-16.23 ± 6.92	-19.69 ± 8.87	-16.34 ± 13.41				
	M	-13.51 ± 12.06	-9.65 ± 11.75	-16.88 ± 11.93				
	p-value	0.562	0.063	0.929				
Peak Hip External Rotation 2 (L)	F + M	2.10 ± 12.74	-5.05 ± 20.44	-20.32 ± 25.38	**0.005**	0.640	**0.004**	0.083
	F	-6.43 ± 9.98	-9.35 ± 20.63	-35.62 ± 22.11				
	M	9.77 ± 9.90	-0.21 ± 20.45	-5.02 ± 18.78				
	p-value	**0.008**	0.200	**0.014**				
Peak Hip Internal Rotation 2 (L)	F + M	11.17 ± 13.37	10.13 ± 16.91	-6.79 ± 24.14	**0.008**	0.998	**0.015**	**0.029**
	F	0.66 ± 7.40	3.60 ± 17.42	-20.66 ± 22.01				
	M	20.62 ± 9.97	17.47 ± 13.80	7.08 ± 17.91				
	p-value	**<0.001**	0.092	**0.010**				

Table 4.52. RSFL Sagittal Plane Mom

Table 4.52. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (L)	F + M	-0.03 ± 0.02	-0.02 ± 0.01	-0.01 ± 0.01	**0.002**	0.426	**0.001**	0.097
	F	-0.01 ± 0.01	-0.01 ± 0.02	-0.01 ± 0.01				
	M	-0.04 ± 0.02	-0.02 ± 0.01	-0.01 ± 0.01				
	p-value	**0.023**	0.387	0.605				
Peak Ankle Plantarflexion 1 (L)	F + M	0.97 ± 0.30	0.95 ± 0.26	0.98 ± 0.24	0.931			
	F	0.83 ± 0.23	0.82 ± 0.27	0.85 ± 0.21				
	M	1.12 ± 0.31	1.07 ± 0.20	1.11 ± 0.21				
	p-value	**0.027**	**0.042**	**0.016**				
Peak Ankle Dorsiflexion 2 (R)	F + M	-0.03 ± 0.07	-0.04 ± 0.11	-0.10 ± 0.13	0.399			
	F	0.00 ± 0.01	-0.04 ± 0.07	-0.09 ± 0.15				
	M	-0.06 ± 0.09	-0.04 ± 0.14	-0.12 ± 0.11				
	p-value	**0.003**	1.000	0.321				
Peak Ankle Plantarflexion 2 (R)	F + M	0.90 ± 0.44	1.02 ± 0.40	0.58 ± 0.53	**0.017**	0.816	0.102	**0.018**
	F	1.10 ± 0.21	0.97 ± 0.32	0.67 ± 0.60				
	M	0.71 ± 0.53	1.08 ± 0.48	0.49 ± 0.47				
	p-value	0.105	0.387	0.730				
Peak Knee Flexion 1 (L)	F + M	-0.43 ± 0.29	-0.35 ± 0.15	-0.47 ± 0.32	0.425			
	F	-0.29 ± 0.25	-0.33 ± 0.16	-0.26 ± 0.19				
	M	-0.57 ± 0.27	-0.38 ± 0.13	-0.67 ± 0.30				
	p-value	**0.043**	0.730	**0.004**				
Peak Knee Extension 1 (L)	F + M	0.13 ± 0.15	0.21 ± 0.30	0.23 ± 0.38	0.878			
	F	0.16 ± 0.14	0.28 ± 0.39	0.42 ± 0.45				
	M	0.09 ± 0.16	0.13 ± 0.18	0.03 ± 0.13				
	p-value	0.143	0.666	0.094				
Peak Knee Flexion 2 (R)	F + M	-0.11 ± 0.17	-0.21 ± 0.19	-0.19 ± 0.25	0.195			
	F	-0.09 ± 0.11	-0.26 ± 0.21	-0.27 ± 0.31				
	M	-0.13 ± 0.21	-0.16 ± 0.17	-0.11 ± 0.16				
	p-value	0.280	0.387	0.258				
Peak Knee Extension 2 (R)	F + M	0.58 ± 0.36	0.48 ± 0.42	0.65 ± 0.39	0.239			
	F	0.36 ± 0.16	0.32 ± 0.15	0.47 ± 0.39				
	M	0.80 ± 0.38	0.65 ± 0.39	0.83 ± 0.32				
	p-value	**0.023**	0.258	**0.040**				

Peak Hip Flexion 1 (L)	F + M	-0.12 ± 0.09	-0.12 ± 0.18	-0.24 ± 0.30	0.626			
	F	-0.16 ± 0.11	-0.19 ± 0.18	-0.42 ± 0.34				
	M	-0.08 ± 0.06	-0.06 ± 0.17	-0.08 ± 0.15				
	p-value	0.075	**0.031**	0.059				
Peak Hip Extension 1 (L)	F + M	0.55 ± 0.25	0.52 ± 0.19	0.62 ± 0.33	0.572			
	F	0.42 ± 0.23	0.45 ± 0.21	0.40 ± 0.25				
	M	0.68 ± 0.21	0.59 ± 0.15	0.84 ± 0.23				
	p-value	**0.017**	0.127	**0.002**				
Peak Hip Flexion 2 (R)	F + M	-0.83 ± 0.69	-0.55 ± 0.49	-0.98 ± 0.54	**0.047**	0.463	0.811	**0.041**
	F	-0.36 ± 0.15	-0.46 ± 0.36	-0.83 ± 0.51				
	M	-1.31 ± 0.69	-0.64 ± 0.61	-1.13 ± 0.55				
	p-value	**0.005**	0.666	0.340				
Peak Hip Extension 2 (R)	F + M	0.18 ± 0.13	0.22 ± 0.14	0.18 ± 0.11	0.678			
	F	0.14 ± 0.06	0.24 ± 0.16	0.14 ± 0.11				
	M	0.23 ± 0.16	0.20 ± 0.14	0.21 ± 0.10				
	p-value	0.159	0.624	0.172				

Table 4.53. RSFL Frontal Plane Mom

Table 4.53. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (L)	F + M	-0.03 ± 0.04	-0.06 ± 0.07	-0.04 ± 0.04	0.494			
	F	-0.02 ± 0.03	-0.04 ± 0.07	-0.03 ± 0.04				
	M	-0.04 ± 0.04	-0.08 ± 0.06	-0.06 ± 0.04				
	p-value	0.393	0.161	0.113				
Peak Ankle Eversion 1 (L)	F + M	0.10 ± 0.06	0.09 ± 0.07	0.09 ± 0.07	0.871			
	F	0.11 ± 0.06	0.10 ± 0.06	0.11 ± 0.07				
	M	0.09 ± 0.07	0.08 ± 0.07	0.07 ± 0.07				
	p-value	0.529	0.387	0.340				
Peak Ankle Inversion 2 (R)	F + M	-0.14 ± 0.17	-0.35 ± 0.42	-0.63 ± 0.55	**0.006**	0.386	**0.004**	0.309
	F	-0.02 ± 0.02	-0.41 ± 0.45	-0.59 ± 0.53				
	M	-0.26 ± 0.18	-0.30 ± 0.41	-0.67 ± 0.61				
	p-value	**0.005**	0.863	0.931				
Peak Ankle Eversion 2 (R)	F + M	0.28 ± 0.25	0.15 ± 0.16	0.18 ± 0.27	0.091			
	F	0.13 ± 0.06	0.17 ± 0.19	0.10 ± 0.19				
	M	0.44 ± 0.29	0.13 ± 0.13	0.27 ± 0.33				
	p-value	**0.008**	0.796	0.546				
Peak Knee Adduction 1 (L)	F + M	-0.01 ± 0.04	-0.03 ± 0.05	-0.03 ± 0.07	0.232			
	F	-0.01 ± 0.04	-0.02 ± 0.05	-0.01 ± 0.06				
	M	-0.01 ± 0.04	-0.04 ± 0.05	-0.05 ± 0.07				
	p-value	1.000	0.546	0.370				
Peak Knee Abduction 1 (L)	F + M	0.39 ± 0.15	0.58 ± 0.19	0.83 ± 0.34	**<0.001**	**0.041**	**<0.001**	**0.009**
	F	0.43 ± 0.12	0.59 ± 0.25	0.67 ± 0.35				
	M	0.35 ± 0.17	0.58 ± 0.13	0.99 ± 0.25				
	p-value	0.248	0.966	**0.042**				
Peak Knee Adduction 2 (R)	F + M	-0.39 ± 0.48	-0.59 ± 0.67	-1.06 ± 0.69	**0.005**	1.000	**0.007**	**0.037**
	F	-0.08 ± 0.05	-0.71 ± 0.71	-1.02 ± 0.76				
	M	-0.71 ± 0.52	-0.47 ± 0.64	-1.11 ± 0.66				
	p-value	**0.011**	0.489	0.931				
Peak Knee Abduction 2 (R)	F + M	0.45 ± 0.23	0.37 ± 0.28	0.44 ± 0.44	0.698			
	F	0.40 ± 0.17	0.39 ± 0.36	0.43 ± 0.52				
	M	0.51 ± 0.28	0.36 ± 0.18	0.45 ± 0.38				
	p-value	0.720	1.000	0.863				

Peak Hip Adduction 1 (L)	F + M	-0.04 ± 0.09	-0.05 ± 0.05	-0.10 ± 0.09	**0.017**	0.792	**0.013**	0.275
	F	-0.02 ± 0.06	-0.03 ± 0.03	-0.06 ± 0.04				
	M	-0.05± 0.11	-0.08 ± 0.06	-0.14 ± 0.10				
	p-value	0.481	**0.031**	0.063				
Peak Hip Abduction 1 (L)	F + M	0.57 ± 0.21	0.86 ± 0.24	1.17 ± 0.32	**<0.001**	**0.004**	**<0.001**	**0.002**
	F	0.63 ± 0.16	0.98 ± 0.22	1.07 ± 0.32				
	M	0.51 ± 0.25	0.73 ± 0.20	1.28 ± 0.31				
	p-value	0.218	**0.024**	0.189				
Peak Hip Adduction 2 (R)	F + M	-0.42 ± 0.60	-0.70 ± 0.82	-1.20 ± 0.86	**0.022**	0.589	**0.017**	0.458
	F	-0.03 ± 0.05	-0.84 ± 0.87	-1.24 ± 1.00				
	M	-0.81 ± 0.65	-0.55 ± 0.78	-1.17 ± 0.76				
	p-value	**0.003**	0.730	0.796				
Peak Hip Abduction 2 (R)	F + M	0.89 ± 0.34	0.66 ± 0.30	0.66 ± 0.46	0.104			
	F	0.80 ± 0.25	0.67 ± 0.39	0.53 ± 0.39				
	M	0.98 ± 0.41	0.66 ± 0.21	0.80 ± 0.52				
	p-value	0.268	0.923	0.233				

Table 4.54. RSFL Transverse Plane Mom

Table 4.54. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (L)	F + M	1.00 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.02	0.473			
	F	0.00 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.01				
	M	-0.01 ± 0.01	-0.01 ± 0.01	-0.02 ± 0.03				
	p-value	0.661	0.489	0.161				
Peak Ankle External Rotation 1 (L)	F + M	0.13 ± 0.07	0.17 ± 0.06	0.23 ± 0.10	**0.002**	0.416	**0.001**	0.068
	F	0.16 ± 0.07	0.18 ± 0.05	0.25 ± 0.12				
	M	0.10 ± 0.07	0.16 ± 0.07	0.21 ± 0.09				
	p-value	0.105	0.666	0.730				
Peak Ankle Internal Rotation 2 (R)	F + M	-0.06 ± 0.08	-0.09 ± 0.10	-0.13 ± 0.08	**0.010**	1.000	**0.010**	0.080
	F	-0.04 ± 0.04	-0.11 ± 0.10	-0.13 ± 0.10				
	M	-0.08 ± 0.10	-0.07 ± 0.11	-0.12 ± 0.07				
	p-value	0.123	0.436	0.796				
Peak Ankle External Rotation 2 (R)	F + M	0.07 ± 0.05	0.09 ± 0.06	0.07 ± 0.04	0.463			
	F	0.06 ± 0.03	0.07 ± 0.06	0.05 ± 0.03				
	M	0.08 ± 0.07	0.11 ± 0.06	0.08 ± 0.04				
	p-value	0.971	0.190	0.408				
Peak Knee Internal Rotation 1 (L)	F + M	0.00 ± 0.01	0.00 ± 0.00	0.00 ± 0.01	0.763			
	F	0.00 ± 0.01	0.00 ± 0.00	0.00 ± 0.01				
	M	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.01				
	p-value	0.436	0.606	0.574				
Peak Knee External Rotation 1 (L)	F + M	0.10 ± 0.03	0.14 ± 0.05	0.16 ± 0.06	**0.002**	0.083	**0.001**	0.391
	F	0.10 ± 0.03	0.12 ± 0.03	0.14 ± 0.06				
	M	0.10 ± 0.04	0.16 ± 0.06	0.18 ± 0.06				
	p-value	0.853	0.113	0.136				
Peak Knee Internal Rotation 2 (R)	F + M	-0.06 ± 0.10	-0.16 ± 0.18	-0.24 ± 0.19	**0.002**	0.323	**0.001**	0.178
	F	-0.01 ± 0.01	-0.19 ± 0.19	-0.26 ± 0.18				
	M	-0.11 ± 0.12	-0.12 ± 0.17	-0.23 ± 0.22				
	p-value	**0.035**	0.605	0.436				
Peak Knee External Rotation 2 (R)	F + M	0.11 ± 0.06	0.08 ± 0.07	0.07 ± 0.09	0.160			
	F	0.11 ± 0.06	0.07 ± 0.07	0.08 ± 0.11				
	M	0.11 ± 0.07	0.10 ± 0.06	0.07 ± 0.06				
	p-value	1.000	0.340	0.666				

Peak Hip Internal Rotation 1 (L)	F + M	-0.03 ± 0.03	-0.05 ± 0.04	-0.06 ± 0.05	**0.028**	**0.046**	0.097	1.000
	F	-0.03 ± 0.03	-0.05 ± 0.05	-0.07 ± 0.07				
	M	-0.03 ± 0.04	-0.06 ± 0.03	-0.05 ± 0.03				
	p-value	0.579	0.277	0.796				
Peak Hip External Rotation 1 (L)	F + M	0.05 ± 0.03	0.05 ± 0.05	0.12 ± 0.08	**<0.001**	1.000	**0.001**	**0.002**
	F	0.05 ± 0.04	0.07 ± 0.05	0.10 ± 0.08				
	M	0.06 ± 0.03	0.04 ± 0.03	0.14 ± 0.08				
	p-value	0.684	0.190	0.387				
Peak Hip Internal Rotation 2 (R)	F + M	-0.05 ± 0.03	-0.06 ± 0.03	-0.10 ± 0.05	**<0.001**	0.931	**<0.001**	**0.003**
	F	-0.04 ± 0.03	-0.06 ± 0.03	-0.09 ± 0.05				
	M	-0.06 ± 0.03	-0.05 ± 0.03	-0.11 ± 0.04				
	p-value	0.280	0.605	0.297				
Peak Hip External Rotation 2 (R)	F + M	0.06 ± 0.04	0.12 ± 0.09	0.14 ± 0.09	**0.007**	0.069	**0.008**	1.000
	F	0.03 ± 0.02	0.12 ± 0.09	0.13 ± 0.09				
	M	0.08 ± 0.05	0.11 ± 0.09	0.14 ± 0.10				
	p-value	**0.007**	0.863	0.931				

Table 4.55. RSFL Sagittal Plane Angle

Table 4.55. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (L)	F + M	-19.67 ± 7.84	-26.61 ± 8.73	-32.87 ± 11.60	**<0.001**	0.081	**<0.001**	0.158
	F	-22.65 ± 7.95	-27.41 ± 10.32	-39.36 ± 11.68				
	M	-16.68 ± 6.84	-25.80 ± 7.36	-26.37 ± 7.39				
	p-value	0.089	0.708	**0.012**				
Peak Ankle Dorsiflex-ion 1 (L)	F + M	-2.96 ± 4.50	-0.73 ± 4.44	-2.42 ± 6.22	0.388			
	F	-4.52 ± 4.77	-1.53 ± 5.01	-2.87 ± 8.41				
	M	-1.39 ± 3.81	0.06 ± 3.93	-1.97 ± 3.33				
	p-value	0.122	0.465	0.770				
Peak Ankle Plantar-flexion 2 (R)	F + M	3.66 ± 5.99	3.61 ± 7.97	4.24 ± 5.03	0.947			
	F	2.25 ± 7.42	0.56 ± 7.85	3.90 ± 5.42				
	M	5.07 ± 4.03	6.32 ± 7.45	4.58 ± 4.92				
	p-value	0.529	0.139	0.605				
Peak Ankle Dorsiflex-ion 2 (R)	F + M	20.75 ± 4.26	21.50 ± 6.18	23.20 ± 5.80	0.376			
	F	21.48 ± 5.15	21.31 ± 7.46	22.08 ± 5.52				
	M	20.02 ± 3.27	21.68 ± 5.04	24.31 ± 6.18				
	p-value	0.458	0.904	0.431				
Peak Knee Extension 1 (L)	F + M	2.54 ± 5.78	5.67 ± 8.69	0.48 ± 7.42	0.112			
	F	4.39 ± 5.52	4.90 ± 10.02	3.58 ± 8.54				
	M	0.69 ± 5.71	6.44 ± 7.65	-2.62 ± 4.74				
	p-value	0.159	0.719	0.075				
Peak Knee Flexion 1 (L)	F + M	11.37 ± 6.38	22.36 ± 9.47	31.06 ± 12.36	**<0.001**	**0.003**	**<0.001**	**0.026**
	F	12.08 ± 6.74	23.15 ± 13.07	30.11 ± 12.25				
	M	10.67 ± 6.27	21.56 ± 4.30	32.01 ± 13.14				
	p-value	0.796	0.605	0.730				
Peak Knee Extension 2 (R)	F + M	6.13 ± 7.61	6.11 ± 9.99	8.24 ± 7.72	0.685			
	F	11.43 ± 6.80	12.52 ± 7.70	11.27 ± 9.15				
	M	0.84 ± 3.70	-0.31 ± 7.77	5.20 ± 4.72				
	p-value	**<0.001**	**0.003**	0.077				
Peak Knee Flexion 2 (R)	F + M	11.80 ± 8.21	16.20 ± 8.25	20.90 ± 10.38	**0.011**	0.353	**0.009**	0.320
	F	17.42 ± 6.89	21.90 ± 5.93	21.78± 13.35				
	M	6.17 ± 4.94	10.50 ± 6.01	20.02 ± 7.02				
	p-value	**0.001**	**0.001**	0.730				

Peak Hip Extension 1 (L)	F + M	27.99 ± 8.29	24.74 ± 10.32	26.35 ± 8.12	0.227			
	F	33.23 ± 5.97	28.56 ± 12.72	30.32 ± 8.70				
	M	22.75 ± 6.96	20.92 ± 5.64	22.37 ± 5.37				
	p-value	**0.002**	0.119	**0.033**				
Peak Hip Flexion 1 (L)	F + M	38.42 ± 9.36	44.29 ± 10.60	55.84 ± 11.34	**<0.001**	0.240	**<0.001**	**0.005**
	F	44.77 ± 6.80	51.16 ± 9.31	62.16 ± 11.47				
	M	32.07 ± 7.03	37.43 ± 6.77	49.52 ± 7.20				
	p-value	**0.001**	**0.003**	**0.013**				
Peak Hip Extension 2 (R)	F + M	5.72 ± 4.43	8.97 ± 7.95	3.34 ± 6.20	**0.034**	0.312	0.574	**0.029**
	F	6.09 ± 3.85	7.72 ± 5.92	1.76 ± 6.95				
	M	5.35 ± 5.13	10.22 ± 9.78	4.92 ± 5.28				
	p-value	0.720	0.521	0.294				
Peak Hip Flexion 2 (R)	F + M	22.14 ± 7.70	42.36 ± 9.20	47.18 ± 13.71	**<0.001**	**<0.001**	**<0.001**	0.426
	F	23.16 ± 8.60	42.89 ± 7.93	47.06 ± 9.38				
	M	21.12 ± 6.99	41.83 ± 10.79	47.30 ± 17.65				
	p-value	0.568	0.814	0.972				

Table 4.56. RSFL Frontal Plane Angle

Table 4.56. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (L)	F + M	-1.91 ± 2.28	-1.92 ± 2.31	-3.15 ± 3.61	0.309			
	F	-2.95 ± 1.35	-2.64 ± 2.04	-5.09 ± 3.28				
	M	-0.86 ± 2.60	-1.21 ± 2.46	-1.21 ± 2.91				
	p-value	**0.029**	0.113	**0.024**				
Peak Ankle Inversion 1 (L)	F + M	-0.16 ± 1.86	0.63 ± 2.32	0.10 ± 2.79	0.580			
	F	-1.24 ± 1.15	-0.06 ± 2.37	-1.80 ± 2.18				
	M	0.93 ± 1.83	1.32 ± 2.18	2.00 ± 1.92				
	p-value	**0.005**	0.217	**0.001**				
Peak Ankle Eversion 2 (R)	F + M	-3.33 ± 2.80	-1.51 ± 2.07	-3.84 ± 3.51	0.073			
	F	-4.55 ± 2.26	-2.57 ± 1.23	-2.79 ± 2.02				
	M	-2.11 ± 2.85	-0.57 ± 2.26	-4.77 ± 4.36				
	p-value	**0.035**	**0.036**	0.321				
Peak Ankle Inversion 2 (R)	F + M	-0.65 ± 2.79	0.65 ± 2.17	-1.46 ± 2.92	0.070			
	F	-2.17 ± 1.99	-0.29 ± 1.38	-1.37 ± 2.66				
	M	0.86 ± 2.72	1.49 ± 2.47	-1.56 ± 3.32				
	p-value	**0.011**	0.092	0.898				
Peak Knee Abduction 1 (L)	F + M	0.16 ± 3.40	1.81 ± 5.77	-1.76 ± 6.18	0.141			
	F	-0.11 ± 3.76	-1.09 ± 5.25	-6.37 ± 5.66				
	M	0.42 ± 3.19	4.71 ± 4.93	2.34 ± 2.85				
	p-value	0.796	**0.031**	**<0.001**				
Peak Knee Adduction 1 (L)	F + M	3.82 ± 3.62	9.23 ± 9.00	8.44 ± 8.20	0.051			
	F	2.54 ± 3.65	4.74 ± 5.83	2.21 ± 4.35				
	M	5.10 ± 3.26	13.72 ± 9.63	14.68 ± 6.05				
	p-value	0.115	**0.029**	**<0.001**				
Peak Knee Abduction 2 (R)	F + M	-3.57 ± 4.59	-8.87 ± 6.09	-16.33 ± 7.52	**<0.001**	**0.037**	**<0.001**	**0.046**
	F	-4.46 ± 3.95	-9.30 ± 7.24	-15.26 ± 5.43				
	M	-2.68 ± 5.21	-8.44 ± 5.11	-17.40 ± 9.38				
	p-value	0.143	0.863	0.796				
Peak Knee Adduction 2 (R)	F + M	1.48 ± 4.01	4.71 ± 4.02	7.73 ± 5.82	**0.005**	0.205	**0.004**	0.513
	F	0.70 ± 5.18	6.70 ± 3.23	7.90 ± 6.56				
	M	2.25 ± 2.39	2.73 ± 3.89	7.55 ± 5.36				
	p-value	0.353	0.050	0.730				

Peak Hip Abduction 1 (L)	F + M	-7.06 ± 6.05	-8.39 ± 9.21	-18.03 ± 8.99	**<0.001**	1.000	**0.001**	**0.002**
	F	-7.53 ± 5.13	-10.21 ± 11.62	-19.31 ± 7.44				
	M	-6.59 ± 7.12	-6.56 ± 6.14	-16.75 ± 10.61				
	p-value	0.739	0.546	0.546				
Peak Hip Adduction 1 (L)	F + M	-1.14 ± 6.05	8.25 ± 6.90	17.14 ± 4.91	**<0.001**	**<0.001**	**<0.001**	**<0.001**
	F	-0.98 ± 5.52	11.25 ± 5.09	16.38 ± 4.58				
	M	-1.30 ± 6.84	5.25 ± 7.42	17.91 ± 5.38				
	p-value	0.909	0.063	0.524				
Peak Hip Abduction 2 (R)	F + M	-2.30 ± 4.35	-0.17 ± 4.45	-4.34 ± 6.87	0.117			
	F	-3.71 ± 3.86	-0.63 ± 3.16	-4.04 ± 7.55				
	M	-0.89 ± 4.54	0.23 ± 5.53	-4.61 ± 6.65				
	p-value	0.739	0.236	0.963				
Peak Hip Adduction 2 (R)	F + M	2.82 ± 6.28	6.95 ± 10.17	6.85 ± 8.18	0.106			
	F	1.27 ± 3.42	3.34 ± 8.90	5.72 ± 4.74				
	M	4.37 ± 8.14	10.57 ± 10.55	7.99 ± 10.81				
	p-value	0.282	0.136	0.572				

Table 4.57. RSFL Transverse Plane Angle

Table 4.57. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (L)	F + M	-0.36 ± 13.55	-6.37 ± 17.18	-3.10 ± 16.26	0.455			
	F	7.43 ± 7.21	-0.35 ± 16.35	8.05 ± 11.42				
	M	-8.15 ± 14.17	-12.39 ± 16.69	-14.25 ± 12.33				
	p-value	**0.006**	0.142	**0.001**				
Peak Ankle Internal Rotation 1 (L)	F + M	10.96 ± 15.14	11.35 ± 13.57	16.11 ± 18.07	0.616			
	F	18.45 ± 8.22	16.05 ± 13.82	26.12 ± 13.82				
	M	3.47 ± 17.08	6.66 ± 12.28	6.11 ± 16.66				
	p-value	**0.022**	0.147	**0.014**				
Peak Ankle External Rotation 2 (R)	F + M	2.57 ± 15.70	-1.68 ± 17.09	6.75 ± 14.10	0.129			
	F	10.85 ± 10.03	5.94 ± 18.39	5.81 ± 13.48				
	M	-5.71 ± 16.36	-9.30 ± 12.32	7.69 ± 15.45				
	p-value	**0.014**	0.055	0.786				
Peak Ankle Internal Rotation 2 (R)	F + M	17.93 ± 14.24	13.20 ± 17.37	23.53 ± 15.06	0.093			
	F	23.79 ± 9.87	21.95 ± 17.92	22.38 ± 15.13				
	M	12.07 ± 15.94	4.46 ± 12.16	24.68 ± 15.82				
	p-value	0.063	**0.014**	0.605				
Peak Knee External Rotation 1 (L)	F + M	-24.95 ± 10.80	-24.38 ± 9.75	-25.76 ± 10.92	0.925			
	F	-22.78 ± 8.24	-28.46 ± 9.21	-26.97 ± 14.03				
	M	-27.13 ± 12.96	-20.30 ± 8.93	-24.55 ± 7.29				
	p-value	0.382	0.074	0.652				
Peak Knee Internal Rotation 1 (L)	F + M	-16.75 ± 10.04	-11.74 ± 10.70	-11.80 ± 10.94	0.138			
	F	-15.31 ± 9.27	-16.87 ± 10.74	-13.11 ± 13.36				
	M	-18.19 ± 11.06	-6.60 ± 8.28	-10.48 ± 8.50				
	p-value	0.536	**0.037**	0.624				
Peak Knee External Rotation 2 (R)	F + M	-3.99 ± 11.27	-8.72 ± 17.82	-25.39 ± 17.08	**<0.001**	0.725	**<0.001**	**0.006**
	F	-10.55 ± 6.24	-14.68 ± 17.11	-26.42 ± 14.73				
	M	2.57 ± 11.57	-2.75 ± 17.37	-24.36 ± 20.02				
	p-value	**0.005**	0.162	0.807				
Peak Knee Internal Rotation 2 (R)	F + M	1.91 ± 11.89	0.72 ± 16.12	-12.73 ± 17.34	**0.008**	0.993	**0.013**	**0.031**
	F	-5.70 ± 7.16	-5.61 ± 14.84	-12.97 ± 15.33				
	M	9.52 ± 10.88	7.05 ± 15.55	-12.48 ± 20.09				
	p-value	**0.003**	0.050	0.796				

Peak Hip External Rotation 1 (L)	F + M	2.96 ± 12.63	-3.08 ± 21.54	-19.06 ± 26.30	**0.006**	0.749	**0.006**	0.071
	F	-4.57 ± 10.88	-9.58 ± 24.09	-36.47 ± 21.00				
	M	10.49 ± 9.63	3.42 ± 17.63	-1.65 ± 18.62				
	p-value	**0.007**	0.222	**0.002**				
Peak Hip Internal Rotation 1 (L)	F + M	10.41 ± 11.19	9.90 ± 19.61	-2.66 ± 23.49	0.063			
	F	3.46 ± 9.41	2.04 ± 18.57	-15.72 ± 20.98				
	M	17.37 ± 8.25	17.77 ± 18.27	10.41 ± 18.64				
	p-value	**0.002**	0.089	**0.013**				
Peak Hip External Rotation 2 (R)	F + M	-21.14 ± 5.91	-22.46 ± 11.49	-26.41 ± 14.20	0.318			
	F	-21.10 ± 4.83	-28.83 ± 7.71	-26.99 ± 16.49				
	M	-21.18 ± 7.10	-16.08 ± 11.39	-25.82 ± 12.47				
	p-value	0.853	**0.019**	0.931				
Peak Hip Internal Rotation 2 (R)	F + M	-12.59 ± 8.48	-12.99 ± 10.63	-16.36 ± 12.75	0.504			
	F	-14.41 ± 6.31	-19.51 ± 6.73	-16.20 ± 12.84				
	M	-10.77 ± 10.24	-6.46 ± 9.95	-16.53 ± 13.44				
	p-value	0.351	**0.005**	0.959				

Table 4.58. RSFLP Sagittal Plane Mom

Table 4.58. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion 2 (R)	F + M	-0.05 ± 0.07	-0.04 ± 0.09	-0.08 ± 0.14	0.398			
	F	-0.01 ± 0.02	-0.04 ± 0.10	-0.04 ± 0.10				
	M	-0.08 ± 0.09	-0.03 ± 0.08	-0.13 ± 0.17				
	p-value	**0.004**	0.888	0.200				
Peak Ankle Plantar-flexion 2 (R)	F + M	0.95 ± 0.49	1.04 ± 0.46	0.68 ± 0.45	0.074			
	F	1.12 ± 0.23	1.03 ± 0.34	0.72 ± 0.39				
	M	0.80 ± 0.62	1.05 ± 0.60	0.64 ± 0.54				
	p-value	0.211	0.423	0.796				
Peak Knee Flexion 2 (R)	F + M	-0.13 ± 0.21	-0.38 ± 0.34	-0.42 ± 0.39	**0.012**	0.053	**0.021**	1.000
	F	-0.08 ± 0.09	-0.48 ± 0.39	-0.59 ± 0.46				
	M	-0.18 ± 0.27	-0.27 ± 0.26	-0.24 ± 0.20				
	p-value	1.000	0.321	0.094				
Peak Knee Extension 2 (R)	F + M	0.56 ± 0.45	0.48 ± 0.55	0.51 ± 0.49	0.602			
	F	0.31 ± 0.17	0.28 ± 0.18	0.33 ± 0.37				
	M	0.77 ± 0.51	0.71 ± 0.73	0.70 ± 0.54				
	p-value	**0.043**	0.370	0.063				
Peak Hip Flexion 2 (R)	F + M	-0.80 ± 0.66	-0.61 ± 0.61	-0.88 ± 0.71	0.274			
	F	-0.37 ± 0.15	-0.50 ± 0.33	-0.68 ± 0.50				
	M	-1.18 ± 0.71	-0.73 ± 0.84	-1.09 ± 0.84				
	p-value	**0.028**	0.888	0.605				
Peak Hip Extension 2 (R)	F + M	0.23 ± 0.21	0.32 ± 0.22	0.33 ± 0.24	0.215			
	F	0.17 ± 0.12	0.37 ± 0.22	0.40 ± 0.28				
	M	0.28 ± 0.26	0.27 ± 0.21	0.27 ± 0.20				
	p-value	0.243	0.321	0.489				

Table 4.59. RSFLP Frontal Plane Mom

Table 4.59. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 2 (R)	F + M	-0.36 ± 0.47	-0.52 ± 0.59	-0.81 ± 0.69	0.069			
	F	-0.02 ± 0.02	-0.62 ± 0.62	-0.80 ± 0.80				
	M	-0.67 ± 0.47	-0.42 ± 0.58	-0.83 ± 0.62				
	p-value	**<0.001**	0.888	1.000				
Peak Ankle Eversion 2 (R)	F + M	0.14 ± 0.16	0.08 ± 0.09	0.08 ± 0.17	0.207			
	F	0.12 ± 0.06	0.07 ± 0.09	0.08 ± 0.15				
	M	0.16 ± 0.21	0.10 ± 0.10	0.09 ± 0.20				
	p-value	1.000	0.370	0.931				
Peak Knee Adduction 2 (R)	F + M	-0.53 ± 0.62	-0.72 ± 0.75	-1.16 ± 0.79	**0.009**	1.000	**0.012**	0.058
	F	-0.07 ± 0.04	-0.81 ± 0.73	-1.02 ± 0.77				
	M	-0.94 ± 0.61	-0.61 ± 0.80	-1.31 ± 0.82				
	p-value	**0.003**	0.606	0.546				
Peak Knee Abduction 2 (R)	F + M	0.38 ± 0.27	0.28 ± 0.22	0.36 ± 0.45	0.554			
	F	0.41 ± 0.17	0.29 ± 0.25	0.38 ± 0.49				
	M	0.35 ± 0.35	0.28 ± 0.21	0.34 ± 0.43				
	p-value	0.356	1.000	1.000				
Peak Hip Adduction 2 (R)	F + M	-0.58 ± 0.70	-0.83 ± 0.87	-1.40 ± 1.00	**0.008**	0.616	**0.006**	0.231
	F	-0.03 ± 0.04	-0.95 ± 0.89	-1.37 ± 1.16				
	M	-1.08 ± 0.62	-0.69 ± 0.88	-1.43 ± 0.88				
	p-value	**0.001**	0.743	0.863				
Peak Hip Abduction 2 (R)	F + M	0.69 ± 0.30	0.51 ± 0.34	0.57 ± 0.56	0.197			
	F	0.80 ± 0.24	0.53 ± 0.41	0.52 ± 0.64				
	M	0.58 ± 0.32	0.49 ± 0.27	0.63 ± 0.51				
	p-value	0.095	0.673	0.340				

Table 4.60. RSFLP Transverse Plane Mom

Table 4.60. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 2 (R)	F + M	-0.06 ± 0.08	-0.10 ± 0.11	-0.17 ± 0.10	**0.003**	1.000	**0.003**	**0.032**
	F	-0.03 ± 0.04	-0.13 ± 0.13	-0.17 ± 0.10				
	M	-0.08 ± 0.10	-0.06 ± 0.09	-0.17 ± 0.10				
	p-value	**0.043**	0.370	1.000				
Peak Ankle External Rotation 2 (R)	F + M	0.09 ± 0.06	0.11 ± 0.06	0.13 ± 0.11	0.350			
	F	0.07 ± 0.04	0.12 ± 0.05	0.11 ± 0.12				
	M	0.11 ± 0.07	0.10 ± 0.08	0.14 ± 0.12				
	p-value	0.211	0.888	0.605				
Peak Knee Internal Rotation 2 (R)	F + M	-0.12 ± 0.14	-0.21 ± 0.23	-0.26 ± 0.19	**0.038**	0.904	**0.032**	0.434
	F	-0.01 ± 0.01	-0.24 ± 0.24	-0.26 ± 0.20				
	M	-0.21 ± 0.13	-0.17 ± 0.23	-0.26 ± 0.20				
	p-value	**<0.001**	0.606	0.931				
Peak Knee External Rotation 2 (R)	F + M	0.09 ± 0.07	0.09 ± 0.06	0.08 ± 0.10	0.514			
	F	0.11 ± 0.06	0.09 ± 0.06	0.08 ± 0.10				
	M	0.07 ± 0.08	0.09 ± 0.08	0.07 ± 0.11				
	p-value	0.243	0.963	0.863				
Peak Hip Internal Rotation 2 (R)	F + M	-0.07 ± 0.05	-0.07 ± 0.05	-0.11 ± 0.09	0.288			
	F	-0.04 ± 0.03	-0.09 ± 0.06	-0.12 ± 0.12				
	M	-0.09 ± 0.05	-0.05 ± 0.06	-0.11 ± 0.07				
	p-value	0.053	0.200	0.666				
Peak Hip External Rotation 2 (R)	F + M	0.05 ± 0.03	0.12 ± 0.08	0.13 ± 0.08	**<0.001**	**0.005**	**0.002**	1.000
	F	0.03 ± 0.02	0.11 ± 0.07	0.12 ± 0.11				
	M	0.06 ± 0.03	0.12 ± 0.09	0.14 ± 0.06				
	p-value	**0.022**	0.963	0.340				

Table 4.61. RSFLP Sagittal Plane Angle

Table 4.61. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (L)	F + M	-24.67 ± 9.27	-24.35 ± 11.01	-33.10 ± 10.23	**0.015**	1.000	0.058	**0.023**
	F	-26.91 ± 7.94	-26.85 ± 14.19	-37.58 ± 11.37				
	M	-22.66 ± 10.32	-21.53 ± 5.46	-28.61 ± 6.90				
	p-value	0.333	0.336	0.060				
Peak Ankle Dorsiflex-ion 1 (L)	F + M	-3.12 ± 4.69	-1.94 ± 4.84	-2.84 ± 7.51	0.820			
	F	-3.06 ± 4.66	-1.63 ± 3.83	-1.80 ± 10.13				
	M	-3.18 ± 4.98	-2.28 ± 6.04	-3.88 ± 3.87				
	p-value	0.960	0.792	0.573				
Peak Ankle Plantar-flexion 2 (R)	F + M	2.84 ± 5.37	3.20 ± 8.86	2.20 ± 5.58	0.905			
	F	1.06 ± 6.14	-1.35 ± 9.33	1.73 ± 5.06				
	M	4.44 ± 4.25	8.32 ± 4.82	2.67 ± 6.34				
	p-value	0.356	**0.036**	0.666				
Peak Ankle Dorsiflex-ion 2 (R)	F + M	19.67 ± 3.20	19.60 ± 6.61	20.86 ± 6.00	0.736			
	F	20.34 ± 3.50	19.11 ± 8.03	18.89 ± 4.37				
	M	19.07 ± 2.95	20.15 ± 5.07	22.84 ± 6.98				
	p-value	0.405	0.758	0.170				
Peak Knee Extension 1 (L)	F + M	1.53 ± 5.95	4.43 ± 7.78	-0.05 ± 7.69	0.183			
	F	3.24 ± 4.89	3.76 ± 9.74	2.80 ± 9.31				
	M	-0.01 ± 6.64	5.18 ± 5.36	-2.90 ± 4.53				
	p-value	0.245	0.719	0.118				
Peak Knee Flexion 1 (L)	F + M	12.18 ± 7.30	20.78 ± 8.11	25.26 ± 12.01	**<0.001**	**0.024**	**<0.001**	0.410
	F	14.03 ± 6.77	23.16 ± 10.08	26.54 ± 12.69				
	M	10.52 ± 7.70	18.11 ± 4.34	23.98 ± 11.92				
	p-value	0.310	0.211	0.665				
Peak Knee Extension 2 (R)	F + M	4.66 ± 5.99	8.24 ± 9.10	9.20 ± 7.15	0.075			
	F	8.63 ± 5.41	13.77 ± 6.79	12.03 ± 9.17				
	M	1.08 ± 3.99	2.02 ± 7.28	6.37 ± 2.57				
	p-value	**0.008**	**<0.001**	**0.040**				
Peak Knee Flexion 2 (R)	F + M	13.32 ± 8.76	17.18 ± 10.12	21.35 ± 11.77	0.068			
	F	18.84 ± 8.86	23.57 ± 6.47	23.97 ± 14.37				
	M	8.35 ± 5.09	9.99 ± 8.65	18.74 ± 8.51				
	p-value	**0.005**	**0.002**	0.361				

Peak Hip Extension 1 (L)	F + M	24.60 ± 8.32	21.23 ± 9.61	24.60 ± 7.54	0.407			
	F	29.42 ± 6.00	23.36 ± 11.76	28.43 ± 7.95				
	M	20.27 ± 7.90	18.83 ± 6.38	20.77 ± 4.97				
	p-value	**0.012**	0.348	**0.026**				
Peak Hip Flexion 1 (L)	F + M	36.47 ± 8.97	43.23 ± 10.74	52 83 ± 10.88	**<0.001**	0.147	**<0.001**	**0.022**
	F	42.83 ± 6.77	49.54 ± 9.69	59.92 ± 9.54				
	M	30.74 ± 6.59	36.14 ± 6.91	45.74 ± 6.90				
	p-value	**0.001**	**0.005**	**0.002**				
Peak Hip Extension 2 (R)	F + M	5.13 ± 4.41	8.36 ± 7.54	2.49 ± 6.58	**0.027**	0.334	0.491	**0.023**
	F	5.29 ± 3.81	5.63 ± 4.81	0.08 ± 7.47				
	M	4.99 ± 5.09	11.43 ± 9.11	4.89 ± 4.82				
	p-value	0.968	0.074	0.222				
Peak Hip Flexion 2 (R)	F + M	24.17 ± 8.51	42.33 ± 8.23	46.66 ± 15.08	**<0.001**	**<0.001**	**<0.001**	0.579
	F	26.27 ± 10.72	44.80 ± 8.75	46.06 ± 12.38				
	M	22.28 ± 5.86	39.56 ± 7.13	47.27 ± 18.15				
	p-value	0.321	0.200	0.871				

Table 4.62. RSFLP Frontal Plane Angle

Table 4.62. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (L)	F + M	-1.93 ± 1.91	-1.64 ± 2.28	-2.93 ± 3.14	0.324			
	F	-2.54 ± 1.29	-2.31 ± 2.23	-4.34 ± 2.85				
	M	-1.38 ± 2.26	-0.88 ± 2.23	-1.68 ± 2.97				
	p-value	0.113	0.167	0.139				
Peak Ankle Inversion 1 (L)	F + M	-0.14 ± 1.53	0.69 ± 1.97	-0.41 ± 3.05	0.338			
	F	-0.88 ± 0.93	0.01 ± 2.37	-2.06 ± 2.59				
	M	0.53 ± 1.69	1.45 ± 1.07	1.24 ± 2.64				
	p-value	**0.040**	0.136	**0.017**				
Peak Ankle Eversion 2 (R)	F + M	-3.48 ± 2.93	-1.50 ± 2.22	-3.52 ± 2.69	**0.035**	0.053	1.000	0.101
	F	-4.58 ± 2.73	-2.98 ± 1.57	-3.17 ± 1.81				
	M	-2.49 ± 2.87	-0.01 ± 1.74	-3.84 ± 3.38				
	p-value	0.182	**<0.001**	0.963				
Peak Ankle Inversion 2 (R)	F + M	-0.42 ± 2.68	0.52 ± 2.42	-1.57 ± 2.81	0.126			
	F	-1.78 ± 1.91	-0.83 ± 2.23	-1.92 ± 2.99				
	M	0.81 ± 2.75	1.86 ± 1.85	-1.23 ± 2.75				
	p-value	**0.030**	**0.020**	0.620				
Peak Knee Abduction 1 (L)	F + M	-0.60 ± 3.11	0.94 ± 5.69	-1.61 ± 5.71	0.324			
	F	-0.85 ± 3.38	-1.43 ± 5.88	-5.44 ± 5.49				
	M	-0.36 ± 3.02	3.60 ± 4.39	1.79 ± 3.32				
	p-value	1.000	0.139	**0.015**				
Peak Knee Adduction 1 (L)	F + M	3.58 ± 2.74	9.04 ± 6.91	7.35 ± 6.41	**0.015**	**0.015**	0.130	0.750
	F	2.71 ± 3.28	6.68 ± 6.47	3.95 ± 4.81				
	M	4.37 ± 1.99	11.70 ± 6.78	10.75 ± 6.18				
	p-value	0.604	0.200	**0.031**				
Peak Knee Abduction 2 (R)	F + M	-5.45 ± 4.82	-10.60 ± 6.77	-16.34 ± 7.66	**<0.001**	0.062	**<0.001**	**0.034**
	F	-6.68 ± 3.71	-10.79 ± 7.66	-16.36 ± 6.87				
	M	-4.34 ± 5.60	-10.38 ± 6.12	-16.32 ± 8.80				
	p-value	0.156	1.000	0.796				
Peak Knee Adduction 2 (R)	F + M	1.22 ± 3.85	3.59 ± 4.77	6.02 ± 5.61	**0.019**	0.508	**0.015**	0.500
	F	0.49 ± 3.91	5.79 ± 4.75	5.64 ± 6.27				
	M	1.88 ± 3.88	1.12 ± 3.62	6.39 ± 5.22				
	p-value	0.449	**0.039**	0.785				

Peak Hip Abduction 1 (L)	F + M	-6.18 ± 6.21	-8.15 ± 9.73	-15.01 ± 8.62	**0.007**	1.000	**0.013**	**0.027**
	F	-7.53 ± 6.17	-11.88 ± 12.05	-19.19 ± 8.27				
	M	-4.96 ± 6.32	-3.95 ± 3.51	-10.83 ± 7.08				
	p-value	0.384	0.094	**0.035**				
Peak Hip Adduction 1 (L)	F + M	-0.61 ± 5.63	10.01 ± 7.07	16.29 ± 4.92	**<0.001**	**<0.001**	**<0.001**	**0.008**
	F	-1.55 ± 5.61	12.68 ± 5.24	15.74 ± 5.04				
	M	0.23 ± 5.82	7.00 ± 7.96	16.85 ± 5.05				
	p-value	0.508	0.099	0.648				
Peak Hip Abduction 2 (R)	F + M	-1.60 ± 4.61	-0.19 ± 4.61	-4.56 ± 6.68	0.066			
	F	-3.34 ± 4.21	-1.36 ± 3.19	-3.78 ± 7.40				
	M	-0.03 ± 4.58	0.99 ± 5.68	-5.26 ± 6.34				
	p-value	0.095	0.234	0.606				
Peak Hip Adduction 2 (R)	F + M	3.40 ± 5.70	5.82 ± 10.09	5.55 ± 6.54	0.576			
	F	2.00 ± 3.16	2.00 ± 8.07	5.16 ± 4.89				
	M	4.67 ± 7.23	10.12 ± 10.88	5.93 ± 8.17				
	p-value	0.661	0.114	1.000				

Table 4.63. RSFLP Transverse Plane Angle

Table 4.63. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (L)	F + M	-0.53 ± 11.32	-6.66 ± 14.86	-0.43 ± 15.99	0.229			
	F	4.96 ± 5.92	-0.79 ± 16.17	8.08 ± 12.33				
	M	-5.48 ± 12.95	-13.26 ± 10.56	-8.95 ± 15.11				
	p-value	**0.041**	0.084	**0.019**				
Peak Ankle Internal Rotation 1 (L)	F + M	11.64 ± 12.30	9.23 ± 13.60	17.40 ± 17.45	0.241			
	F	16.60 ± 8.08	13.91 ± 14.61	26.35 ± 13.86				
	M	7.17 ± 14.06	3.95 ± 10.90	8.45 ± 16.58				
	p-value	0.096	0.136	**0.024**				
Peak Ankle External Rotation 2 (R)	F + M	1.58 ± 15.81	0.25 ± 19.98	7.60 ± 13.21	0.186			
	F	9.49 ± 10.46	10.22 ± 22.39	8.56 ± 14.36				
	M	-5.53 ± 16.84	-10.96 ± 8.27	6.64 ± 12.74				
	p-value	**0.034**	**0.024**	0.768				
Peak Ankle Internal Rotation 2 (R)	F + M	18.78 ± 14.60	13.70 ± 18.64	22.65 ± 13.00	0.241			
	F	23.96 ± 12.31	24.27 ± 17.97	24.07 ± 12.55				
	M	14.14 ± 15.53	1.80 ± 10.93	21.23 ± 14.04				
	p-value	0.278	**0.002**	0.796				
Peak Knee External Rotation 1 (L)	F + M	-24.86 ± 10.94	-23.06 ± 10.31	-26.11 ± 11.46	0.710			
	F	-22.54 ± 8.65	-28.05 ± 10.53	-28.24 ± 14.74				
	M	-26.95 ± 12.76	-17.44 ± 6.94	-23.98 ± 7.18				
	p-value	0.396	**0.029**	0.447				
Peak Knee Internal Rotation 1 (L)	F + M	-16.26 ± 10.39	-11.75 ± 11.09	-14.28 ± 10.51	0.421			
	F	-14.90 ± 9.22	-16.84 ± 12.70	-15.73 ± 13.28				
	M	-17.48 ± 11.70	-6.02 ± 5.10	-12.83 ± 7.31				
	p-value	0.720	0.059	0.796				
Peak Knee External Rotation 2 (R)	F + M	-4.95 ± 11.43	-10.16 ± 15.88	-24.69 ± 16.84	**0.002**	1.000	**0.002**	**0.025**
	F	-11.13 ± 6.93	-13.66 ± 15.19	-25.26 ± 14.16				
	M	0.61 ± 12.09	-6.22 ± 16.72	-24.11 ± 20.04				
	p-value	**0.035**	0.139	1.000				
Peak Knee Internal Rotation 2 (R)	F + M	1.73 ± 11.40	-1.82 ± 15.78	-13.55 ± 18.43	**0.011**	0.867	**0.012**	0.083
	F	-4.24 ± 6.90	-6.73 ± 14.77	-12.50 ± 16.00				
	M	7.11 ± 12.25	3.70 ± 15.93	-14.60 ± 21.52				
	p-value	0.053	0.139	0.796				

Peak Hip External Rotation 1 (L)	F + M	2.85 ± 18.21	-4.32 ± 20.44	-18.13 ± 25.72	**0.016**	0.689	**0.014**	0.180
	F	-8.46 ± 13.96	-9.44 ± 21.16	-34.09 ± 22.40				
	M	13.04 ± 15.70	1.44 ± 19.28	-2.16 ± 18.18				
	p-value	**0.006**	0.287	**0.004**				
Peak Hip Internal Rotation 1 (L)	F + M	12.14 ± 17.51	10.70 ± 17.01	-2.85 ± 23.75	0.145			
	F	1.32 ± 9.76	3.16 ± 17.09	-16.27 ± 21.53				
	M	21.87 ± 17.50	19.17 ± 13.14	10.58 ± 18.16				
	p-value	**0.006**	**0.049**	**0.011**				
Peak Hip External Rotation 2 (R)	F + M	-21.61 ± 6.67	-21.76 ± 11.62	-26.16 ± 15.18	0.415			
	F	-21.15 ± 5.15	-27.84 ± 7.57	-26.58 ± 17.29				
	M	-22.02 ± 8.06	-14.92 ± 11.93	-25.74 ± 13.78				
	p-value	0.661	**0.011**	1.000				
Peak Hip Internal Rotation 2 (R)	F + M	-11.76 ± 9.09	-12.41 ± 9.93	-15.46 ± 12.93	0.546			
	F	-12.46 ± 6.20	-17.14 ± 6.86	-15.48 ± 13.00				
	M	-11.13 ± 11.40	-7.08 ± 10.51	-15.44 ± 13.64				
	p-value	0.761	**0.032**	0.995				

Table 4.64. SSL Sagittal Plane Mom

Table 4.64. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.02 ± 0.04	-0.05 ± 0.05	-0.04 ± 0.06	0.549			
	F	-0.01 ± 0.02	-0.07 ± 0.09	-0.06 ± 0.07				
	M	-0.03 ± 0.05	-0.02 ± 0.04	-0.02 ± 0.02				
	p-value	0.780	0.436	0.606				
Peak Ankle Plantar-flexion	F + M	0.80 ± 0.48	0.68 ± 0.42	0.76 ± 0.38	0.991			
	F	0.78 ± 0.21	0.49 ± 0.43	0.61 ± 0.31				
	M	0.82 ± 0.67	0.87 ± 0.33	0.91 ± 0.40				
	p-value	0.838	0.051	0.094				
Peak Knee Flexion	F + M	-0.19 ± 0.17	-0.19 ± 0.15	-0.28 ± 0.23	0.430			
	F	-0.15 ± 0.07	-0.16 ± 0.10	-0.27 ± 0.25				
	M	-0.23 ± 0.24	-0.22 ± 0.18	-0.30 ± 0.22				
	p-value	0.497	0.796	0.743				
Peak Knee Extension	F + M	0.49 ± 0.36	0.77 ± 0.66	0.64 ± 0.65	0.690			
	F	0.34 ± 0.21	0.93 ± 0.70	0.34 ± 0.37				
	M	0.63 ± 0.43	0.61 ± 0.62	0.93 ± 0.76				
	p-value	0.218	0.489	0.050				
Peak Hip Flexion	F + M	-0.89 ± 0.91	-1.21 ± 1.07	-1.18 ± 0.89	0.389			
	F	-0.28 ± 0.11	-1.48 ± 1.14	-0.88 ± 0.51				
	M	-1.51 ± 0.94	-0.94 ± 0.98	-1.47 ± 1.11				
	p-value	**<0.001**	0.297	0.258				
Peak Hip Extension	F + M	0.21 ± 0.22	0.16 ± 0.18	0.18 ± 0.27	0.686			
	F	0.17 ± 0.10	0.08 ± 0.16	0.13 ± 0.19				
	M	0.24 ± 0.31	0.23 ± 0.18	0.24 ± 0.33				
	p-value	1.000	0.094	0.730				

Table 4.65. SSL Frontal Plane Mom

Table 4.65. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.25 ± 0.55	-0.39 ± 0.45	-0.59 ± 0.66	0.056			
	F	-0.01 ± 0.02	-0.47 ± 0.49	-0.66 ± 0.72				
	M	-0.49 ± 0.71	-0.30 ± 0.41	-0.51 ± 0.62				
	p-value	0.063	0.605	0.743				
Peak Ankle Eversion	F + M	0.20 ± 0.16	0.12 ± 0.14	0.14 ± 0.18	0.164			
	F	0.19 ± 0.04	-0.09 ± 0.13	0.11 ± 0.15				
	M	0.22 ± 0.24	0.16 ± 0.15	0.17 ± 0.21				
	p-value	0.604	0.297	0.796				
Peak Knee Adduction	F + M	-0.59 ± 0.70	-0.59 ± 0.63	-1.00 ± 0.77	0.071			
	F	-0.17 ± 0.09	-0.79 ± 0.73	-1.02 ± 0.73				
	M	-1.00 ± 0.80	-0.40 ± 0.48	-0.98 ± 0.86				
	p-value	**0.004**	0.340	1.000				
Peak Knee Abduction	F + M	0.33 ± 0.21	0.32 ± 0.29	0.34 ± 0.36	0.942			
	F	0.48 ± 0.11	0.24 ± 0.32	0.34 ± 0.35				
	M	0.19 ± 0.19	0.39 ± 0.25	0.34 ± 0.38				
	p-value	**0.001**	0.267	0.993				
Peak Hip Adduction	F + M	-0.79 ± 0.82	-0.64 ± 0.57	-1.34 ± 0.91	**0.030**	1.000	0.091	**0.046**
	F	-0.29 ± 0.11	-0.75 ± 0.62	-1.52 ± 1.01				
	M	-1.29 ± 0.92	-0.52 ± 0.53	-1.16 ± 0.83				
	p-value	0.075	0.605	0.489				
Peak Hip Abduction	F + M	0.61 ± 0.37	0.61 ± 0.34	0.47 ± 0.45	0.450			
	F	0.83 ± 0.20	0.55 ± 0.40	0.45 ± 0.44				
	M	0.39 ± 0.36	0.68 ± 0.28	0.49 ± 0.49				
	p-value	**0.003**	0.445	0.868				

Table 4.66. SSL Transverse Plane Mom

Table 4.66. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.10 ± 0.14	-0.07 ± 0.07	-0.14 ± 0.09	**0.026**	1.000	0.050	0.061
	F	-0.03 ± 0.03	-0.06 ± 0.05	-0.13 ± 0.08				
	M	-0.18 ± 0.17	-0.09 ± 0.10	-0.16 ± 0.10				
	p-value	**0.043**	0.730	0.815				
Peak Ankle External Rotation	F + M	0.08 ± 0.04	0.11 ± 0.06	0.12 ± 0.08	**0.041**	0.172	0.051	1.000
	F	0.09 ± 0.03	0.12 ± 0.06	0.13 ± 0.09				
	M	0.06 ± 0.04	0.11 ± 0.07	0.12 ± 0.07				
	p-value	0.075	0.605	0.931				
Peak Knee Internal Rotation	F + M	-0.12 ± 0.15	-0.12 ± 0.12	-0.19 ± 0.15	0.065			
	F	-0.03 ± 0.02	-0.13 ± 0.14	-0.19 ± 0.15				
	M	-0.20 ± 0.18	-0.10 ± 0.12	-0.20 ± 0.16				
	p-value	0.063	0.931	0.963				
Peak Knee External Rotation	F + M	0.08 ± 0.04	0.11 ± 0.06	0.10 ± 0.07	0.285			
	F	0.10 ± 0.03	0.11 ± 0.06	0.09 ± 0.07				
	M	0.07 ± 0.04	0.11 ± 0.06	0.11 ± 0.07				
	p-value	0.104	0.984	0.587				
Peak Hip Internal Rotation	F + M	-0.05 ± 0.06	-0.06 ± 0.07	-0.11 ± 0.12	0.323			
	F	-0.03 ± 0.02	-0.09 ± 0.09	-0.14 ± 0.13				
	M	-0.06 ± 0.08	-0.04 ± 0.03	-0.08 ± 0.11				
	p-value	0.529	0.387	0.481				
Peak Hip External Rotation	F + M	0.10 ± 0.06	0.14 ± 0.06	0.16 ± 0.09	**0.033**	0.225	**0.035**	1.000
	F	0.06 ± 0.02	0.16 ± 0.05	0.13 ± 0.06				
	M	0.14 ± 0.07	0.11 ± 0.07	0.20 ± 0.11				
	p-value	**0.005**	0.113	0.222				

Table 4.67. SSL Sagittal Plane Angle

Table 4.67. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-8.92 ± 7.58	1.01 ± 5.67	-2.42 ± 6.92	**<0.001**	**<0.001**	**0.014**	0.354
	F	-12.42 ± 7.57	1.08 ± 7.55	-4.54 ± 7.98				
	M	-5.43 ± 6.06	0.93 ± 3.37	-0.29 ± 5.29				
	p-value	**0.035**	0.959	0.201				
Peak Ankle Dorsiflex-ion	F + M	9.34 ± 3.04	12.10 ± 5.07	12.63± 4.74	**0.049**	0.156	0.068	0.976
	F	10.53 ± 2.62	12.68 ± 6.32	12.32 ± 5.23				
	M	8.16 ± 3.08	11.52 ± 3.73	12.94 ± 4.49				
	p-value	0.080	0.643	0.790				
Peak Knee Extension	F + M	2.92 ± 4.90	5.06 ± 6.25	0.74 ± 5.57	0.076			
	F	4.46 ± 4.62	5.02 ± 7.58	1.86 ± 6.52				
	M	1.39 ± 4.91	5.10 ± 5.06	-0.38 ± 4.53				
	p-value	0.166	0.981	0.411				
Peak Knee Flexion	F + M	15.73 ± 6.54	26.12 ± 9.79	29.31 ± 14.30	**<0.001**	**0.011**	**<0.001**	0.745
	F	16.97 ± 7.20	26.61 ± 12.27	25.19 ± 12.98				
	M	14.49 ± 5.92	25.63 ± 7.24	33.43 ± 15.10				
	p-value	0.411	0.838	0.232				
Peak Hip Extension	F + M	11.22 ± 7.39	9.09 ± 10.42	7.63 ± 7.41	0.427			
	F	15.86 ± 6.51	13.29 ± 11.43	10.86 ± 5.55				
	M	6.58 ± 5.00	4.89 ± 7.76	4.40 ± 7.90				
	p-value	**0.002**	0.087	0.062				
Peak Hip Flexion	F + M	22.72 ± 8.87	22.65 ± 10.43	23.59 ± 9.18	0.946			
	F	27.89 ± 7.44	26.83 ± 10.76	25.55 ± 10.17				
	M	17.55 ± 7.17	18.47 ± 8.71	21.62 ± 8.18				
	p-value	**0.005**	0.089	0.380				

Table 4.68. SSL Frontal Plane Angle

Table 4.68. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-2.37 ± 2.40	-2.27 ± 3.57	-3.80 ± 4.40	0.472			
	F	-3.14 ± 1.47	-3.02 ± 2.87	-6.31 ± 5.00				
	M	-1.60 ± 2.95	-1.52 ± 4.19	-1.56 ± 2.23				
	p-value	**0.035**	0.161	**0.036**				
Peak Ankle Inversion	F + M	-0.10 ± 1.99	0.83 ± 2.98	-0.74 ± 4.44	0.356			
	F	-0.74 ± 1.46	-0.05 ± 2.95	-3.56 ± 3.83				
	M	0.53 ± 2.31	1.72 ± 2.91	2.09 ± 3.07				
	p-value	0.161	0.218	**0.003**				
Peak Knee Abduction	F + M	-1.24 ± 4.19	-3.05 ± 8.80	-5.30 ± 8.27	0.315			
	F	-2.78 ± 4.43	-7.17 ± 10.08	-12.10 ± 8.45				
	M	0.30 ± 3.50	1.07 ± 4.99	-0.02 ± 1.68				
	p-value	0.063	0.050	**0.001**				
Peak Knee Adduction	F + M	3.75 ± 3.79	5.88 ± 7.79	5.41 ± 6.90	0.553			
	F	2.18 ± 3.38	2.89 ± 7.28	1.89 ± 4.74				
	M	5.32 ± 3.66	9.24 ± 7.32	9.37 ± 7.01				
	p-value	0.105	0.114	**0.036**				
Peak Hip Abduction	F + M	-16.78 ± 4.01	-21.91 ± 8.68	-32.95 ± 5.28	**<0.001**	**0.042**	**<0.001**	**<0.001**
	F	-17.16 ± 4.55	-23.69 ± 9.86	-32.47 ± 4.99				
	M	-16.40 ± 3.60	-20.12 ± 7.46	-33.44 ± 5.82				
	p-value	0.682	0.398	0.710				
Peak Hip Adduction	F + M	-1.72 ± 5.66	1.57 ± 4.70	3.02 ± 8.96	0.088			
	F	-0.73 ± 3.75	0.83 ± 4.53	3.96 ± 9.07				
	M	-2.70 ± 7.18	2.31 ± 5.03	2.07 ± 9.30				
	p-value	0.218	0.666	0.730				

Table 4.69. SSL Transverse Plane Angle

Table 4.69. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-0.43 ± 13.80	-7.50 ± 20.57	0.64 ± 22.88	0.399			
	F	4.07 ± 8.61	-0.50 ± 19.71	15.60 ± 16.72				
	M	-4.93 ± 16.82	-14.50 ± 20.01	-14.32 ± 18.15				
	p-value	0.149	0.154	**0.002**				
Peak Ankle Internal Rotation	F + M	13.66 ± 14.74	12.09 ± 18.76	21.98 ± 20.95	0.390			
	F	19.63 ± 8.80	17.59 ± 18.66	35.29 ± 18.88				
	M	7.68 ± 17.37	6.58 ± 18.20	8.67 ± 13.33				
	p-value	0.068	0.223	**0.003**				
Peak Knee External Rotation	F + M	-23.19 ± 12.35	-23.03 ± 9.89	-23.27 ± 10.47	0.998			
	F	-19.73 ± 9.85	-26.88 ± 10.14	-25.38 ± 12.72				
	M	-26.66 ± 14.08	-19.19 ± 8.48	-21.16 ± 7.82				
	p-value	0.218	0.100	0.409				
Peak Knee Internal Rotation	F + M	-15.16 ± 11.37	-11.30 ± 10.95	-9.70 ± 10.85	0.300			
	F	-12.44 ± 10.12	-15.96 ± 12.16	-11.50 ± 12.44				
	M	-17.88 ± 12.41	-6.63 ± 7.61	-7.91 ± 9.39				
	p-value	0.297	0.069	0.500				
Peak Hip External Rotation	F + M	0.27 ± 12.36	-5.91 ± 20.08	-25.72 ± 26.83	**0.006**	1.000	**0.007**	0.056
	F	-7.17 ± 9.60	-12.72 ± 21.46	-43.21 ± 20.50				
	M	7.70 ± 10.38	0.90 ± 17.09	-8.23 ± 20.53				
	p-value	**0.011**	0.161	**0.004**				
Peak Hip Internal Rotation	F + M	7.93 ± 12.02	8.49 ± 19.07	-8.21 ± 23.64	**0.013**	1.000	**0.030**	**0.028**
	F	0.43 ± 9.42	-1.03 ± 17.25	-22.24 ± 17.91				
	M	15.43 ± 9.54	18.00 ± 16.47	5.81 ± 20.60				
	p-value	**0.002**	**0.029**	**0.007**				

Table 4.70. SSLP Sagittal Plane Mom

Table 4.70. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.01 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.02	0.417			
	F	-0.01 ± 0.01	0.00 ± 0.01	-0.01 ± 0.02				
	M	-0.01 ± 0.01	-0.01 ± 0.01	-0.02 ± 0.03				
	p-value	0.270	0.200	0.730				
Peak Ankle Plantar-flexion	F + M	0.73 ± 0.44	0.78 ± 0.34	0.82 ± 0.45	0.797			
	F	0.77 ± 0.14	0.73 ± 0.35	0.62 ± 0.31				
	M	0.70 ± 0.62	0.82 ± 0.35	1.03 ± 0.48				
	p-value	0.706	0.600	**0.042**				
Peak Knee Flexion	F + M	-0.25 ± 0.34	-0.26 ± 0.21	-0.34 ± 0.28	0.175			
	F	-0.15 ± 0.05	-0.29 ± 0.19	-0.29 ± 0.33				
	M	-0.36 ± 0.46	-0.23 ± 0.23	-0.41 ± 0.22				
	p-value	0.912	0.297	0.139				
Peak Knee Extension	F + M	0.58 ± 0.57	0.64 ± 0.60	0.58 ± 0.50	0.942			
	F	0.32 ± 0.30	0.72 ± 0.62	0.40 ± 0.39				
	M	0.83 ± 0.68	0.57 ± 0.61	0.76 ± 0.56				
	p-value	0.075	0.730	0.222				
Peak Hip Flexion	F + M	-0.92 ± 1.00	-1.05 ± 1.00	-1.02 ± 0.82	0.817			
	F	-0.23 ± 0.15	-1.26 ± 1.03	-0.83 ± 0.57				
	M	-1.62 ± 1.01	-0.84 ± 0.98	-1.21 ± 1.00				
	p-value	**0.003**	0.489	0.489				
Peak Hip Extension	F + M	0.19 ± 0.21	0.21 ± 0.17	0.22 ± 0.26	0.795			
	F	0.19 ± 0.09	0.20 ± 0.16	0.11 ± 0.18				
	M	0.20 ± 0.30	0.23 ± 0.19	0.33 ± 0.29				
	p-value	0.945	0.773	0.066				

Table 4.71. SSLP Frontal Plane Mom

Table 4.71. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.28 ± 0.55	-0.33 ± 0.37	-0.69 ± 0.69	0.081			
	F	-0.02 ± 0.02	-0.38 ± 0.38	-0.45 ± 0.54				
	M	-0.53 ± 0.71	-0.28 ± 0.37	-0.93 ± 0.76				
	p-value	**0.043**	0.863	0.113				
Peak Ankle Eversion	F + M	0.23 ± 0.20	0.17 ± 0.13	0.14 ± 0.17	0.192			
	F	0.20 ± 0.04	0.16 ± 0.16	0.21 ± 0.20				
	M	0.27 ± 0.28	0.17 ± 0.12	0.07 ± 0.12				
	p-value	0.739	1.000	0.113				
Peak Knee Adduction	F + M	-0.61 ± 0.75	-0.47 ± 0.53	-0.96 ± 0.62	**0.017**	1.000	**0.045**	**0.035**
	F	-0.14 ± 0.11	-0.60 ± 0.64	-0.87 ± 0.55				
	M	-1.08 ± 0.82	-0.34 ± 0.40	-1.05 ± 0.70				
	p-value	**<0.001**	0.863	0.706				
Peak Knee Abduction	F + M	0.41 ± 0.28	0.44 ± 0.27	0.38 ± 0.37	0.867			
	F	0.51 ± 0.15	0.37 ± 0.29	0.45 ± 0.36				
	M	0.31 ± 0.34	0.50 ± 0.24	0.31 ± 0.40				
	p-value	0.109	0.301	0.455				
Peak Hip Adduction	F + M	-0.77 ± 0.86	-0.51 ± 0.44	-1.27 ± 0.86	**0.012**	1.000	**0.031**	**0.026**
	F	-0.20 ± 0.12	-0.56 ± 0.43	-1.30 ± 0.82				
	M	-1.34 ± 0.92	-0.46 ± 0.48	-1.24 ± 0.95				
	p-value	**0.011**	0.489	0.796				
Peak Hip Abduction	F + M	0.73 ± 0.45	0.77 ± 0.36	0.59 ± 0.45	0.332			
	F	0.87 ± 0.17	0.70 ± 0.43	0.65 ± 0.39				
	M	0.58 ± 0.60	0.85 ± 0.28	0.53 ± 0.51				
	p-value	0.159	0.388	0.600				

Table 4.72. SSLP Transverse Plane Mom

Table 4.72. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.10 ± 0.13	-0.07 ± 0.08	-0.16 ± 0.10	**0.006**	1.000	**0.033**	**0.009**
	F	-0.03 ± 0.04	-0.06 ± 0.09	-0.11 ± 0.06				
	M	-0.18 ± 0.16	-0.07 ± 0.06	-0.22 ± 0.11				
	p-value	**0.019**	0.436	**0.008**				
Peak Ankle External Rotation	F + M	0.11 ± 0.05	0.16 ± 0.08	0.16 ± 0.08	**0.036**	0.061	0.098	0.996
	F	0.12 ± 0.04	0.17 ± 0.07	0.16 ± 0.08				
	M	0.09 ± 0.06	0.16 ± 0.09	0.16 ± 0.09				
	p-value	0.222	0.807	0.972				
Peak Knee Internal Rotation	F + M	-0.13 ± 0.17	-0.09 ± 0.10	-0.21 ± 0.16	**0.008**	1.000	**0.023**	**0.018**
	F	-0.02 ± 0.02	-0.10 ± 0.13	-0.13 ± 0.10				
	M	-0.23 ± 0.20	-0.07 ± 0.07	-0.30 ± 0.18				
	p-value	**0.023**	1.000	**0.024**				
Peak Knee External Rotation	F + M	0.12 ± 0.06	0.15 ± 0.07	0.12 ± 0.07	0.306			
	F	0.14 ± 0.03	0.16 ± 0.07	0.13 ± 0.07				
	M	0.11 ± 0.08	0.15 ± 0.07	0.12 ± 0.08				
	p-value	0.293	0.688	0.731				
Peak Hip Internal Rotation	F + M	-0.04 ± 0.07	-0.05 ± 0.07	-0.10 ± 0.10	0.080			
	F	-0.03 ± 0.04	-0.07 ± 0.09	-0.09 ± 0.10				
	M	-0.06 ± 0.08	-0.02 ± 0.02	-0.11 ± 0.10				
	p-value	0.684	0.730	0.546				
Peak Hip External Rotation	F + M	0.15 ± 0.11	0.15 ± 0.08	0.17 ± 0.08	0.452			
	F	0.10 ± 0.04	0.17 ± 0.09	0.15 ± 0.07				
	M	0.21 ± 0.12	0.14 ± 0.06	0.20 ± 0.09				
	p-value	**0.011**	0.605	0.222				

Table 4.73. SSLP Sagittal Plane Angle

Table 4.73. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-7.70 ± 5.86	0.66 ± 4.82	-4.70 ± 5.99	**<0.001**	**<0.001**	0.278	**0.017**
	F	-9.83 ± 5.12	0.97 ± 6.28	-7.71 ± 6.15				
	M	-5.57 ± 6.01	0.35 ± 3.12	-1.68 ± 4.23				
	p-value	0.106	0.793	**0.028**				
Peak Ankle Dorsiflex-ion	F + M	9.43 ±4.81	11.20 ± 5.71	10.49 ± 5.20	0.581			
	F	11.25 ± 5.32	11.69 ± 6.67	10.29 ± 5.80				
	M	7.61 ± 3.64	10.71 ± 4.93	10.70 ± 4.88				
	p-value	0.091	0.727	0.874				
Peak Knee Extension	F + M	2.38 ± 5.38	4.81 ± 7.36	0.76 ± 5.66	0.149			
	F	3.58 ±4.92	4.43 ± 9.10	1.34 ± 6.54				
	M	1.17 ± 5.79	5.18 ± 5.64	0.17 ± 4.94				
	p-value	0.329	0.837	0.673				
Peak Knee Flexion	F + M	16.27 ± 9.78	27.56 ± 8.66	29.45 ± 13.27	**<0.001**	**0.006**	**0.004**	1.000
	F	18.24 ± 10.84	28.92 ± 10.44	25.85 ± 12.80				
	M	14.30 ± 8.71	26.21 ± 6.81	33.05 ± 13.46				
	p-value	0.383	0.523	0.262				
Peak Hip Extension	F + M	11.47 ± 7.44	10.04 ± 10.35	9.64 ± 7.61	0.519			
	F	15.24 ± 6.77	13.39 ± 11.67	11.89 ± 7.53				
	M	7.71 ± 6.28	6.69 ± 8.15	7.40 ± 7.42				
	p-value	**0.019**	0.177	0.220				
Peak Hip Flexion	F + M	21.64 ± 9.46	23.15 ± 11.63	23.84 ± 10.72	0.807			
	F	26.36 ± 8.12	27.15 ± 12.96	26.03 ± 11.69				
	M	16.92 ± 8.58	19.16 ± 9.15	21.64 ± 9.83				
	p-value	**0.019**	0.190	0.666				

Table 4.74. SSLP Frontal Plane Angle

Table 4.74. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-2.04 ± 2.26	-2.44 ± 4.30	-4.08 ± 4.74	0.431			
	F	-2.84 ± 1.69	-2.77 ± 2.85	-6.54 ± 5.42				
	M	-1.24 ± 2.55	-2.12 ± 5.56	-1.89 ± 2.79				
	p-value	**0.043**	0.136	0.059				
Peak Ankle Inversion	F + M	0.06 ± 1.58	0.77 ± 2.58	-0.99 ± 4.44	0.324			
	F	-0.61 ± 0.85	0.44 ± 3.16	-3.66 ± 4.24				
	M	0.73 ± 1.88	1.11 ± 1.98	1.68 ± 2.80				
	p-value	0.063	0.730	**0.003**				
Peak Knee Abduction	F + M	-1.27 ± 4.64	-2.57 ± 9.42	-7.31 ± 10.52	0.118			
	F	-2.97 ± 5.39	-6.89 ± 11.11	-14.21 ± 11.07				
	M	0.42 ± 3.15	1.75 ± 4.78	-0.42 ± 2.36				
	p-value	0.105	0.050	**0.011**				
Peak Knee Adduction	F + M	3.59 ± 3.13	6.35 ± 6.86	6.97 ± 7.12	0.177			
	F	2.28 ± 2.99	3.62 ± 6.85	3.38 ± 5.47				
	M	4.89 ± 2.82	9.08 ±	10.56 ± 6.98				
	p-value	0.105	0.136	**0.040**				
Peak Hip Abduction	F + M	-17.73 ± 4.25	-21.47 ± 7.82	-33.99 ± 5.83	**<0.001**	0.503	**<0.001**	**<0.001**
	F	-18.93 ± 4.47	-23.32 ± 8.75	-34.50 ± 6.96				
	M	-16.53 ± 3.85	-19.62 ± 6.77	-33.48 ± 4.81				
	p-value	0.214	0.331	0.721				
Peak Hip Adduction	F + M	-0.90 ± 5.87	4.14 ± 5.76	4.09 ± 10.25	0.067			
	F	-0.24 ± 3.48	3.23 ± 4.88	5.34 ± 10.81				
	M	-1.57 ± 7.73	5.05 ± 6.70	2.84 ± 10.14				
	p-value	0.626	0.518	0.620				

Table 4.75. SSLP Transverse Plane Angle

Table 4.75. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-1.58 ± 11.89	-7.32 ± 18.35	2.01 ± 22.43	0.335			
	F	3.12 ± 5.47	-3.71 ± 21.10	15.97 ± 18.62				
	M	-6.29 ± 14.81	-10.92 ± 15.52	-11.95 ± 16.83				
	p-value	0.076	0.421	**0.004**				
Peak Ankle Internal Rotation	F + M	11.60 ± 14.16	12.05 ± 19.53	22.43 ± 21.94	0.149			
	F	17.71 ± 10.23	16.32 ± 18.47	35.01 ± 19.84				
	M	5.49 ± 15.36	7.79 ± 20.70	9.85 ± 16.53				
	p-value	0.051	0.370	**0.010**				
Peak Knee External Rotation	F + M	-23.07 ± 11.81	-22.80 ± 9.86	-22.67 ± 11.03	0.993			
	F	-19.90 ± 9.70	-27.66 ± 10.25	-25.50 ± 13.49				
	M	-26.24 ± 13.33	-17.93 ± 6.93	-19.84 ± 7.67				
	p-value	0.239	**0.031**	0.290				
Peak Knee Internal Rotation	F + M	-15.21 ± 10.48	-11.79 ± 11.36	-11.50 ± 11.46	0.516			
	F	-12.99 ± 10.85	-16.29 ± 13.42	-14.48 ± 12.16				
	M	-17.43 ± 10.17	-7.30 ± 6.96	-8.51 ± 10.55				
	p-value	0.357	0.093	0.283				
Peak Hip External Rotation	F + M	-0.79 ± 13.35	-6.34 ± 18.39	-24.88 ± 26.61	**0.014**	1.000	**0.016**	0.084
	F	-9.05 ± 11.20	-12.86 ± 19.06	-41.06 ± 21.07				
	M	7.46 ± 9.97	0.18 ± 16.13	-8.70 ± 21.71				
	p-value	**0.005**	0.161	**0.011**				
Peak Hip Internal Rotation	F + M	8.24 ± 12.50	7.85 ± 17.21	-8.75 ± 23.49	**0.008**	1.000	**0.017**	**0.024**
	F	0.00 ± 8.72	-0.51 ± 18.15	-22.99 ± 17.00				
	M	16.48 ± 10.14	16.21 ± 11.93	5.49 ± 20.67				
	p-value	**0.002**	**0.040**	**0.011**				

Table 4.76. SSR Sagittal Plane Mom

Table 4.76. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.02 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.01	**<0.001**	**0.003**	**0.001**	1.000
	F	-0.02 ± 0.01	-0.01 ± 0.01	0.00 ± 0.01				
	M	-0.03 ± 0.02	-0.01 ± 0.01	-0.02 ± 0.02				
	p-value	0.796	1.000	0.077				
Peak Ankle Plantar-flexion	F + M	0.77 ± 0.21	0.87 ± 0.23	0.83 ± 0.20	0.425			
	F	0.73 ± 0.22	0.76 ± 0.17	0.77 ± 0.12				
	M	0.82 ± 0.20	0.98 ± 0.23	0.89 ± 0.25				
	p-value	0.337	**0.036**	0.220				
Peak Knee Flexion	F + M	-0.15 ± 0.09	-0.18 ± 0.08	-0.21 ± 0.07	0.056			
	F	-0.12 ± 0.06	-0.17 ± 0.06	-0.18 ± 0.07				
	M	-0.18 ± 0.11	-0.20 ± 0.10	-0.23 ± 0.07				
	p-value	0.146	0.482	0.153				
Peak Knee Extension	F + M	0.33 ± 0.18	0.44 ± 0.24	0.43 ± 0.28	0.409			
	F	0.36 ± 0.21	0.39 ± 0.22	0.31 ± 0.12				
	M	0.30 ± 0.16	0.49 ± 0.26	0.56 ± 0.35				
	p-value	0.631	0.436	0.190				
Peak Hip Flexion	F + M	-0.20 ± 0.13	-0.29 ± 0.22	-0.46 ± 0.22	**<0.001**	0.409	**<0.001**	**0.028**
	F	-0.27 ± 0.11	-0.34 ± 0.25	-0.51 ± 0.23				
	M	-0.13 ± 0.11	-0.23 ± 0.19	-0.41 ± 0.21				
	p-value	**0.019**	0.436	0.387				
Peak Hip Extension	F + M	0.18 ± 0.10	0.25 ± 0.15	0.22 ± 0.09	0.208			
	F	0.13 ± 0.08	0.21 ± 0.15	0.19 ± 0.06				
	M	0.22 ± 0.11	0.29 ± 0.16	0.25 ± 0.11				
	p-value	**0.043**	0.161	0.258				

Table 4.77. SSR Frontal Plane Mom

Table 4.77. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.09 ± 0.07	-0.08 ± 0.06	-0.07 ± 0.06	0.575			
	F	-0.05 ± 0.04	-0.07 ± 0.04	-0.04 ± 0.02				
	M	-0.13 ± 0.06	-0.09 ± 0.07	-0.10 ± 0.07				
	p-value	**0.002**	0.383	**0.014**				
Peak Ankle Eversion	F + M	0.09 ± 0.06	0.11 ± 0.06	0.12 ± 0.04	0.113			
	F	0.12 ± 0.04	0.11 ± 0.06	0.14 ± 0.02				
	M	0.05 ± 0.05	0.11 ± 0.06	0.11 ± 0.05				
	p-value	**0.004**	0.817	0.179				
Peak Knee Adduction	F + M	-0.21 ± 0.16	-0.18 ± 0.11	-0.24 ± 0.15	0.439			
	F	-0.16 ± 0.13	-0.21 ± 0.14	-0.18 ± 0.09				
	M	-0.26 ± 0.17	-0.15 ± 0.05	-0.30 ± 0.17				
	p-value	0.165	0.730	0.077				
Peak Knee Abduction	F + M	0.34 ± 0.14	0.46 ± 0.17	0.53 ± 0.21	**0.007**	0.127	**0.006**	0.582
	F	0.39 ± 0.15	0.43 ± 0.19	0.62 ± 0.25				
	M	0.30 ± 0.12	0.49 ± 0.15	0.44 ± 0.13				
	p-value	0.176	0.524	0.073				
Peak Hip Adduction	F + M	-0.27 ± 0.18	-0.22 ± 0.09	-0.28 ± 0.15	0.335			
	F	-0.21 ± 0.15	-0.19 ± 0.07	-0.23 ± 0.14				
	M	-0.34 ± 0.19	-0.24 ± 0.10	-0.33 ± 0.15				
	p-value	0.121	0.223	0.135				
Peak Hip Abduction	F + M	0.73 ± 0.17	0.91 ± 0.18	0.88 ± 0.20	**0.008**	**0.012**	**0.041**	0.958
	F	0.78 ± 0.19	0.94 ± 0.11	0.93 ± 0.20				
	M	0.68 ± 0.13	0.87 ± 0.24	0.83 ± 0.20				
	p-value	0.198	0.425	0.309				

Table 4.78. SSR Transverse Plane Mom

Table 4.78. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.03 ± 0.04	-0.04 ± 0.04	-0.07 ± 0.05	**0.041**	0.452	**0.036**	0.884
	F	-0.02 ± 0.03	-0.05 ± 0.05	-0.04 ± 0.04				
	M	-0.05 ± 0.05	-0.04 ± 0.02	-0.09 ± 0.06				
	p-value	0.190	0.863	0.077				
Peak Ankle External Rotation	F + M	0.08 ± 0.03	0.11 ± 0.04	0.14 ± 0.06	**0.002**	**0.111**	**0.001**	0.471
	F	0.09 ± 0.03	0.12 ± 0.04	0.15 ± 0.08				
	M	0.07 ± 0.03	0.11 ± 0.04	0.12 ± 0.02				
	p-value	0.436	0.605	0.605				
Peak Knee Internal Rotation	F + M	-0.04 ± 0.04	-0.04 ± 0.03	-0.06 ± 0.03	**0.047**	1.000	0.223	0.050
	F	-0.03 ± 0.03	-0.04 ± 0.04	-0.05 ± 0.03				
	M	-0.05 ± 0.05	-0.03 ± 0.02	-0.07 ± 0.03				
	p-value	0.393	0.931	0.370				
Peak Knee External Rotation	F + M	0.07 ± 0.02	0.11 ± 0.04	0.12 ± 0.04	**<0.001**	**0.002**	**<0.001**	0.801
	F	0.08 ± 0.02	0.11 ± 0.04	0.13 ± 0.04				
	M	0.06 ± 0.02	0.11 ± 0.04	0.11 ± 0.03				
	p-value	0.155	0.819	0.341				
Peak Hip Internal Rotation	F + M	-0.04 ± 0.03	-0.07 ± 0.06	-0.05 ± 0.03	0.179			
	F	-0.05 ± 0.04	-0.06 ± 0.06	-0.04 ± 0.02				
	M	-0.03 ± 0.02	-0.08 ± 0.06	-0.07 ± 0.04				
	p-value	0.190	0.605	0.113				
Peak Hip External Rotation	F + M	0.05 ± 0.02	0.08 ± 0.04	0.10 ± 0.05	**<0.001**	**0.014**	**<0.001**	0.331
	F	0.04 ± 0.02	0.09 ± 0.04	0.11 ± 0.07				
	M	0.05 ± 0.02	0.08 ± 0.04	0.10 ± 0.03				
	p-value	0.353	0.730	0.863				

Table 4.79. SSR Sagittal Plane Angle

Table 4.79. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-11.00 ± 9.95	1.06 ± 10.40	-2.00 ± 5.86	**<0.001**	**<0.001**	0.064	0.449
	F	-15.96 ± 8.44	-3.84 ± 11.65	-3.86 ± 7.06				
	M	-6.04 ± 9.13	5.96 ± 6.31	-0.15 ± 3.92				
	p-value	**0.021**	**0.041**	0.187				
Peak Ankle Dorsiflex-ion	F + M	9.91 ± 3.24	13.81 ± 6.50	11.89 ± 5.25	0.255			
	F	9.76 ± 3.43	11.82 ± 6.42	9.91 ± 2.49				
	M	10.05 ± 3.21	15.79 ± 6.29	13.86 ± 6.61				
	p-value	1.000	0.161	0.077				
Peak Knee Extension	F + M	13.10 ± 7.61	10.63 ± 8.70	8.91 ± 8.10	0.286			
	F	17.26 ± 7.60	14.16 ± 8.44	9.78 ± 9.60				
	M	8.94 ± 5.09	7.11 ± 7.86	8.03 ± 6.75				
	p-value	**0.010**	0.085	0.661				
Peak Knee Flexion	F + M	26.72 ± 8.48	29.60 ± 8.15	29.55 ± 11.99	0.561			
	F	31.97 ± 7.32	32.64 ± 6.15	28.22 ± 13.08				
	M	21.46 ± 6.08	26.56 ± 9.08	31.09 ± 11.40				
	p-value	**0.003**	0.116	0.627				
Peak Hip Extension	F + M	5.18 ± 4.29	8.67 ± 8.14	2.30 ± 7.22	**0.022**	0.302	0.462	**0.018**
	F	5.59 ± 4.80	6.35 ± 6.08	0.32 ± 6.75				
	M	4.78 ± 3.94	10.98 ± 9.59	4.27 ± 7.52				
	p-value	0.631	0.258	0.489				
Peak Hip Flexion	F + M	16.77 ± 4.82	31.25 ± 7.76	31.10 ± 13.07	**<0.001**	**<0.001**	**<0.001**	1.000
	F	16.50 ± 5.25	29.22 ± 6.23	25.82 ± 9.91				
	M	17.05 ± 4.61	33.27 ± 8.94	36.39 ± 14.22				
	p-value	0.806	0.281	0.086				

Table 4.80. SSR Frontal Plane Angle

Table 4.80. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-4.82 ± 3.39	-2.21 ± 1.88	-5.37 ± 4.50	**0.006**	**0.011**	1.000	**0.025**
	F	-6.43 ± 3.09	-3.28 ± 1.67	-5.14 ± 4.72				
	M	-3.21 ± 2.99	-1.27 ± 1.58	-5.61 ± 4.54				
	p-value	**0.043**	**0.021**	0.863				
Peak Ankle Inversion	F + M	-1.55 ± 2.70	0.58 ± 2.49	-1.68 ± 2.74	**0.023**	0.053	0.998	**0.043**
	F	-2.88 ± 2.18	-0.63 ± 1.79	-1.46 ± 1.78				
	M	-0.23 ± 2.60	1.67 ± 2.61	-1.90 ± 3.56				
	p-value	**0.024**	0.053	0.747				
Peak Knee Abduction	F + M	-16.79 ± 5.18	-24.89 ± 7.93	-34.86 ± 8.44	**<0.001**	**0.003**	**<0.001**	**<0.001**
	F	-17.62 ± 5.11	-24.38 ± 10.25	-32.86 ± 7.74				
	M	-15.96 ± 5.38	-25.39 ± 5.30	-36.87 ± 9.07				
	p-value	0.487	0.796	0.327				
Peak Knee Adduction	F + M	-3.07 ± 4.22	1.89 ± 7.66	1.36 ± 8.53	0.061			
	F	-2.35 ± 4.89	1.43 ± 8.57	3.51 ± 8.25				
	M	-3.79 ± 3.53	2.35 ± 7.13	-0.80 ± 8.73				
	p-value	0.459	0.807	0.297				
Peak Hip Abduction	F + M	-3.02 ± 3.89	-3.84 ± 6.46	-7.64 ± 6.37	0.051			
	F	-4.32 ± 3.44	-5.14 ± 5.26	-8.22 ± 6.94				
	M	-1.73 ± 4.04	-2.70 ± 7.49	-7.06 ± 6.11				
	p-value	0.190	0.321	0.730				
Peak Hip Adduction	F + M	1.76 ± 4.46	4.15 ± 8.24	2.88 ± 4.22	0.461			
	F	0.90 ± 3.46	-0.12 ± 6.30	3.22 ± 4.08				
	M	2.61 ± 5.33	8.43 ± 7.97	2.54 ± 4.59				
	p-value	0.407	**0.023**	0.745				

Table 4.81. SSR Transverse Plane Angle

Table 4.81. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	7.70 ± 15.38	-0.61 ± 17.88	7.41 ± 12.78	0.192			
	F	15.00 ± 10.60	7.85 ± 19.21	7.11 ± 10.59				
	M	0.41 ± 16.39	-9.07 ± 12.20	7.71 ± 15.32				
	p-value	**0.030**	**0.040**	0.924				
Peak Ankle Internal Rotation	F + M	24.73 ± 15.46	17.05 ± 17.66	27.64 ± 13.00	**0.025**	0.088	1.000	**0.037**
	F	31.72 ± 11.15	26.36 ± 18.96	26.89 ± 11.13				
	M	17.74 ± 16.48	7.73 ± 10.38	28.39 ± 15.29				
	p-value	**0.043**	**0.011**	0.863				
Peak Knee External Rotation	F + M	-7.62 ± 12.18	-9.77 ± 18.69	-26.86 ± 19.17	**0.002**	0.971	**0.003**	**0.011**
	F	-14.79 ± 7.05	-15.56 ± 15.96	-28.51 ± 18.15				
	M	-0.46 ± 12.22	-3.97 ± 20.30	-25.20 ± 21.11				
	p-value	**0.009**	0.094	1.000				
Peak Knee Internal Rotation	F + M	-0.74 ± 12.12	0.54 ± 18.45	-12.00 ± 17.22	**0.042**	0.993	0.101	0.066
	F	-7.51 ± 7.15	-6.41 ± 13.84	-12.96 ± 16.84				
	M	6.03 ± 12.53	7.49 ± 20.57	-11.05 ± 18.56				
	p-value	**0.008**	0.112	0.821				
Peak Hip External Rotation	F + M	-19.52 ± 6.28	-22.52 ± 12.20	-27.06 ± 14.01	0.124			
	F	-18.86 ± 4.68	-29.63 ± 8.12	-28.90 ± 17.30				
	M	-20.17 ± 7.78	-15.42 ± 11.69	-25.23 ± 10.50				
	p-value	0.653	**0.009**	0.594				
Peak Hip Internal Rotation	F + M	-10.94 ± 6.90	-11.19 ± 11.65	-14.73 ± 12.75	0.486			
	F	-12.10 ± 4.73	-17.57 ± 7.75	-15.14 ± 14.00				
	M	-9.79 ± 8.67	-4.81 ± 11.69	-14.32 ± 12.21				
	p-value	0.469	**0.015**	0.896				

Table 4.82. SSRP Sagittal Plane Mom

Table 4.82. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.03 ± 0.01	-0.01 ± 0.00	-0.01 ± 0.01	**<0.001**	**<0.001**	**<0.001**	1.000
	F	-0.02 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.01				
	M	-0.03 ± 0.02	-0.01 ± 0.00	-0.01 ± 0.01				
	p-value	0.739	0.222	0.387				
Peak Ankle Plantar-flexion	F + M	0.76 ± 0.23	0.92 ± 0.23	0.88 ± 0.19	0.067			
	F	0.66 ± 0.15	0.79 ± 0.16	0.85 ± 0.15				
	M	0.86 ± 0.26	1.05 ± 0.21	0.91 ± 0.23				
	p-value	0.075	**0.019**	0.546				
Peak Knee Flexion	F + M	-0.14 ± 0.13	-0.24 ± 0.09	-0.27 ± 0.11	**<0.001**	**0.002**	**<0.001**	1.000
	F	-0.10 ± 0.04	-0.22 ± 0.05	-0.23 ± 0.08				
	M	-0.19 ± 0.17	-0.26 ± 0.12	-0.31 ± 0.13				
	p-value	0.099	0.402	0.175				
Peak Knee Extension	F + M	0.40 ± 0.24	0.42 ± 0.21	0.32 ± 0.28	0.444			
	F	0.41 ± 0.23	0.39 ± 0.20	0.19 ± 0.11				
	M	0.40 ± 0.25	0.45 ± 0.22	0.45 ± 0.34				
	p-value	0.959	0.548	**0.043**				
Peak Hip Flexion	F + M	-0.21 ± 0.14	-0.28 ± 0.23	-0.37 ± 0.22	0.051			
	F	-0.26 ± 0.12	-0.36 ± 0.27	-0.47 ± 0.21				
	M	-0.16 ± 0.14	-0.20 ± 0.16	-0.28 ± 0.20				
	p-value	0.087	0.153	0.076				
Peak Hip Extension	F + M	0.20 ± 0.12	0.28 ± 0.10	0.30 ± 0.12	**0.018**	0.056	**0.037**	1.000
	F	0.12 ± 0.05	0.27 ± 0.11	0.21 ± 0.04				
	M	0.27 ± 0.13	0.28 ± 0.10	0.38 ± 0.13				
	p-value	**0.002**	0.816	**0.002**				

Table 4.83. SSRP Frontal Plane Mom

Table 4.83. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.08 ± 0.06	-0.08 ± 0.07	-0.06 ± 0.06	0.433			
	F	-0.05 ± 0.03	-0.06 ± 0.04	-0.04 ± 0.04				
	M	-0.12 ± 0.06	-0.10 ± 0.09	-0.09 ± 0.07				
	p-value	**0.008**	0.195	0.072				
Peak Ankle Eversion	F + M	0.08 ± 0.06	0.11 ± 0.05	0.13 ± 0.05	**0.020**	0.322	**0.016**	0.488
	F	0.11 ± 0.05	0.11 ± 0.05	0.13 ± 0.03				
	M	0.05 ± 0.05	0.10 ± 0.05	0.12 ± 0.06				
	p-value	**0.027**	0.902	0.677				
Peak Knee Adduction	F + M	-0.23 ± 0.14	-0.19 ± 0.09	-0.24 ± 0.13	0.473			
	F	-0.18 ± 0.11	-0.21 ± 0.12	-0.20 ± 0.10				
	M	-0.28 ± 0.15	-0.17 ± 0.05	-0.28 ± 0.15				
	p-value	0.113	0.358	0.178				
Peak Knee Abduction	F + M	0.38 ± 0.15	0.47 ± 0.15	0.57 ± 0.22	**0.006**	0.345	**0.005**	0.229
	F	0.39 ± 0.17	0.48 ± 0.18	0.64 ± 0.24				
	M	0.38 ± 0.13	0.46 ± 0.12	0.50 ± 0.18				
	p-value	0.892	0.862	0.168				
Peak Hip Adduction	F + M	-0.29 ± 0.16	-0.26 ± 0.08	-0.31 ± 0.13	0.590			
	F	-0.24 ± 0.10	-0.23 ± 0.07	-0.25 ± 0.10				
	M	-0.33 ± 0.20	-0.28 ± 0.09	-0.37 ± 0.13				
	p-value	0.263	0.201	**0.043**				
Peak Hip Abduction	F + M	0.74 ± 0.16	0.89 ± 0.17	0.87 ± 0.22	**0.034**	0.052	0.105	0.988
	F	0.74 ± 0.21	0.95 ± 0.13	0.90 ± 0.19				
	M	0.75 ± 0.12	0.83 ± 0.19	0.84 ± 0.26				
	p-value	0.922	0.134	0.553				

Table 4.84. SSRP Transverse Plane Mom

Table 4.84. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.03 ± 0.03	-0.05 ± 0.05	-0.06 ± 0.05	0.075			
	F	-0.02 ± 0.02	-0.05 ± 0.06	-0.05 ± 0.04				
	M	-0.04 ± 0.04	-0.04 ± 0.03	-0.08 ± 0.06				
	p-value	0.247	0.297	0.258				
Peak Ankle External Rotation	F + M	0.10 ± 0.04	0.14 ± 0.06	0.18 ± 0.07	**<0.001**	**0.018**	**<0.001**	0.380
	F	0.09 ± 0.02	0.15 ± 0.08	0.19 ± 0.08				
	M	0.11 ± 0.05	0.13 ± 0.04	0.16 ± 0.05				
	p-value	0.353	0.605	0.489				
Peak Knee Internal Rotation	F + M	-0.04 ± 0.03	-0.04 ± 0.04	-0.07 ± 0.03	**0.004**	1.000	**0.009**	**0.011**
	F	-0.03 ± 0.02	-0.05 ± 0.05	-0.06 ± 0.03				
	M	-0.05 ± 0.04	-0.04 ± 0.03	-0.08 ± 0.04				
	p-value	0.353	0.796	0.258				
Peak Knee External Rotation	F + M	0.09 ± 0.04	0.13 ± 0.04	0.15 ± 0.06	**<0.001**	**0.003**	**<0.001**	1.000
	F	0.08 ± 0.02	0.13 ± 0.04	0.15 ± 0.05				
	M	0.10 ± 0.05	0.13 ± 0.04	0.14 ± 0.07				
	p-value	0.165	0.931	0.546				
Peak Hip Internal Rotation	F + M	-0.04 ± 0.03	-0.06 ± 0.05	-0.04 ± 0.03	0.415			
	F	-0.04 ± 0.04	-0.05 ± 0.04	-0.04 ± 0.02				
	M	-0.04 ± 0.03	-0.07 ± 0.05	-0.05 ± 0.04				
	p-value	0.631	0.546	0.387				
Peak Hip External Rotation	F + M	0.06 ± 0.03	0.09 ± 0.03	0.13 ± 0.06	**<0.001**	0.220	**<0.001**	**0.003**
	F	0.05 ± 0.02	0.09 ± 0.03	0.14 ± 0.07				
	M	0.08 ± 0.02	0.08 ± 0.03	0.12 ± 0.05				
	p-value	**0.011**	0.489	0.730				

Table 4.85. SSRP Sagittal Plane Angle

Table 4.85. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-11.36 ± 9.55	-0.01 ± 8.13	-7.34 ± 8.84	**0.001**	**<0.001**	0.426	0.053
	F	-17.09 ± 7.34	-5.93 ± 7.44	-11.30 ± 9.28				
	M	-5.62 ± 8.09	5.25 ± 4.19	-3.39 ± 6.69				
	p-value	**0.004**	**0.001**	0.055				
Peak Ankle Dorsiflex-ion	F + M	10.90 ± 4.20	11.58 ± 6.02	9.01 ± 5.09	0.302			
	F	10.58 ± 4.21	9.61 ± 7.00	7.24 ± 2.18				
	M	11.22 ± 4.38	13.54 ± 4.40	10.77 ± 6.57				
	p-value	0.746	0.173	0.146				
Peak Knee Extension	F + M	12.55 ± 8.03	10.19 ± 8.99	9.29 ± 7.05	0.437			
	F	15.01 ± 9.29	13.88 ± 10.10	9.01 ± 9.16				
	M	10.10 ± 6.04	6.51 ± 6.24	9.56 ± 4.63				
	p-value	0.178	0.081	0.874				
Peak Knee Flexion	F + M	24.60 ± 8.69	27.42 ± 8.56	32.02 ± 11.69	0.070			
	F	29.41 ± 7.39	31.23 ± 8.38	32.67 ± 13.79				
	M	19.79 ± 7.32	23.62 ± 7.28	31.37 ± 9.97				
	p-value	**0.009**	0.056	0.822				
Peak Hip Extension	F + M	5.10 ± 4.54	7.22 ± 7.40	1.12 ± 7.54	**0.024**	0.688	0.187	**0.022**
	F	4.34 ± 4.42	4.41 ± 5.87	-1.57 ± 6.75				
	M	5.86 ± 4.76	10.03 ± 8.01	3.80 ± 7.69				
	p-value	0.466	0.109	0.135				
Peak Hip Flexion	F + M	18.70 ± 7.00	27.60 ± 8.71	27.72 ± 13.34	**0.009**	**0.024**	**0.022**	1.000
	F	17.82 ± 8.11	23.99 ± 8.78	23.88 ± 10.13				
	M	19.59 ± 5.99	31.20 ± 7.40	31.57 ± 15.57				
	p-value	0.585	0.078	0.232				

Table 4.86. SSRP Frontal Plane Angle

Table 4.86. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-4.63 ± 3.52	-2.38 ± 2.06	-4.65 ± 3.36	0.085			
	F	-6.12 ± 2.98	-3.64 ± 1.14	-3.76 ± 1.49				
	M	-3.14 ± 3.51	-1.25 ± 2.08	-5.44 ± 4.38				
	p-value	**0.043**	**0.015**	0.743				
Peak Ankle Inversion	F + M	-1.26 ± 2.95	0.39 ± 2.26	-2.07 ± 2.71	**0.028**	0.187	0.728	**0.026**
	F	-2.69 ± 2.48	-0.74 ± 2.14	-1.81 ± 1.85				
	M	0.18 ± 2.78	1.40 ± 1.95	-2.33 ± 3.48				
	p-value	**0.026**	**0.048**	0.695				
Peak Knee Abduction	F + M	-20.47 ± 4.59	-26.39 ± 6.89	-36.75 ± 6.00	**<0.001**	**0.009**	**<0.001**	**<0.001**
	F	-21.09 ± 4.39	-25.71 ± 7.66	-36.40 ± 4.25				
	M	-19.85 ± 4.92	-27.07 ± 6.43	-37.10 ± 7.63				
	p-value	0.561	0.689	0.811				
Peak Knee Adduction	F + M	-3.44 ± 4.74	1.46 ± 7.34	0.37 ± 9.37	0.103			
	F	-2.77 ± 5.03	2.89 ± 8.53	4.00 ± 6.44				
	M	-4.10 ± 4.59	0.02 ± 6.07	-3.26 ± 10.74				
	p-value	0.544	0.423	0.101				
Peak Hip Abduction	F + M	-2.61 ± 4.22	-3.26 ± 6.61	-8.11 ± 6.06	**0.009**	0.980	**0.012**	**0.041**
	F	-4.16 ± 3.44	-5.18 ± 3.94	-8.68 ± 6.29				
	M	-1.06 ± 4.52	-1.55 ± 8.17	-7.55 ± 6.15				
	p-value	0.101	0.273	0.706				
Peak Hip Adduction	F + M	2.97 ± 5.16	4.12 ± 8.08	2.53 ± 4.50	0.720			
	F	2.13 ± 3.74	0.42 ± 6.00	3.57 ± 4.54				
	M	3.82 ± 6.37	7.82 ± 8.47	1.49 ± 4.48				
	p-value	1.000	**0.024**	0.340				

Table 4.87. SSRP Transverse Plane Angle

Table 4.87. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	6.28 ± 16.46	0.48 ± 18.69	10.18 ± 12.09	0.097			
	F	14.14 ± 11.99	9.03 ± 21.96	9.79 ± 10.25				
	M	-1.58 ± 17.05	-8.08 ± 9.79	10.58 ± 14.33				
	p-value	**0.028**	**0.049**	0.894				
Peak Ankle Internal Rotation	F + M	23.83 ± 16.51	18.04 ± 16.95	27.77 ± 12.14	0.076			
	F	30.68 ± 11.29	28.23 ± 15.55	27.94 ± 11.10				
	M	16.98 ± 18.54	7.86 ± 11.62	27.60 ± 13.78				
	p-value	**0.043**	**0.003**	0.931				
Peak Knee External Rotation	F + M	-10.28 ± 12.31	-11.50 ± 17.89	-26.91 ± 16.66	**0.003**	0.993	**0.006**	**0.014**
	F	-15.17 ± 7.77	-17.09 ± 16.30	-28.23 ± 14.40				
	M	-5.40 ± 14.36	-5.90 ± 18.54	-25.60 ± 19.45				
	p-value	0.089	0.063	0.931				
Peak Knee Internal Rotation	F + M	-2.67 ± 11.84	-0.38 ± 17.09	-14.24 ± 16.42	**0.018**	0.954	0.066	**0.025**
	F	-7.84 ± 8.35	-7.14 ± 13.60	-14.46 ± 14.60				
	M	2.49 ± 12.92	6.39 ± 18.25	-14.02 ± 18.97				
	p-value	**0.048**	0.093	0.957				
Peak Hip External Rotation	F + M	-19.64 ± 7.58	-21.91 ± 11.63	-26.71 ± 14.40	0.164			
	F	-19.59 ± 5.22	-29.12 ± 8.27	-28.86 ± 17.96				
	M	-19.70 ± 9.69	-14.71 ± 10.10	-24.56 ± 10.36				
	p-value	0.976	**0.004**	0.543				
Peak Hip Internal Rotation	F + M	-10.62 ± 7.32	-12.32 ± 10.96	-13.98 ± 14.51	0.654			
	F	-10.87 ± 5.37	-18.40 ± 8.61	-14.49 ± 16.83				
	M	-10.37 ± 9.17	-6.24 ± 9.90	-13.47 ± 12.80				
	p-value	0.884	**0.013**	0.886				

Table 4.88. ST Sagittal Plane Mom

Table 4.88. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.03 ± 0.02	-0.02 ± 0.02	-0.01 ± 0.01	0.056			
	F	-0.02 ± 0.01	-0.03 ± 0.02	-0.01 ± 0.01				
	M	-0.03 ± 0.03	-0.01 ± 0.01	-0.02 ± 0.01				
	p-value	0.382	0.258	0.340				
Peak Ankle Plantar-flexion	F + M	1.18 ± 0.20	1.41 ± 0.25	1.27 ± 0.23	**0.012**	**0.009**	0.482	0.231
	F	1.16 ± 0.12	1.23 ± 0.18	1.16 ± 0.22				
	M	1.19 ± 0.27	1.59 ± 0.18	1.39 ± 0.18				
	p-value	0.727	**0.001**	**0.025**				
Peak Knee Flexion	F + M	-0.54 ± 0.25	-0.43 ± 0.22	-0.51 ± 0.34	0.463			
	F	-0.43 ± 0.25	-0.36 ± 0.23	-0.33 ± 0.22				
	M	-0.65 ± 0.21	-0.50 ± 0.19	-0.69 ± 0.34				
	p-value	**0.045**	0.190	**0.018**				
Peak Knee Extension	F + M	0.11 ± 0.19	0.21 ± 0.17	0.22 ± 0.16	**0.008**	**0.028**	**0.018**	1.000
	F	0.18 ± 0.24	0.26 ± 0.18	0.23 ± 0.20				
	M	0.04 ± 0.06	0.16 ± 0.15	0.21 ± 0.12				
	p-value	0.123	0.387	0.863				
Peak Hip Flexion	F + M	-0.32 ± 0.17	-0.52 ± 0.18	-0.51 ± 0.18	**0.001**	**0.004**	**0.006**	0.999
	F	-0.35 ± 0.19	-0.48 ± 0.19	-0.52 ± 0.16				
	M	-0.30 ± 0.16	-0.55 ± 0.19	-0.51 ± 0.20				
	p-value	0.569	0.440	0.883				
Peak Hip Extension	F + M	0.66 ± 0.26	0.58 ± 0.24	0.64 ± 0.33	0.605			
	F	0.63 ± 0.26	0.46 ± 0.22	0.45 ± 0.25				
	M	0.70 ± 0.28	0.69 ± 0.21	0.83 ± 0.29				
	p-value	0.247	**0.024**	0.931				

Table 4.89. ST Frontal Plane Mom

Table 4.89. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.02 ± 0.03	-0.02 ± 0.03	-0.01 ± 0.02	0.257			
	F	0.00 ± 0.00	-0.02 ± 0.03	0.00 ± 0.01				
	M	-0.04 ± 0.04	-0.03 ± 0.03	-0.02 ± 0.02				
	p-value	**0.035**	0.094	**0.019**				
Peak Ankle Eversion	F + M	0.18 ± 0.10	0.21 ± 0.09	0.21 ± 0.07	0.545			
	F	0.25 ± 0.06	0.22 ± 0.08	0.24 ± 0.08				
	M	0.12 ± 0.08	0.19 ± 0.11	0.18 ± 0.05				
	p-value	**0.001**	0.583	0.084				
Peak Knee Adduction	F + M	-0.27 ± 0.10	-0.18 ± 0.09	-0.24 ± 0.10	**0.013**	**0.010**	0.576	0.190
	F	-0.27 ± 0.12	-0.20 ± 0.11	-0.24 ± 0.09				
	M	-0.28 ± 0.08	-0.15 ± 0.08	-0.23 ± 0.12				
	p-value	0.782	0.347	0.866				
Peak Knee Abduction	F + M	0.24 ± 0.15	0.40 ± 0.17	0.56 ± 0.22	**<0.001**	0.114	**<0.001**	0.144
	F	0.27 ± 0.16	0.47 ± 0.18	0.52 ± 0.22				
	M	0.22 ± 0.14	0.32 ± 0.13	0.59 ± 0.23				
	p-value	0.529	0.161	0.546				
Peak Hip Adduction	F + M	-0.60 ± 0.13	-0.33 ± 0.18	-0.57 ± 0.24	**<0.001**	**<0.001**	0.946	**0.001**
	F	-0.62 ± 0.14	-0.40 ± 0.18	-0.55 ± 0.19				
	M	-0.59 ± 0.13	-0.27 ± 0.16	-0.59 ± 0.30				
	p-value	0.619	0.149	0.715				
Peak Hip Abduction	F + M	0.27 ± 0.15	0.61 ± 0.24	0.74 ± 0.26	**<0.001**	**<0.001**	**<0.001**	0.196
	F	0.32 ± 0.17	0.69 ± 0.23	0.79 ± 0.19				
	M	0.23 ± 0.12	0.53 ± 0.24	0.70 ± 0.32				
	p-value	0.123	0.161	0.931				

Table 4.90. ST Transverse Plane Mom

Table 4.90. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.15 ± 0.07	-0.13 ± 0.07	-0.11 ± 0.06	0.272			
	F	-0.14 ± 0.08	-0.10 ± 0.07	-0.08 ± 0.05				
	M	-0.16 ± 0.07	-0.15 ± 0.06	-0.15 ± 0.05				
	p-value	0.404	0.128	**0.018**				
Peak Ankle External Rotation	F + M	0.08 ± 0.06	0.10 ± 0.07	0.13 ± 0.07	**0.045**	0.770	**0.038**	0.557
	F	0.08 ± 0.06	0.14 ± 0.07	0.14 ± 0.08				
	M	0.07 ± 0.06	0.07 ± 0.06	0.12 ± 0.06				
	p-value	0.853	**0.031**	0.730				
Peak Knee Internal Rotation	F + M	-0.10 ± 0.04	-0.09 ± 0.04	-0.10 ± 0.04	0.662			
	F	-0.12 ± 0.05	-0.10 ± 0.05	-0.09 ± 0.03				
	M	-0.09 ± 0.03	-0.09 ± 0.03	-0.12 ± 0.04				
	p-value	0.143	0.796	0.094				
Peak Knee External Rotation	F + M	0.05 ± 0.04	0.08 ± 0.04	0.10 ± 0.05	**0.003**	0.082	**0.003**	0.857
	F	0.04 ± 0.03	0.09 ± 0.04	0.08 ± 0.04				
	M	0.06 ± 0.05	0.07 ± 0.04	0.12 ± 0.05				
	p-value	0.143	0.258	0.063				
Peak Hip Internal Rotation	F + M	-0.08 ± 0.04	-0.10 ± 0.03	-0.11 ± 0.05	0.169			
	F	-0.10 ± 0.04	-0.09 ± 0.04	-0.10 ± 0.06				
	M	-0.07 ± 0.05	-0.10 ± 0.02	-0.12 ± 0.04				
	p-value	0.089	0.730	0.297				
Peak Hip External Rotation	F + M	0.06 ± 0.03	0.07 ± 0.04	0.07 ± 0.03	0.371			
	F	0.05 ± 0.03	0.07 ± 0.03	0.06 ± 0.04				
	M	0.07 ± 0.02	0.06 ± 0.04	0.08 ± 0.03				
	p-value	0.063	0.546	0.340				

Table 4.91. ST Sagittal Plane Angle

Table 4.91. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-24.62 ± 9.84	-25.94 ± 9.61	-26.03 ± 11.99	0.835			
	F	-29.88 ± 9.26	-28.95 ± 11.92	-32.41 ± 13.76				
	M	-19.36 ± 7.56	-22.93 ± 5.79	-19.65 ± 4.96				
	p-value	**0.012**	0.192	**0.019**				
Peak Ankle Dorsiflex-ion	F + M	1.34 ± 8.55	8.09 ± 6.51	10.25 ± 6.99	**0.001**	**0.022**	**0.002**	0.767
	F	1.35 ± 11.30	5.13 ± 6.56	11.85 ± 8.70				
	M	1.32 ± 5.18	11.05 ± 5.23	8.65 ± 4.75				
	p-value	0.994	0.050	0.348				
Peak Knee Extension	F + M	4.17 ± 6.51	4.30 ± 7.96	3.06 ± 7.04	0.849			
	F	7.35 ± 3.97	4.11 ± 7.82	4.68 ± 6.85				
	M	1.00 ± 7.16	4.49 ± 8.56	1.45 ± 7.25				
	p-value	**0.025**	0.922	0.346				
Peak Knee Flexion	F + M	28.26 ± 8.50	30.30 ± 7.77	37.97 ± 6.34	**<0.001**	0.795	**<0.001**	**0.012**
	F	30.08 ± 9.93	32.31 ± 8.05	36.75 ± 3.88				
	M	26.44 ± 6.81	28.29 ± 7.39	39.19 ± 8.19				
	p-value	0.579	0.340	0.546				
Peak Hip Extension	F + M	7.72 ± 8.48	1.57 ± 11.90	6.88 ± 8.63	0.126			
	F	11.24 ± 8.06	8.34 ± 11.72	11.81 ± 5.63				
	M	4.21 ± 7.71	-5.20 ± 7.77	1.95 ± 8.48				
	p-value	0.062	**0.011**	**0.010**				
Peak Hip Flexion	F + M	36.03 ± 9.66	43.20 ± 9.43	53.23 ± 11.15	**<0.001**	0.096	**<0.001**	**0.013**
	F	42.89 ± 6.87	48.34 ± 8.92	57.82 ± 10.03				
	M	29.18 ± 6.72	38.06 ± 7.07	48.63 ± 10.78				
	p-value	**<0.001**	**0.015**	0.079				

Table 4.92. ST Frontal Plane Angle

Table 4.92. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-4.25 ± 2.07	-3.96 ± 4.02	-4.82 ± 4.54	0.794			
	F	-4.90 ± 2.51	-3.99 ± 3.23	-7.40 ± 4.62				
	M	-3.59 ± 3.37	-3.93 ± 4.89	-2.24 ± 2.74				
	p-value	0.218	0.863	**0.008**				
Peak Ankle Inversion	F + M	2.33 ± 2.27	1.81 ± 2.85	0.21 ± 2.79	**0.046**	0.904	**0.048**	0.205
	F	0.99 ± 1.95	0.48 ± 2.44	-1.78 ± 2.46				
	M	3.66 ± 1.75	3.13 ± 2.72	2.19 ± 1.26				
	p-value	**0.005**	**0.046**	**0.001**				
Peak Knee Abduction	F + M	-1.82 ± 4.58	-1.86 ± 6.84	-5.06 ± 8.09	0.240			
	F	-2.60 ± 5.43	-3.21 ± 7.70	-10.46 ± 7.82				
	M	-1.04 ± 3.66	-0.51 ± 5.99	0.34 ± 3.52				
	p-value	0.631	0.340	**0.011**				
Peak Knee Adduction	F + M	13.57 ± 8.31	16.61 ± 11.42	8.13 ± 8.89	**0.033**	0.699	0.235	**0.031**
	F	9.05 ± 6.77	9.74 ± 11.05	2.59 ± 6.48				
	M	18.09 ± 7.40	23.48 ± 6.99	13.66 ± 7.56				
	p-value	**0.011**	**0.006**	**0.004**				
Peak Hip Abduction	F + M	-16.77 ± 5.48	-11.73 ± 5.66	-13.34 ± 5.01	**0.018**	**0.017**	0.157	0.749
	F	-16.60 ± 5.67	-8.80 ± 4.12	-13.00 ± 5.99				
	M	-16.93 ± 5.58	-14.65 ± 5.66	-13.69 ± 4.14				
	p-value	0.898	**0.023**	0.779				
Peak Hip Adduction	F + M	-6.31 ± 5.26	0.19 ± 3.79	2.72 ± 5.92	**<0.001**	**<0.001**	**<0.001**	0.424
	F	-6.60 ± 5.65	0.13 ± 3.61	2.00 ± 5.45				
	M	-6.02 ± 5.13	0.26 ± 4.18	3.44 ± 6.61				
	p-value	0.812	0.945	0.623				

Table 4.93. ST Transverse Plane Angle

Table 4.93. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-15.43 ± 14.37	-13.10 ± 17.96	-4.68 ± 15.63	0.108			
	F	-7.01 ± 11.28	-4.23 ± 16.21	6.09 ± 13.67				
	M	-23.86 ± 12.29	-21.98 ± 15.66	-15.46 ± 8.43				
	p-value	**0.005**	**0.031**	**0.001**				
Peak Ankle Internal Rotation	F + M	24.42 ± 16.11	21.54 ± 18.81	24.03 ± 18.22	0.866			
	F	28.88 ± 13.16	22.70 ± 19.35	35.73 ± 14.64				
	M	19.95 ± 18.17	20.38 ± 19.35	12.34 ± 13.54				
	p-value	0.224	0.803	**0.003**				
Peak Knee External Rotation	F + M	-31.87 ± 15.18	-29.04 ± 10.36	-25.84 ± 11.06	0.340			
	F	-27.11 ± 10.61	-30.22 ± 10.47	-28.28 ± 12.79				
	M	-36.62 ± 17.99	-27.86 ± 10.74	-23.40 ± 9.11				
	p-value	0.167	0.643	0.365				
Peak Knee Internal Rotation	F + M	-13.50 ± 9.64	-9.81 ± 9.88	-6.20 ± 10.42	**0.008**	0.591	0.082	0.626
	F	-11.67 ± 9.63	-13.46 ± 11.51	-8.24 ± 12.30				
	M	-15.32 ± 9.81	-6.15 ± 6.71	-4.15 ± 8.36				
	p-value	0.413	0.119	0.422				
Peak Hip External Rotation	F + M	-7.33 ± 10.52	-5.14 ± 17.01	-23.57 ± 24.58	**0.006**	0.975	**0.023**	**0.010**
	F	-11.94 ± 9.91	-10.39 ± 20.63	-39.57 ± 17.99				
	M	-2.71 ± 9.39	0.11 ± 11.28	-7.56 ± 19.59				
	p-value	0.063	0.222	**0.006**				
Peak Hip Internal Rotation	F + M	10.73 ± 12.64	10.34 ± 17.43	-5.71 ± 25.74	**0.017**	1.000	**0.032**	**0.045**
	F	2.45 ± 9.20	2.36 ± 18.39	-21.38 ± 20.13				
	M	19.00 ± 10.02	18.31 ± 12.83	9.97 ± 21.21				
	p-value	**0.001**	**0.049**	**0.005**				

Table 4.94. STP Sagittal Plane Mom

Table 4.94. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsi-flexion	F + M	-0.03 ± 0.02	-0.02 ± 0.01	-0.01 ± 0.02	**0.003**	0.271	**0.002**	0.240
	F	-0.03 ± 0.02	-0.02 ± 0.01	-0.02 ± 0.02				
	M	-0.03 ± 0.02	-0.02 ± 0.02	-0.01 ± 0.01				
	p-value	0.815	0.863	0.605				
Peak Ankle Plantar-flexion	F + M	1.27 ± 0.21	1.35 ± 0.28	1.34 ± 0.27	0.527			
	F	1.20 ± 0.06	1.22 ± 0.21	1.16 ± 0.17				
	M	1.34 ± 0.28	1.47 ± 0.28	1.53 ± 0.23				
	p-value	0.139	0.052	**0.002**				
Peak Knee Flexion	F + M	-0.56 ± 0.34	-0.41 ± 0.24	-0.40 ± 0.29	0.189			
	F	-0.39 ± 0.28	-0.34 ± 0.25	-0.26 ± 0.22				
	M	-0.73 ± 0.30	-0.48 ± 0.24	-0.54 ± 0.29				
	p-value	**0.035**	0.258	**0.031**				
Peak Knee Extension	F + M	0.19 ± 0.17	0.26 ± 0.15	0.30 ± 0.20	0.135			
	F	0.26 ± 0.17	0.23 ± 0.10	0.31 ± 0.24				
	M	0.12 ± 0.16	0.29 ± 0.19	0.30 ± 0.18				
	p-value	0.063	0.931	0.666				
Peak Hip Flexion	F + M	-0.53 ± 0.23	-0.66 ± 0.26	-0.66 ± 0.22	0.097			
	F	-0.60 ± 0.22	-0.64 ± 0.26	-0.59 ± 0.16				
	M	-0.45 ± 0.22	-0.69 ± 0.27	-0.72 ± 0.27				
	p-value	0.152	0.716	0.234				
Peak Hip Extension	F + M	0.57 ± 0.30	0.60 ± 0.27	0.55 ± 0.32	0.878			
	F	0.52 ± 0.22	0.46 ± 0.18	0.35 ± 0.24				
	M	0.63 ± 0.36	0.74 ± 0.28	0.75 ± 0.26				
	p-value	0.417	**0.024**	**0.004**				

Table 4.95. STP Frontal Plane Mom

Table 4.95. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion	F + M	-0.03 ± 0.04	-0.02 ± 0.03	-0.01 ± 0.02	0.284			
	F	0.00 ± 0.01	-0.02 ± 0.02	0.00 ± 0.01				
	M	-0.06 ± 0.04	-0.03 ± 0.03	-0.02 ± 0.02				
	p-value	**0.006**	0.605	**0.024**				
Peak Ankle Eversion	F + M	0.18 ± 0.11	0.19 ± 0.10	0.20 ± 0.08	0.862			
	F	0.26 ± 0.07	0.18 ± 0.11	0.22 ± 0.09				
	M	0.11 ± 0.08	0.20 ± 0.09	0.17 ± 0.06				
	p-value	**<0.001**	0.787	0.188				
Peak Knee Adduction	F + M	-0.41 ± 0.16	-0.17 ± 0.12	-0.27 ± 0.14	**<0.001**	**<0.001**	**0.013**	0.114
	F	-0.43 ± 0.17	-0.16 ± 0.15	-0.30 ± 0.15				
	M	-0.38 ± 0.14	-0.18 ± 0.09	-0.25 ± 0.14				
	p-value	0.684	0.730	0.387				
Peak Knee Abduction	F + M	0.21 ± 0.12	0.37 ± 0.19	0.50 ± 0.16	**<0.001**	**0.012**	**<0.001**	**0.042**
	F	0.24 ± 0.13	0.46 ± 0.20	0.49 ± 0.16				
	M	0.18 ± 0.12	0.27 ± 0.14	0.51 ± 0.16				
	p-value	0.243	**0.033**	0.893				
Peak Hip Adduction	F + M	-0.74 ± 0.19	-0.33 ± 0.28	-0.53 ± 0.23	**<0.001**	**<0.001**	**0.045**	0.137
	F	-0.81 ± 0.21	-0.29 ± 0.24	-0.57 ± 0.21				
	M	-0.67 ± 0.13	-0.38 ± 0.33	-0.48 ± 0.26				
	p-value	0.098	0.556	0.401				
Peak Hip Abduction	F + M	0.29 ± 0.19	0.53 ± 0.26	0.66 ± 0.26	**<0.001**	**0.017**	**<0.001**	0.387
	F	0.37 ± 0.22	0.66 ± 0.26	0.75 ± 0.21				
	M	0.20 ± 0.09	0.40 ± 0.19	0.57 ± 0.29				
	p-value	**0.029**	0.113	0.436				

Table 4.96. STP Transverse Plane Mom

Table 4.96. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation	F + M	-0.21 ± 0.10	-0.13 ± 0.09	-0.14 ± 0.08	**0.016**	**0.026**	0.059	0.984
	F	-0.19 ± 0.10	-0.06 ± 0.06	-0.09 ± 0.06				
	M	-0.23 ± 0.11	-0.19 ± 0.06	-0.18 ± 0.08				
	p-value	0.579	**0.001**	**0.014**				
Peak Ankle External Rotation	F + M	0.08 ± 0.06	0.10 ± 0.07	0.13 ± 0.07	0.055			
	F	0.08 ± 0.06	0.15 ± 0.07	0.16 ± 0.08				
	M	0.07 ± 0.06	0.04 ± 0.02	0.10 ± 0.04				
	p-value	0.481	**<0.001**	0.258				
Peak Knee Internal Rotation	F + M	-0.16 ± 0.07	-0.10 ± 0.05	-0.12 ± 0.06	**0.027**	**0.023**	0.327	0.557
	F	-0.17 ± 0.08	-0.08 ± 0.05	-0.09 ± 0.04				
	M	-0.14 ± 0.06	-0.12 ± 0.05	-0.15 ± 0.06				
	p-value	0.449	0.138	**0.025**				
Peak Knee External Rotation	F + M	0.04 ± 0.03	0.06 ± 0.03	0.08 ± 0.03	**0.001**	0.096	**0.001**	0.444
	F	0.04 ± 0.02	0.07 ± 0.03	0.08 ± 0.03				
	M	0.05 ± 0.04	0.05 ± 0.03	0.09 ± 0.03				
	p-value	1.000	0.136	0.546				
Peak Hip Internal Rotation	F + M	-0.11 ± 0.06	-0.10 ± 0.05	-0.12 ± 0.06	0.757			
	F	-0.10 ± 0.04	-0.09 ± 0.04	-0.10 ± 0.06				
	M	-0.12 ± 0.08	-0.11 ± 0.05	-0.13 ± 0.05				
	p-value	0.579	0.258	0.063				
Peak Hip External Rotation	F + M	0.06 ± 0.03	0.05 ± 0.03	0.06 ± 0.02	0.513			
	F	0.06 ± 0.02	0.06 ± 0.03	0.05 ± 0.02				
	M	0.07 ± 0.03	0.05 ± 0.03	0.07 ± 0.02				
	p-value	0.783	0.560	0.079				

Table 4.97. STP Sagittal Plane Angle

Table 4.97. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion	F + M	-29.28 ± 9.93	-24.89 ± 8.31	-26.01 ± 12.29	0.395			
	F	-34.70 ± 9.80	-28.58 ± 8.46	-33.61 ± 12.56				
	M	-23.86 ± 6.84	-21.20 ± 6.67	-18.41 ± 5.74				
	p-value	**0.010**	0.057	**0.005**				
Peak Ankle Dorsiflex-ion	F + M	2.61 ± 8.25	8.71 ± 10.86	14.32 ± 8.74	**<0.001**	0.155	**0.001**	0.252
	F	2.32 ± 10.22	3.56 ± 9.37	13.35 ± 10.87				
	M	2.90 ± 6.24	13.86 ± 10.15	15.29 ± 6.49				
	p-value	0.879	**0.040**	0.652				
Peak Knee Extension	F + M	2.19 ± 7.38	4.05 ± 7.61	5.32 ± 8.99	0.482			
	F	5.52 ± 3.89	4.17 ± 8.84	6.33 ± 7.87				
	M	-1.15 ± 8.66	3.93 ± 6.69	4.31 ± 10.36				
	p-value	**0.039**	0.948	0.648				
Peak Knee Flexion	F + M	28.04 ± 8.84	29.04 ± 7.90	39.11 ± 8.36	**0.002**	1.000	**0.002**	**0.019**
	F	29.12 ± 8.57	31.39 ± 6.74	36.59 ± 6.49				
	M	26.96 ± 9.43	26.70 ± 8.64	41.64 ± 9.59				
	p-value	0.684	0.297	0.436				
Peak Hip Extension	F + M	-0.09 ± 10.19	-1.68 ± 12.07	4.04 ± 9.80	0.263			
	F	4.11 ± 8.53	4.79 ± 11.57	10.00 ± 5.64				
	M	-4.29 ± 10.35	-8.15 ± 9.04	-1.93 ± 9.59				
	p-value	0.063	**0.018**	**0.005**				
Peak Hip Flexion	F + M	33.69 ± 10.96	40.28 ± 11.09	51.76 ± 10.28	**<0.001**	0.182	**<0.001**	**0.007**
	F	40.57 ± 9.43	47.72 ± 11.03	54.57 ± 10.20				
	M	26.82 ± 7.73	32.85 ± 3.94	48.96 ± 10.13				
	p-value	**0.002**	**0.002**	0.259				

Table 4.98. STP Frontal Plane Angle

Table 4.98. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion	F + M	-4.87 ± 4.00	-3.34 ± 3.89	-5.32 ± 4.95	0.491			
	F	-5.44 ± 3.01	-4.85 ± 3.72	-7.95 ± 5.27				
	M	-4.29 ± 4.90	-1.83 ± 3.63	-2.69 ± 2.96				
	p-value	0.190	0.136	**0.019**				
Peak Ankle Inversion	F + M	2.39 ± 2.06	1.28 ± 3.16	-0.29 ± 3.86	**0.035**	0.606	**0.029**	0.349
	F	1.26 ± 1.75	-0.63 ± 2.56	-2.84 ± 3.70				
	M	3.52 ± 1.75	3.18 ± 2.53	2.27 ± 1.83				
	p-value	**0.010**	**0.006**	**0.002**				
Peak Knee Abduction	F + M	-3.03 ± 4.86	-2.83 ± 8.16	-2.83 ± 5.98	0.994			
	F	-4.31 ± 5.40	-3.69 ± 7.22	-6.76 ± 4.94				
	M	-1.75 ± 4.14	-1.97 ± 9.36	0.67 ± 4.58				
	p-value	0.393	0.605	**0.021**				
Peak Knee Adduction	F + M	14.12 ± 8.85	18.08 ± 11.31	10.04 ± 11.66	0.085			
	F	9.40 ± 7.43	11.90 ± 12.31	2.77 ± 9.38				
	M	18.84 ± 7.79	24.25 ± 5.87	17.31 ± 9.05				
	p-value	**0.012**	**0.015**	**0.004**				
Peak Hip Abduction	F + M	-19.08 ± 8.09	-12.31 ± 5.43	-11.64 ± 5.63	**0.001**	**0.007**	**0.003**	0.986
	F	-18.36 ± 7.65	-8.64 ± 2.85	-10.56 ± 5.05				
	M	-19.81 ± 8.86	-15.98 ± 4.91	-12.71 ± 6.26				
	p-value	0.853	**0.004**	0.489				
Peak Hip Adduction	F + M	-7.58 ± 5.75	0.13 ± 5.29	1.00 ± 6.60	**<0.001**	**<0.001**	**<0.001**	0.960
	F	-5.33 ± 4.79	1.26 ± 4.73	1.44 ± 5.77				
	M	-9.83 ± 5.96	-0.99 ± 5.85	0.55 ± 7.66				
	p-value	0.079	0.382	0.784				

Table 4.99. STP Transverse Plane Angle

Table 4.99. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation	F + M	-16.24 ± 13.43	-10.16 ± 21.17	-2.36 ± 20.44	0.078			
	F	-9.71 ± 11.01	2.96 ± 16.99	11.10 ± 18.96				
	M	-22.78 ± 12.85	-23.27 ± 16.64	-15.81 ± 10.97				
	p-value	**0.025**	**0.004**	**0.002**				
Peak Ankle Internal Rotation	F + M	26.27 ± 15.62	24.21 ± 20.13	25.45 ± 17.60	0.938			
	F	30.19 ± 12.52	26.39 ± 19.05	36.39 ± 13.89				
	M	22.35 ± 18.00	22.03 ± 22.09	14.51 ± 14.01				
	p-value	0.273	0.660	**0.004**				
Peak Knee External Rotation	F + M	-32.80 ± 16.60	-30.33 ± 9.97	-27.36 ± 11.16	0.445			
	F	-28.39 ± 12.49	-31.23 ± 11.78	-30.62 ± 10.82				
	M	-37.21 ± 19.55	-29.43 ± 8.39	-24.10 ± 11.12				
	p-value	0.393	0.605	0.387				
Peak Knee Internal Rotation	F + M	-12.95 ± 12.14	-8.37 ± 11.96	-7.47 ± 11.12	0.309			
	F	-10.22 ± 12.23	-12.51 ± 11.42	-10.79 ± 11.82				
	M	-15.68 ± 12.04	-4.23 ± 11.62	-4.14 ± 9.92				
	p-value	0.328	0.147	0.215				
Peak Hip External Rotation	F + M	-11.21 ± 13.33	-9.07 ± 22.24	-23.88 ± 23.81	0.103			
	F	-17.25 ± 14.59	-9.57 ± 19.29	-37.47 ± 20.51				
	M	-5.16 ± 9.01	-8.58 ± 26.04	-10.29 ± 19.19				
	p-value	0.075	0.730	**0.014**				
Peak Hip Internal Rotation	F + M	10.84 ± 14.00	11.45 ± 17.99	-4.15 ± 24.57	**0.027**	1.000	0.057	0.053
	F	2.27 ± 9.22	4.36 ± 20.07	-19.29 ± 19.22				
	M	19.40 ± 12.99	18.54 ± 13.10	10.99 ± 19.96				
	p-value	**0.003**	0.095	**0.005**				

Table 4.100. TSL Sagittal Plane Mom

Table 4.100. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (L)	F + M	-0.03 ± 0.02	-0.04 ± 0.03	-0.04 ± 0.02	0.583			
	F	-0.03 ± 0.02	-0.04 ± 0.03	-0.03 ± 0.02				
	M	-0.03 ± 0.02	-0.04 ± 0.02	-0.05 ± 0.02				
	p-value	0.739	0.730	**0.006**				
Peak Ankle Plantarflexion 1 (L)	F + M	0.96 ± 0.35	1.08 ± 0.37	1.09 ± 0.29	0.392			
	F	0.97 ± 0.44	0.90 ± 0.29	1.02 ± 0.28				
	M	0.94 ± 0.23	1.26 ± 0.37	1.16 ± 0.29				
	p-value	0.811	**0.037**	0.328				
Peak Ankle Dorsiflexion 3 (L)	F + M	-0.03 ± 0.04	-0.03 ± 0.04	-0.03 ± 0.04	0.645			
	F	-0.02 ± 0.02	-0.02 ± 0.02	-0.03 ± 0.05				
	M	-0.03 ± 0.06	-0.03 ± 0.06	-0.03 ± 0.04				
	p-value	0.661	0.673	0.297				
Peak Ankle Plantarflexion 3 (L)	F + M	0.77 ± 0.43	0.77 ± 0.41	1.07 ± 0.47	0.062			
	F	0.81 ± 0.26	0.64 ± 0.46	0.90 ± 0.32				
	M	0.73 ± 0.56	0.89 ± 0.33	1.24 ± 0.54				
	p-value	0.677	0.198	0.119				
Peak Knee Flexion 1 (L)	F + M	-0.19 ± 0.14	-0.17 ± 0.14	-0.21 ± 0.18	0.554			
	F	-0.16 ± 0.14	-0.11 ± 0.08	-0.20 ± 0.16				
	M	-0.21 ± 0.14	-0.23 ± 0.17	-0.23 ± 0.20				
	p-value	0.123	0.136	0.796				
Peak Knee Extension 1 (L)	F + M	0.41 ± 0.26	0.55 ± 0.36	0.85 ± 0.40	**<0.001**	0.504	**<0.001**	**0.035**
	F	0.51 ± 0.29	0.66 ± 0.43	1.11 ± 0.31				
	M	0.31 ± 0.21	0.44 ± 0.24	0.59 ± 0.29				
	p-value	0.084	0.203	**0.002**				
Peak Knee Flexion 3 (L)	F + M	-0.26 ± 0.30	-0.25 ± 0.13	-0.39 ± 0.29	0.105			
	F	-0.15 ± 0.09	-0.25 ± 0.17	-0.37 ± 0.32				
	M	-0.38 ± 0.39	-0.25 ± 0.09	-0.41 ± 0.27				
	p-value	0.481	0.666	0.606				
Peak Knee Extension 3 (L)	F + M	0.57 ± 0.52	0.71 ± 0.58	0.50 ± 0.41	0.747			
	F	0.39 ± 0.26	0.78 ± 0.59	0.39 ± 0.35				
	M	0.74 ± 0.67	0.63 ± 0.60	0.62 ± 0.46				
	p-value	0.436	0.863	0.258				

Peak Hip Flexion 1 (L)	F + M	-0.17 ± 0.12	-0.30 ± 0.22	-0.49 ± 0.35	**0.002**	0.146	**0.001**	0.353
	F	-0.21 ± 0.15	-0.38 ± 0.28	-0.66 ± 0.36				
	M	-0.14 ± 0.07	-0.21 ± 0.12	-0.34 ± 0.28				
	p-value	0.481	0.136	0.093				
Peak Hip Extension 1 (L)	F + M	0.34 ± 0.16	0.41 ± 0.27	0.40 ± 0.27	0.890			
	F	0.28 ± 0.15	0.29 ± 0.28	0.26 ± 0.09				
	M	0.41 ± 0.13	0.52 ± 0.20	0.54 ± 0.32				
	p-value	**0.011**	0.063	**0.031**				
Peak Hip Flexion 3 (L)	F + M	-0.97 ± 1.02	-1.26 ± 1.13	-1.02 ± 0.65	0.541			
	F	-0.27 ± 0.18	-1.49 ± 1.14	-0.82 ± 0.37				
	M	-1.67 ± 1.03	-1.04 ± 1.14	-1.22 ± 0.81				
	p-value	**0.003**	0.387	0.297				
Peak Hip Extension 3 (L)	F + M	0.26 ± 0.31	0.21 ± 0.20	0.42 ± 0.35	0.129			
	F	0.20 ± 0.15	0.17 ± 0.17	0.32 ± 0.21				
	M	0.33 ± 0.41	0.25 ± 0.24	0.52 ± 0.43				
	p-value	0.796	0.796	0.387				

Table 4.101. TSL Frontal Plane Mom

Table 4.101. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (L)	F + M	-0.04 ± 0.04	-0.02 ± 0.03	-0.01 ± 0.01	**0.006**	**0.018**	**0.020**	1.000
	F	-0.02 ± 0.02	-0.02 ± 0.02	-0.01 ± 0.01				
	M	-0.07 ± 0.04	-0.02 ± 0.03	-0.02 ± 0.01				
	p-value	**0.004**	0.666	**0.008**				
Peak Ankle Eversion 1 (L)	F + M	0.33 ± 0.15	0.39 ± 0.21	0.41 ± 0.24	0.833			
	F	0.34 ± 0.10	0.46 ± 0.23	0.44 ± 0.23				
	M	0.32 ± 0.19	0.32 ± 0.17	0.38 ± 0.26				
	p-value	1.0000	0.094	0.605				
Peak Ankle Inversion 3 (L)	F + M	-0.25 ± 0.47	-0.49 ± 0.59	-0.33 ± 0.33	0.439			
	F	-0.03 ± 0.03	-0.48 ± 0.49	-0.26 ± 0.32				
	M	-0.48 ± 0.60	-0.49 ± 0.70	-0.40 ± 0.35				
	p-value	**0.002**	1.000	0.258				
Peak Ankle Eversion 3 (L)	F + M	0.22 ± 0.17	0.13 ± 0.12	0.26 ± 0.26	0.264			
	F	0.19 ± 0.04	0.14 ± 0.15	0.25 ± 0.22				
	M	0.24 ± 0.25	0.12 ± 0.09	0.27 ± 0.30				
	p-value	0.481	0.931	0.931				
Peak Knee Adduction 1 (L)	F + M	-0.21 ± 0.11	-0.19 ± 0.07	-0.27 ± 0.17	0.125			
	F	-0.16 ± 0.08	-0.20 ± 0.07	-0.28 ± 0.18				
	M	-0.25 ± 0.12	-0.17 ± 0.06	-0.25 ± 0.17				
	p-value	0.075	0.392	0.760				
Peak Knee Abduction 1 (L)	F + M	0.57 ± 0.22	0.76 ± 0.26	0.70 ± 0.45	0.188			
	F	0.53 ± 0.14	0.77 ± 0.32	0.49 ± 0.29				
	M	0.61 ± 0.28	0.75 ± 0.20	0.91 ± 0.50				
	p-value	0.436	0.910	**0.044**				
Peak Knee Adduction 3 (L)	F + M	-0.65 ± 0.74	-0.82 ± 0.79	-0.85 ± 0.40	0.073			
	F	-0.19 ± 0.09	-0.99 ± 0.85	-0.87 ± 0.44				
	M	-1.12 ± 0.83	-0.65 ± 0.73	-0.83 ± 0.39				
	p-value	**0.003**	0.340	0.931				
Peak Knee Abduction 3 (L)	F + M	0.34 ± 0.25	0.27 ± 0.30	0.47 ± 0.40	0.164			
	F	0.44 ± 0.18	0.19 ± 0.31	0.50 ± 0.44				
	M	0.25 ± 0.28	0.35 ± 0.29	0.44 ± 0.38				
	p-value	0.087	0.280	0.764				

Peak Hip Adduction 1 (L)	F + M	-0.34 ± 0.16	-0.31 ± 0.16	-0.37 ± 0.19	0.461			
	F	-0.27 ± 0.08	-0.27 ± 0.07	-0.31 ± 0.17				
	M	-0.42 ± 0.19	-0.35 ± 0.20	-0.44 ± 0.19				
	p-value	0.052	0.605	0.190				
Peak Hip Abduction 1 (L)	F + M	0.87 ± 0.27	1.21 ± 0.38	1.29 ± 0.60	**0.009**	0.052	**0.012**	0.930
	F	0.87 ± 0.17	1.36 ± 0.33	1.20 ± 0.46				
	M	0.87 ± 0.36	1.07 ± 0.38	1.38 ± 0.73				
	p-value	0.991	0.102	0.548				
Peak Hip Adduction 3 (L)	F + M	-0.89 ± 0.83	-0.91 ± 0.84	-1.40 ± 0.69	**0.044**	1.000	0.063	0.131
	F	-0.33 ± 0.13	-0.93 ± 0.82	-1.52 ± 0.84				
	M	-1.45 ± 0.86	-0.89 ± 0.90	-1.27 ± 0.53				
	p-value	**0.003**	1.000	0.489				
Peak Hip Abduction 3 (L)	F + M	0.59 ± 0.35	0.51 ± 0.40	0.63 ± 0.43	0.660			
	F	0.77 ± 0.21	0.49 ± 0.45	0.63 ± 0.48				
	M	0.40 ± 0.37	0.53 ± 0.37	0.63 ± 0.40				
	p-value	**0.013**	0.839	0.996				

Table 4.102. TSL Transverse Plane Mom

Table 4.102. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (L)	F + M	-0.05 ± 0.03	-0.05 ± 0.04	-0.09 ± 0.07	0.110			
	F	-0.04 ± 0.03	-0.06 ± 0.05	-0.08 ± 0.05				
	M	-0.05 ± 0.04	-0.05 ± 0.03	-0.11 ± 0.09				
	p-value	0.436	0.730	0.730				
Peak Ankle External Rotation 1 (L)	F + M	0.13 ± 0.09	0.19 ± 0.09	0.21 ± 0.11	**0.027**	0.094	**0.046**	1.000
	F	0.14 ± 0.09	0.18 ± 0.11	0.21 ± 0.10				
	M	0.12 ± 0.09	0.20 ± 0.08	0.22 ± 0.12				
	p-value	0.607	0.624	0.936				
Peak Ankle Internal Rotation 3 (L)	F + M	-0.09 ± 0.12	-0.14 ± 0.15	-0.16 ± 0.10	**0.039**	0.440	**0.035**	0.885
	F	-0.02 ± 0.02	-0.12 ± 0.12	-0.12 ± 0.07				
	M	-0.16 ± 0.13	-0.16 ± 0.19	-0.19 ± 0.12				
	p-value	**0.007**	0.730	0.136				
Peak Ankle External Rotation 3 (L)	F + M	0.08 ± 0.05	0.11 ± 0.08	0.15 ± 0.11	0.067			
	F	0.09 ± 0.05	0.11 ± 0.06	0.16 ± 0.12				
	M	0.06 ± 0.05	0.11 ± 0.09	0.15 ± 0.10				
	p-value	0.165	0.666	0.931				
Peak Knee Internal Rotation 1 (L)	F + M	-0.04 ± 0.02	-0.05 ± 0.04	-0.07 ± 0.05	0.189			
	F	-0.03 ± 0.02	-0.05 ± 0.05	-0.06 ± 0.03				
	M	-0.04 ± 0.03	-0.05 ± 0.04	-0.08 ± 0.06				
	p-value	0.247	0.546	0.546				
Peak Knee External Rotation 1 (L)	F + M	0.12 ± 0.05	0.22 ± 0.08	0.25 ± 0.14	**<0.001**	**0.005**	**<0.001**	0.810
	F	0.12 ± 0.05	0.23 ± 0.10	0.23 ± 0.13				
	M	0.12 ± 0.05	0.22 ± 0.07	0.27 ± 0.15				
	p-value	0.796	0.730	0.605				
Peak Knee Internal Rotation 3 (L)	F + M	-0.11 ± 0.14	-0.18 ± 0.21	-0.17 ± 0.13	0.118			
	F	-0.02 ± 0.02	-0.18 ± 0.17	-0.13 ± 0.11				
	M	-0.20 ± 0.16	-0.19 ± 0.25	-0.21 ± 0.14				
	p-value	**0.004**	0.931	0.190				
Peak Knee External Rotation 3 (L)	F + M	0.08 ± 0.05	0.10 ± 0.06	0.14 ± 0.09	0.054			
	F	0.09 ± 0.04	0.11 ± 0.07	0.13 ± 0.10				
	M	0.07 ± 0.05	0.09 ± 0.06	0.14 ± 0.09				
	p-value	0.075	0.489	0.931				

Peak Hip Internal Rotation 1 (L)	F + M	-0.08 ± 0.05	-0.16 ± 0.10	-0.17 ± 0.09	**0.004**	**0.038**	**0.006**	1.000
	F	-0.08 ± 0.04	-0.17 ± 0.10	-0.20 ± 0.08				
	M	-0.08 ± 0.07	-0.14 ± 0.09	-0.13 ± 0.09				
	p-value	0.393	0.436	0.094				
Peak Hip External Rotation 1 (L)	F + M	0.05 ± 0.02	0.09 ± 0.03	0.14 ± 0.07	**<0.001**	**0.046**	**<0.001**	**0.001**
	F	0.05 ± 0.03	0.09 ± 0.03	0.13 ± 0.05				
	M	0.05 ± 0.02	0.08 ± 0.04	0.15 ± 0.08				
	p-value	0.796	0.489	0.730				
Peak Hip Internal Rotation 3 (L)	F + M	-0.05 ± 0.08	-0.08 ± 0.08	-0.09 ± 0.10	0.161			
	F	-0.03 ± 0.04	-0.10 ± 0.09	-0.07 ± 0.09				
	M	-0.07 ± 0.10	-0.07 ± 0.07	-0.11 ± 0.12				
	p-value	0.393	0.666	0.436				
Peak Hip External Rotation 3 (L)	F + M	0.13 ± 0.12	0.14 ± 0.07	0.21 ± 0.10	**0.002**	0.588	**0.002**	0.107
	F	0.07 ± 0.03	0.15 ± 0.08	0.19 ± 0.08				
	M	0.18 ± 0.15	0.13 ± 0.06	0.22 ± 0.12				
	p-value	0.190	0.666	0.546				

Table 4.103. TSL Sagittal Plane Angle

Table 4.103. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (L)	F + M	-9.91 ± 9.27	-0.59 ± 7.75	-3.34 ± 9.01	**0.004**	**0.005**	**0.045**	1.000
	F	-12.28 ± 11.64	-0.62 ± 10.60	-7.77 ± 9.89				
	M	-7.53 ± 5.76	-0.57 ± 3.91	1.10 ± 5.50				
	p-value	0.263	0.991	**0.032**				
Peak Ankle Dorsiflex-ion 1 (L)	F + M	12.13 ± 5.20	14.19 ± 5.40	14.65 ± 7.20	0.397			
	F	13.50 ± 6.05	13.98 ± 6.34	16.31 ± 8.63				
	M	10.89 ± 4.24	14.41 ± 4.65	12.99 ± 5.44				
	p-value	0.286	0.873	0.344				
Peak Ankle Plantar-flexion 3 (L)	F + M	-7.90 ± 6.88	1.26 ± 6.48	-3.86 ± 8.76	**0.002**	**0.001**	0.179	0.333
	F	-10.82 ± 6.55	-0.15 ± 7.43	-8.96 ± 9.49				
	M	-4.98 ± 6.16	2.68 ± 5.42	1.25 ± 3.83				
	p-value	0.055	0.370	**0.009**				
Peak Ankle Dorsiflex-ion 3 (L)	F + M	8.91 ± 3.32	10.43 ± 5.11	11.23 ± 5.21	0.292			
	F	10.19 ± 3.21	10.31 ± 4.54	11.24 ± 6.03				
	M	7.64 ± 3.06	10.54 ± 5.84	11.22 ± 4.61				
	p-value	0.075	0.743	0.730				
Peak Knee Extension 1 (L)	F + M	10.08 ± 7.59	15.80 ± 9.27	18.61 ± 11.70	**0.026**	0.199	**0.025**	0.762
	F	13.36 ± 6.84	13.38 ± 8.26	20.02 ± 12.62				
	M	6.80 ± 7.13	18.23 ± 10.06	17.20 ± 11.28				
	p-value	0.050	0.280	0.625				
Peak Knee Flexion 1 (L)	F + M	21.90 ± 9.91	39.69 ± 9.34	49.65 ± 11.79	**<0.001**	**<0.001**	**<0.001**	**0.017**
	F	25.44 ± 10.93	39.83 ± 9.90	49.27 ± 11.32				
	M	18.36 ± 7.73	39.55 ± 9.35	50.04 ± 12.92				
	p-value	0.112	0.950	0.894				
Peak Knee Extension 3 (L)	F + M	3.13 ± 4.82	5.81 ± 7.46	2.76 ± 6.66	0.297			
	F	4.49 ± 4.90	5.49 ± 7.52	2.86 ± 6.39				
	M	1.76 ± 4.57	6.12 ± 7.85	2.66 ± 7.31				
	p-value	0.218	0.863	0.605				
Peak Knee Flexion 3 (L)	F + M	16.08 ± 6.19	27.44 ± 9.24	30.82 ± 12.92	**<0.001**	**0.002**	**<0.001**	0.655
	F	18.08 ± 6.28	27.34 ± 11.05	26.94 ± 11.68				
	M	14.07 ± 5.71	27.54 ± 7.69	34.71 ± 13.58				
	p-value	0.152	0.964	0.212				

Peak Hip Extension 1 (L)	F + M	20.23 ± 9.40	17.18 ± 10.89	22.27 ± 8.45	0.288			
	F	26.63 ± 5.62	19.66 ± 11.94	26.55 ± 7.56				
	M	13.82 ± 7.99	14.70 ± 9.78	17.99 ± 7.29				
	p-value	**0.001**	0.349	**0.026**				
Peak Hip Flexion 1 (L)	F + M	28.42 ± 9.88	31.15 ± 9.58	38.21 ± 11.09	**0.015**	0.795	**0.014**	0.121
	F	34.95 ± 7.26	34.75 ± 7.04	43.49 ± 12.45				
	M	21.89 ± 7.66	27.55 ± 10.79	32.92 ± 6.62				
	p-value	**0.002**	0.161	**0.040**				
Peak Hip Extension 3 (L)	F + M	13.32 ± 8.10	10.65 ± 10.65	11.78 ± 6.74	0.634			
	F	16.97 ± 7.98	14.46 ± 11.65	14.45 ± 6.35				
	M	9.66 ± 6.72	6.83 ± 8.53	9.10 ± 6.34				
	p-value	**0.040**	0.132	0.093				
Peak Hip Flexion 3 (L)	F + M	25.14 ± 8.92	24.67 ± 10.72	33.29 ± 11.96	**0.027**	0.999	0.061	0.051
	F	30.22 ± 5.83	27.53 ± 12.34	36.41 ± 14.08				
	M	20.06 ± 8.76	21.80 ± 8.56	30.18 ± 9.17				
	p-value	**0.007**	0.270	0.282				

Table 4.104. TSL Frontal Plane Angle

Table 4.104. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (L)	F + M	-2.39 ± 2.42	-1.83 ± 3.12	-4.22 ± 5.22	0.373			
	F	-3.27 ± 1.27	-3.37 ± 3.19	-7.19 ± 5.54				
	M	-1.51 ± 3.01	-0.29 ± 2.28	-1.24 ± 2.69				
	p-value	**0.043**	**0.024**	**0.024**				
Peak Ankle Inversion 1 (L)	F + M	-0.03 ± 1.84	1.75 ± 2.74	-0.29 ± 3.66	0.069			
	F	-0.72 ± 1.10	0.70 ± 2.87	-2.72 ± 3.19				
	M	0.66 ± 2.20	2.79 ± 2.31	2.15 ± 2.23				
	p-value	0.093	0.109	**0.002**				
Peak Ankle Eversion 3 (L)	F + M	-2.72 ± 2.77	-2.62 ± 4.00	-3.97 ± 4.35	0.522			
	F	-3.42 ± 1.18	-3.74 ± 3.20	-6.48 ± 4.54				
	M	-2.02 ± 3.70	-1.50 ± 4.57	-1.74 ± 2.80				
	p-value	**0.023**	0.113	**0.036**				
Peak Ankle Inversion 3 (L)	F + M	-0.51 ± 1.91	0.93 ± 2.74	-1.25 ± 3.48	0.065			
	F	-1.08 ± 1.01	0.01 ± 3.00	-3.39 ± 3.28				
	M	0.06 ± 2.45	1.85 ± 2.25	0.65 ± 2.49				
	p-value	0.193	0.161	**0.011**				
Peak Knee Abduction 1 (L)	F + M	-0.14 ± 5.00	-0.25 ± 12.27	-10.58 ± 16.59	**0.048**	1.000	0.144	0.068
	F	-2.96 ± 5.14	-6.65 ± 12.24	-23.17 ± 13.07				
	M	2.67 ± 2.96	6.15 ± 8.83	2.01 ± 7.58				
	p-value	**0.008**	**0.022**	**<0.001**				
Peak Knee Adduction 1 (L)	F + M	9.52 ± 6.89	18.03 ± 12.82	9.06 ± 13.93	**0.036**	0.077	0.999	0.067
	F	5.19 ± 6.61	10.10 ± 11.40	-1.37 ± 8.10				
	M	13.85 ± 3.87	25.96 ± 8.81	19.50 ± 10.09				
	p-value	**0.002**	**0.004**	**<0.001**				
Peak Knee Abduction 3 (L)	F + M	-1.38 ± 4.30	-2.29 ± 8.77	-9.92 ± 10.08	**0.003**	0.979	**0.005**	**0.018**
	F	-3.54 ± 3.76	-6.36 ± 9.58	-17.27 ± 8.50				
	M	0.78 ± 3.81	1.78 ± 5.87	-2.58 ± 4.72				
	p-value	**0.020**	**0.045**	**<0.001**				
Peak Knee Adduction 3 (L)	F + M	3.54 ± 3.92	5.00 ± 7.44	4.10 ± 5.83	0.749			
	F	2.05 ± 3.14	2.26 ± 7.65	0.94 ± 4.34				
	M	5.03 ± 4.21	8.09 ± 6.26	7.25 ± 5.56				
	p-value	0.090	0.109	**0.016**				

Peak Hip Abduction 1 (L)	F + M	-16.96 ± 4.27	-18.60 ± 7.81	-29.78 ± 7.85	**<0.001**	1.000	**<0.001**	**0.001**
	F	-16.69 ± 4.80	-18.98 ± 7.55	-30.27 ± 5.35				
	M	-17.22 ± 3.90	-18.21 ± 8.51	-29.29 ± 10.09				
	p-value	0.789	0.843	0.801				
Peak Hip Adduction 1 (L)	F + M	-1.09 ± 3.79	2.99 ± 6.71	4.35 ± 7.97	**0.028**	0.148	**0.032**	0.889
	F	-0.23 ± 3.45	6.78 ± 6.31	3.17 ± 8.24				
	M	-1.94 ± 4.11	-0.79 ± 4.86	5.52 ± 8.00				
	p-value	0.481	**0.019**	0.605				
Peak Hip Abduction 3 (L)	F + M	-18.09 ± 5.80	-20.14 ± 7.36	-30.79 ± 8.33	**<0.001**	0.763	**<0.001**	**<0.001**
	F	-19.03 ± 5.79	-20.38 ± 9.45	-32.79 ± 6.72				
	M	-17.15 ± 5.95	-19.89 ± 5.09	-28.80 ± 9.67				
	p-value	0.436	0.796	0.113				
Peak Hip Adduction 3 (L)	F + M	-5.00 ± 7.08	-2.53 ± 5.52	-1.39 ± 9.52	0.325			
	F	-4.30 ± 5.05	-3.25 ± 5.97	-0.61 ± 12.06				
	M	-5.69 ± 8.91	-1.81 ± 5.28	-2.16 ± 6.76				
	p-value	0.673	0.596	0.742				

Table 4.105. TSL Transverse Plane Angle

Table 4.105. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (L)	F + M	-1.38 ± 13.02	-12.63 ± 18.66	-2.07 ± 19.78	0.089			
	F	3.96 ± 6.20	-4.96 ± 19.00	10.72 ± 16.31				
	M	-6.72 ± 16.01	-20.31 ± 15.71	-14.87 ± 14.05				
	p-value	0.065	0.080	**0.003**				
Peak Ankle Internal Rotation 1 (L)	F + M	13.43 ± 14.76	9.63 ± 19.99	18.19 ± 21.31	0.363			
	F	20.15 ± 7.87	19.17 ± 19.52	31.19 ± 18.72				
	M	6.70 ± 17.24	0.09 ± 16.23	5.20 ± 15.32				
	p-value	**0.038**	**0.039**	**0.005**				
Peak Ankle External Rotation 3 (L)	F + M	1.86 ± 13.02	-7.48 ± 18.53	7.31 ± 20.57	0.081			
	F	6.39 ± 6.10	-0.64 ± 20.41	20.26 ± 16.55				
	M	-2.66 ± 16.59	-14.32 ± 14.42	-5.64 ± 15.75				
	p-value	0.123	0.120	**0.004**				
Peak Ankle Internal Rotation 3 (L)	F + M	15.26 ± 15.07	13.81 ± 20.41	22.26 ± 20.70	0.374			
	F	21.41 ± 6.56	21.34 ± 19.64	35.55 ± 15.99				
	M	9.11 ± 18.77	6.29 ± 19.30	8.98 ± 16.06				
	p-value	0.066	0.121	**0.003**				
Peak Knee External Rotation 1 (L)	F + M	-26.26 ± 12.93	-23.41 ± 10.64	-18.16 ± 9.71	0.088			
	F	-22.15 ± 11.08	-28.75 ± 11.24	-19.72 ± 11.44				
	M	-30.38 ± 13.88	-18.07 ± 7.05	-16.60 ± 8.00				
	p-value	0.160	**0.028**	0.512				
Peak Knee Internal Rotation 1 (L)	F + M	-15.98 ± 13.01	-6.87 ± 12.61	-4.38 ± 11.72	**0.014**	0.083	**0.018**	0.908
	F	-10.65 ± 12.11	-12.45 ± 11.99	-7.21 ± 11.78				
	M	-21.32 ± 12.13	-1.28 ± 11.14	-1.55 ± 11.62				
	p-value	0.065	0.057	0.320				
Peak Knee External Rotation 3 (L)	F + M	-23.84 ± 11.84	-20.72 ± 10.30	-20.33 ± 10.67	0.663			
	F	-20.74 ± 9.57	-26.19 ± 8.86	-22.14 ± 11.84				
	M	-26.94 ± 13.52	-15.26 ± 8.93	-18.52 ± 9.71				
	p-value	0.252	**0.019**	0.488				
Peak Knee Internal Rotation 3 (L)	F + M	-14.77 ± 11.45	-9.10 ± 10.64	-5.65 ± 11.35	**0.047**	0.325	**0.044**	0.731
	F	-10.44 ± 10.24	-14.80 ± 10.73	-6.58 ± 12.52				
	M	-19.09 ± 11.42	-3.41 ± 7.25	-4.72 ± 10.73				
	p-value	0.091	**0.018**	0.739				

Peak Hip External Rotation 1 (L)	F + M	1.37 ± 11.65	-0.31 ± 19.39	-18.91 ± 25.71	**0.004**	0.991	**0.007**	**0.018**
	F	-6.14 ± 9.88	-8.94 ± 20.74	-34.85 ± 19.79				
	M	8.88 ± 7.98	8.32 ± 14.17	-2.97 ± 21.00				
	p-value	**0.004**	0.113	**0.006**				
Peak Hip Internal Rotation 1 (L)	F + M	13.42 ± 12.63	15.23 ± 18.59	-1.88 ± 24.41	**0.016**	0.987	**0.047**	**0.027**
	F	4.87 ± 10.42	6.75 ± 19.34	-16.94 ± 18.00				
	M	21.97 ± 8.10	23.71 ± 14.09	13.17 ± 20.79				
	p-value	**0.001**	**0.049**	**0.005**				
Peak Hip External Rotation 3 (L)	F + M	-1.27 ± 15.47	-6.14 ± 19.12	-25.17 ± 26.89	**0.012**	1.000	**0.014**	0.080
	F	-10.91 ± 13.93	-12.91 ± 19.97	-43.49 ± 19.26				
	M	8.37 ± 10.22	0.63 ± 16.60	-6.86 ± 20.28				
	p-value	**0.007**	0.161	**0.004**				
Peak Hip Internal Rotation 3 (L)	F + M	6.32 ± 13.11	6.41 ± 18.46	-10.36 ± 24.15	**0.012**	1.000	**0.027**	**0.030**
	F	-1.72 ± 11.01	-1.16 ± 18.30	-25.19 ± 17.29				
	M	14.35 ± 9.89	13.98 ± 16.13	4.47 ± 21.11				
	p-value	**0.003**	0.081	**0.005**				

Table 4.106. TSLP Sagittal Plane Mom

Table 4.106. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (L)	F + M	-0.03 ± 0.02	-0.04 ± 0.02	-0.03 ± 0.02	0.485			
	F	-0.03 ± 0.02	-0.04 ± 0.02	-0.02 ± 0.02				
	M	-0.03 ± 0.01	-0.04 ± 0.02	-0.05 ± 0.01				
	p-value	0.579	0.931	**<0.001**				
Peak Ankle Plantarflexion 1 (L)	F + M	0.90 ± 0.35	1.15 ± 0.36	1.03 ± 0.29	0.090			
	F	0.93 ± 0.44	1.01 ± 0.24	0.87 ± 0.21				
	M	0.88 ± 0.24	1.28 ± 0.42	1.19 ± 0.27				
	p-value	0.745	0.115	**0.014**				
Peak Ankle Dorsiflexion 3 (L)	F + M	-0.03 ± 0.05	-0.04 ± 0.07	-0.04 ± 0.06	0.672			
	F	-0.02 ± 0.02	-0.02 ± 0.03	-0.05 ± 0.07				
	M	-0.04 ± 0.06	-0.07 ± 0.10	-0.04 ± 0.05				
	p-value	0.720	0.234	0.666				
Peak Ankle Plantarflexion 3 (L)	F + M	0.66 ± 0.40	0.70 ± 0.48	0.73 ± 0.36	0.873			
	F	0.71 ± 0.20	0.64 ± 0.50	0.53 ± 0.31				
	M	0.61 ± 0.54	0.75 ± 0.48	0.93 ± 0.30				
	p-value	0.574	0.641	**0.014**				
Peak Knee Flexion 1 (L)	F + M	-0.17 ± 0.12	-0.19 ± 0.12	-0.22 ± 0.15	0.677			
	F	-0.12 ± 0.08	-0.15 ± 0.09	-0.17 ± 0.12				
	M	-0.23 ± 0.12	-0.24 ± 0.13	-0.27 ± 0.17				
	p-value	**0.015**	0.136	0.258				
Peak Knee Extension 1 (L)	F + M	0.39 ± 0.25	0.53 ± 0.39	0.74 ± 0.42	**0.013**	0.536	**0.010**	0.213
	F	0.44 ± 0.25	0.66 ± 0.50	0.98 ± 0.38				
	M	0.33 ± 0.26	0.39 ± 0.18	0.50 ± 0.32				
	p-value	0.357	0.155	**0.011**				
Peak Knee Flexion 3 (L)	F + M	-0.19 ± 0.20	-0.25 ± 0.18	-0.29 ± 0.14	**0.012**	0.256	**0.010**	0.695
	F	-0.12 ± 0.06	-0.25 ± 0.21	-0.23 ± 0.06				
	M	-0.26 ± 0.26	-0.24 ± 0.17	-0.35 ± 0.18				
	p-value	0.579	1.000	0.113				
Peak Knee Extension 3 (L)	F + M	0.60 ± 0.48	0.88 ± 0.82	0.70 ± 0.49	0.761			
	F	0.38 ± 0.26	0.98 ± 0.83	0.69 ± 0.47				
	M	0.82 ± 0.56	0.78 ± 0.84	0.70 ± 0.55				
	p-value	**0.029**	0.796	0.796				

Peak Hip Flexion 1 (L)	F + M	-0.16 ± 0.13	-0.21 ± 0.15	-0.43 ± 0.37	**0.005**	0.459	**0.003**	0.224
	F	-0.20 ± 0.16	-0.29 ± 0.19	-0.57 ± 0.42				
	M	-0.12 ± 0.08	-0.15 ± 0.04	-0.31 ± 0.29				
	p-value	0.353	0.093	0.174				
Peak Hip Extension 1 (L)	F + M	0.33 ± 0.19	0.48 ± 0.34	0.50 ± 0.37	0.206			
	F	0.22 ± 0.14	0.37 ± 0.37	0.28 ± 0.16				
	M	0.45 ± 0.15	0.58 ± 0.30	0.72 ± 0.39				
	p-value	**0.005**	0.113	**0.014**				
Peak Hip Flexion 3 (L)	F + M	-0.89 ± 0.97	-1.29 ± 1.31	-1.20 ± 0.77	0.450			
	F	-0.23 ± 0.17	-1.51 ± 1.36	-1.12 ± 0.63				
	M	-1.55 ± 1.00	-1.07 ± 1.30	-1.29 ± 0.91				
	p-value	**0.002**	0.340	0.796				
Peak Hip Extension 3 (L)	F + M	0.24 ± 0.26	0.25 ± 0.19	0.34 ± 0.20	0.158			
	F	0.20 ± 0.13	0.23 ± 0.16	0.27 ± 0.16				
	M	0.27 ± 0.35	0.27 ± 0.22	0.41 ± 0.21				
	p-value	0.536	0.664	0.146				

Table 4.107. TSLP Frontal Plane Mom

Table 4.107. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (L)	F + M	-0.03 ± 0.03	-0.01 ± 0.02	-0.01 ± 0.02	0.248			
	F	-0.01 ± 0.01	-0.01 ± 0.02	-0.01 ± 0.01				
	M	-0.04 ± 0.04	-0.02 ± 0.02	-0.02 ± 0.02				
	p-value	0.156	0.605	0.077				
Peak Ankle Eversion 1 (L)	F + M	0.29 ± 0.11	0.40 ± 0.22	0.42 ± 0.24	0.086			
	F	0.31 ± 0.06	0.43 ± 0.17	0.42 ± 0.22				
	M	0.28 ± 0.14	0.38 ± 0.27	0.42 ± 0.26				
	p-value	0.631	0.297	0.730				
Peak Ankle Inversion 3 (L)	F + M	-0.21 ± 0.38	-0.31 ± 0.47	-0.24 ± 0.31	0.369			
	F	-0.02 ± 0.03	-0.28 ± 0.38	-0.10 ± 0.20				
	M	-0.40 ± 0.48	-0.35 ± 0.57	-0.37 ± 0.34				
	p-value	0.063	0.666	**0.040**				
Peak Ankle Eversion 3 (L)	F + M	0.23 ± 0.21	0.23 ± 0.29	0.33 ± 0.31	0.440			
	F	0.18 ± 0.03	0.28 ± 0.37	0.38 ± 0.29				
	M	0.29 ± 0.30	0.18 ± 0.18	0.29 ± 0.34				
	p-value	1.000	0.931	0.340				
Peak Knee Adduction 1 (L)	F + M	-0.20 ± 0.12	-0.19 ± 0.07	-0.29 ± 0.16	**0.027**	0.986	0.075	**0.043**
	F	-0.14 ± 0.08	-0.18 ± 0.08	-0.30 ± 0.19				
	M	-0.26 ± 0.12	-0.19 ± 0.05	-0.28 ± 0.13				
	p-value	**0.029**	0.863	0.730				
Peak Knee Abduction 1 (L)	F + M	0.61 ± 0.23	0.87 ± 0.34	0.84 ± 0.43	**0.043**	0.066	0.123	0.990
	F	0.59 ± 0.15	0.79 ± 0.32	0.57 ± 0.24				
	M	0.64 ± 0.29	0.95 ± 0.36	1.12 ± 0.40				
	p-value	0.677	0.323	**0.003**				
Peak Knee Adduction 3 (L)	F + M	-0.57 ± 0.70	-0.59 ± 0.68	-0.78 ± 0.40	**0.025**	0.952	**0.021**	0.293
	F	-0.12 ± 0.05	-0.63 ± 0.76	-0.76 ± 0.43				
	M	-1.02 ± 0.76	-0.55 ± 0.64	-0.79 ± 0.40				
	p-value	**<0.001**	0.863	0.863				
Peak Knee Abduction 3 (L)	F + M	0.40 ± 0.29	0.49 ± 0.35	0.55 ± 0.44	0.447			
	F	0.48 ± 0.16	0.47 ± 0.33	0.51 ± 0.34				
	M	0.31 ± 0.37	0.50 ± 0.39	0.58 ± 0.55				
	p-value	0.075	1.000	0.730				

Peak Hip Adduction 1 (L)	F + M	-0.33 ± 0.18	-0.33 ± 0.12	-0.37 ± 0.17	0.683			
	F	-0.23 ± 0.13	-0.29 ± 0.10	-0.27 ± 0.12				
	M	-0.43 ± 0.18	-0.37 ± 0.13	-0.46 ± 0.16				
	p-value	**0.019**	0.094	**0.014**				
Peak Hip Abduction 1 (L)	F + M	0.98 ± 0.27	1.33 ± 0.38	1.49 ± 0.51	**<0.001**	**0.022**	**<0.001**	0.557
	F	0.97 ± 0.16	1.46 ± 0.24	1.36 ± 0.42				
	M	0.99 ± 0.36	1.21 ± 0.47	1.62 ± 0.57				
	p-value	0.861	0.181	0.275				
Peak Hip Adduction 3 (L)	F + M	-0.80 ± 0.94	-0.78 ± 0.73	-1.25 ± 0.61	**0.022**	1.000	**0.020**	0.211
	F	-0.19 ± 0.07	-0.75 ± 0.72	-1.21 ± 0.65				
	M	-1.41 ± 1.02	-0.80 ± 0.77	-1.29 ± 0.61				
	p-value	**<0.001**	1.000	0.931				
Peak Hip Abduction 3 (L)	F + M	0.71 ± 0.44	0.83 ± 0.46	0.79 ± 0.49	0.741			
	F	0.84 ± 0.18	0.88 ± 0.47	0.78 ± 0.33				
	M	0.59 ± 0.58	0.77 ± 0.47	0.80 ± 0.63				
	p-value	0.219	0.628	0.946				

Table 4.108. TSLP Transverse Plane Mom

Table 4.108. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (L)	F + M	-0.04 ± 0.04	-0.05 ± 0.03	-0.07 ± 0.05	**0.011**	0.127	**0.012**	1.000
	F	-0.03 ± 0.03	-0.06 ± 0.04	-0.06 ± 0.05				
	M	-0.04 ± 0.04	-0.04 ± 0.02	-0.09 ± 0.06				
	p-value	0.481	0.297	0.606				
Peak Ankle External Rotation 1 (L)	F + M	0.15 ± 0.08	0.24 ± 0.09	0.26 ± 0.14	**0.005**	**0.033**	**0.008**	0.943
	F	0.16 ± 0.10	0.25 ± 0.10	0.25 ± 0.13				
	M	0.14 ± 0.06	0.23 ± 0.09	0.27 ± 0.16				
	p-value	0.853	0.489	0.931				
Peak Ankle Internal Rotation 3 (L)	F + M	-0.08 ± 0.12	-0.07 ± 0.09	-0.09 ± 0.07	0.359			
	F	-0.01 ± 0.01	-0.05 ± 0.08	-0.04 ± 0.04				
	M	-0.15 ± 0.14	-0.09 ± 0.10	-0.13 ± 0.07				
	p-value	**0.015**	0.190	**0.003**				
Peak Ankle External Rotation 3 (L)	F + M	0.10 ± 0.07	0.17 ± 0.10	0.16 ± 0.07	**0.002**	**0.015**	**0.005**	1.000
	F	0.10 ± 0.04	0.19 ± 0.10	0.18 ± 0.08				
	M	0.09 ± 0.09	0.14 ± 0.09	0.15 ± 0.06				
	p-value	0.218	0.222	0.436				
Peak Knee Internal Rotation 1 (L)	F + M	-0.03 ± 0.02	-0.04 ± 0.02	-0.06 ± 0.05	**0.038**	1.000	**0.033**	0.345
	F	-0.03 ± 0.02	-0.04 ± 0.02	-0.05 ± 0.03				
	M	-0.03 ± 0.03	-0.04 ± 0.03	-0.08 ± 0.06				
	p-value	0.912	0.673	0.370				
Peak Knee External Rotation 1 (L)	F + M	0.15 ± 0.05	0.28 ± 0.08	0.29 ± 0.14	**<0.001**	**<0.001**	**<0.001**	1.000
	F	0.15 ± 0.06	0.30 ± 0.07	0.25 ± 0.12				
	M	0.14 ± 0.04	0.26 ± 0.09	0.33 ± 0.16				
	p-value	1.000	0.387	0.387				
Peak Knee Internal Rotation 3 (L)	F + M	-0.09 ± 0.15	-0.09 ± 0.13	-0.10 ± 0.07	0.244			
	F	-0.01 ± 0.01	-0.08 ± 0.12	-0.06 ± 0.05				
	M	-0.18 ± 0.18	-0.11 ± 0.15	-0.14 ± 0.07				
	p-value	**0.011**	0.222	**0.024**				
Peak Knee External Rotation 3 (L)	F + M	0.11 ± 0.09	0.16 ± 0.10	0.17 ± 0.09	**0.030**	0.072	0.068	1.000
	F	0.11 ± 0.03	0.20 ± 0.11	0.18 ± 0.10				
	M	0.12 ± 0.12	0.12 ± 0.07	0.15 ± 0.09				
	p-value	0.684	0.190	0.666				

Peak Hip Internal Rotation 1 (L)	F + M	-0.07 ± 0.05	-0.16 ± 0.11	-0.18 ± 0.09	**<0.001**	**0.004**	**<0.001**	0.765
	F	-0.06 ± 0.05	-0.15 ± 0.10	-0.19 ± 0.08				
	M	-0.07 ± 0.05	-0.17 ± 0.12	-0.18 ± 0.11				
	p-value	0.739	0.931	0.546				
Peak Hip External Rotation 1 (L)	F + M	0.06 ± 0.03	0.09 ± 0.05	0.14 ± 0.06	**<0.001**	0.071	**<0.001**	**0.043**
	F	0.05 ± 0.03	0.10 ± 0.04	0.13 ± 0.05				
	M	0.07 ± 0.02	0.09 ± 0.05	0.16 ± 0.07				
	p-value	0.075	0.340	0.387				
Peak Hip Internal Rotation 3 (L)	F + M	-0.03 ± 0.04	-0.04 ± 0.06	-0.06 ± 0.06	0.372			
	F	-0.03 ± 0.03	-0.06 ± 0.09	-0.04 ± 0.05				
	M	-0.03 ± 0.04	-0.03 ± 0.03	-0.08 ± 0.07				
	p-value	0.853	0.796	0.297				
Peak Hip External Rotation 3 (L)	F + M	0.15 ± 0.15	0.22 ± 0.13	0.22 ± 0.12	**0.017**	0.078	**0.027**	1.000
	F	0.07 ± 0.03	0.24 ± 0.14	0.22 ± 0.12				
	M	0.23 ± 0.18	0.19 ± 0.13	0.22 ± 0.13				
	p-value	**0.002**	0.222	1.000				

Table 4.109. TSLP Sagittal Plane Angle

Table 4.109. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (L)	F + M	-11.55 ± 8.07	-1.12 ± 5.73	-2.38 ± 9.87	**<0.001**	**0.001**	**0.002**	1.000
	F	-13.89 ± 8.22	0.33 ± 5.79	-7.64 ± 10.34				
	M	-9.22 ± 7.61	-2.58 ± 5.62	2.89 ± 6.14				
	p-value	0.204	0.295	**0.018**				
Peak Ankle Dorsiflex-ion 1 (L)	F + M	9.33 ± 5.56	12.60 ± 4.90	15.24 ± 6.11	**<0.001**	0.277	**<0.001**	0.070
	F	9.01 ± 6.77	13.94 ± 5.44	15.51 ± 7.39				
	M	9.65 ± 4.38	11.26 ± 4.17	14.97 ± 4.94				
	p-value	0.806	0.257	0.859				
Peak Ankle Plantar-flexion 3 (L)	F + M	-7.03 ± 6.71	-0.88 ± 5.03	-5.53 ± 9.72	**0.014**	**0.010**	0.574	0.347
	F	-8.69 ± 6.68	-0.87 ± 7.01	-10.66 ± 11.16				
	M	-5.37 ± 6.66	-0.89 ± 2.14	-0.41 ± 4.12				
	p-value	0.280	0.995	**0.020**				
Peak Ankle Dorsiflex-ion 3 (L)	F + M	8.56 ± 3.22	9.41 ± 5.34	9.22 ± 4.74	0.825			
	F	9.59 ± 2.95	10.59 ± 6.80	10.65 ± 5.29				
	M	7.53 ± 3.28	8.23 ± 3.34	7.79 ± 3.91				
	p-value	0.156	0.363	0.210				
Peak Knee Extension 1 (L)	F + M	9.83 ± 6.89	15.09 ± 7.52	16.65 ± 10.72	**0.040**	0.171	**0.048**	0.927
	F	12.09 ± 6.75	13.31 ± 8.92	17.28 ± 12.41				
	M	7.56 ± 6.57	16.87 ± 5.77	16.01 ± 9.44				
	p-value	0.146	0.330	0.810				
Peak Knee Flexion 1 (L)	F + M	21.76 ± 9.93	39.34 ± 8.35	47.39 ± 10.35	**<0.001**	**<0.001**	**<0.001**	**0.044**
	F	24.53 ± 11.29	39.93 ± 8.30	47.18 ± 8.28				
	M	18.98 ± 7.97	38.74 ± 8.85	47.60 ± 12.60				
	p-value	0.220	0.771	0.935				
Peak Knee Extension 3 (L)	F + M	3.51 ± 5.28	4.60 ± 6.70	2.05 ± 6.64	0.470			
	F	4.82 ± 4.45	4.33 ± 8.56	2.49 ± 7.29				
	M	2.21 ± 5.93	4.88 ± 4.68	1.61 ± 6.34				
	p-value	0.280	0.868	0.790				
Peak Knee Flexion 3 (L)	F + M	15.89 ± 5.78	26.75 ± 8.26	28.74 ± 13.22	**<0.001**	**0.001**	**0.002**	1.000
	F	16.42 ± 6.18	27.91 ± 10.60	25.88 ± 13.18				
	M	15.36 ± 5.63	25.58 ± 5.44	31.60 ± 13.38				
	p-value	0.971	0.730	0.546				

Peak Hip Extension 1 (L)	F + M	17.94 ± 8.35	16.27 ± 10.56	22.08 ± 8.02	0.148			
	F	22.71 ± 6.39	18.92 ± 12.11	25.43 ± 8.35				
	M	13.17 ± 7.48	13.63 ± 8.62	18.72 ± 6.45				
	p-value	**0.007**	0.301	0.075				
Peak Hip Flexion 1 (L)	F + M	26.19 ± 9.23	30.37 ± 11.29	39.12 ± 9.69	**<0.001**	0.497	**<0.001**	**0.035**
	F	31.44 ± 7.90	33.86 ± 9.60	44.17 ± 10.32				
	M	20.94 ± 7.50	26.88 ± 12.31	34.07 ± 5.99				
	p-value	**0.007**	0.199	**0.022**				
Peak Hip Extension 3 (L)	F + M	13.73 ± 7.21	10.56 ± 10.43	13.68 ± 5.97	0.399			
	F	18.03 ± 5.87	16.09 ± 10.49	16.26 ± 5.11				
	M	9.44 ± 5.87	5.02 ± 7.21	11.11 ± 5.88				
	p-value	**0.004**	**0.019**	0.065				
Peak Hip Flexion 3 (L)	F + M	24.18 ± 8.09	26.54 ± 10.23	34.71 ± 10.84	**0.005**	0.838	**0.005**	**0.044**
	F	28.48 ± 5.86	31.00 ± 11.04	37.48 ± 12.12				
	M	19.88 ± 7.93	22.08 ± 7.47	31.93 ± 9.24				
	p-value	**0.013**	0.062	0.290				

Table 4.110. TSLP Frontal Plane Angle

Table 4.110. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (L)	F + M	-2.17 ± 2.23	-2.09 ± 3.53	-4.50 ± 5.69	0.382			
	F	-2.84 ± 1.14	-3.37 ± 3.86	-7.85 ± 5.99				
	M	-1.50 ± 2.86	-0.80 ± 2.80	-1.15 ± 2.79				
	p-value	0.052	0.222	**0.011**				
Peak Ankle Inversion 1 (L)	F + M	0.17 ± 1.77	1.22 ± 2.43	-0.44 ± 3.87	0.248			
	F	-0.34 ± 1.22	0.32 ± 2.61	-2.97 ± 3.42				
	M	0.68 ± 2.14	2.12 ± 1.98	2.09 ± 2.39				
	p-value	0.208	0.119	**0.002**				
Peak Ankle Eversion 3 (L)	F + M	-2.74 ± 2.71	-2.83 ± 4.29	-3.97 ± 4.42	0.566			
	F	-3.42 ± 1.33	-3.22 ± 2.83	-6.61 ± 4.75				
	M	-2.05 ± 3.56	-2.45 ± 5.56	-1.62 ± 2.47				
	p-value	0.075	0.190	**0.015**				
Peak Ankle Inversion 3 (L)	F + M	-0.45 ± 2.06	0.19 ± 2.25	-1.60 ± 3.36	0.128			
	F	-1.04 ± 0.93	-0.41 ± 2.52	-3.78 ± 3.18				
	M	0.14 ± 2.70	0.79 ± 1.91	0.34 ± 2.18				
	p-value	0.209	0.271	**0.007**				
Peak Knee Abduction 1 (L)	F + M	-0.16 ± 4.85	-0.95 ± 12.98	-11.34 ± 15.62	**0.010**	0.996	**0.016**	**0.033**
	F	-2.89 ± 4.91	-7.35 ± 11.81	-21.42 ± 14.69				
	M	2.56 ± 3.01	5.46 ± 11.24	-1.26 ± 8.63				
	p-value	**0.008**	**0.031**	**0.003**				
Peak Knee Adduction 1 (L)	F + M	10.90 ± 7.39	18.46 ± 10.61	9.70 ± 12.59	**0.027**	0.082	0.978	**0.040**
	F	6.45 ± 6.91	12.47 ± 10.47	1.00 ± 8.06				
	M	15.36 ± 4.86	24.46 ± 6.97	18.39 ± 10.07				
	p-value	**0.004**	**0.011**	**0.001**				
Peak Knee Abduction 3 (L)	F + M	-1.38 ± 3.95	-3.71 ± 7.83	-9.27 ± 10.04	**0.008**	0.718	**0.007**	0.093
	F	-3.05 ± 4.19	-7.44 ± 8.56	-15.97 ± 9.61				
	M	0.30 ± 3.01	0.02 ± 5.07	-2.56 ± 4.54				
	p-value	0.055	**0.039**	**0.002**				
Peak Knee Adduction 3 (L)	F + M	3.86 ± 3.57	5.35 ± 7.03	4.14 ± 5.11	0.670			
	F	2.74 ± 3.41	2.81 ± 7.50	1.90 ± 5.21				
	M	4.99 ± 3.53	7.90 ± 5.83	6.39 ± 4.13				
	p-value	0.164	0.127	0.060				

Peak Hip Abduction 1 (L)	F + M	-17.48 ± 4.55	-19.68 ± 7.32	-30.82 ± 6.93	**<0.001**	0.636	**<0.001**	**<0.001**
	F	-16.59 ± 5.74	-22.32 ± 7.31	-31.92 ± 6.21				
	M	-18.38 ± 3.00	-17.05 ± 6.68	-29.73 ± 7.79				
	p-value	0.395	0.130	0.519				
Peak Hip Adduction 1 (L)	F + M	-0.44 ± 4.49	2.53 ± 5.97	6.13 ± 9.02	**0.015**	0.439	**0.012**	0.299
	F	-0.03 ± 4.74	4.75 ± 5.75	4.16 ± 10.89				
	M	-0.84 ± 4.43	0.32 ± 5.62	8.09 ± 6.76				
	p-value	0.699	0.118	0.372				
Peak Hip Abduction 3 (L)	F + M	-18.14 ± 5.10	-21.30 ± 7.58	-30.98 ± 8.31	**<0.001**	0.433	**<0.001**	**<0.001**
	F	-17.77 ± 5.17	-23.47 ± 9.38	-33.58 ± 7.39				
	M	-18.52 ± 5.27	-19.13 ± 4.86	-28.39 ± 8.78				
	p-value	0.912	0.387	0.161				
Peak Hip Adduction 3 (L)	F + M	-2.87 ± 5.92	0.37 ± 6.71	-0.12 ± 9.91	0.372			
	F	-2.54 ± 3.62	-1.49 ± 7.80	-0.80 ± 11.38				
	M	-3.20 ± 7.78	2.24 ± 5.20	0.55 ± 8.84				
	p-value	0.810	0.249	0.783				

Table 4.111. TSLP Transverse Plane Angle

Table 4.111. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (L)	F + M	-2.27 ± 12.92	-9.99 ± 17.44	-0.99 ± 20.30	0.246			
	F	1.96 ± 7.17	-2.98 ± 17.77	12.38 ± 15.94				
	M	-6.50 ± 16.16	-17.01 ± 14.83	-14.35 ± 14.83				
	p-value	0.147	0.088	**0.002**				
Peak Ankle Internal Rotation 1 (L)	F + M	12.35 ± 14.03	10.57 ± 21.19	19.47 ± 22.78	0.484			
	F	17.83 ± 8.43	18.26 ± 23.03	34.32 ± 19.42				
	M	6.86 ± 16.66	2.89 ± 17.05	4.62 ± 15.17				
	p-value	0.080	0.127	**0.002**				
Peak Ankle External Rotation 3 (L)	F + M	1.65 ± 14.09	-3.37 ± 16.52	9.44 ± 19.92	0.140			
	F	6.23 ± 6.13	1.90 ± 17.11	22.57 ± 16.44				
	M	-2.94 ± 18.31	-8.63 ± 15.00	-3.69 ± 13.59				
	p-value	0.150	0.184	**0.002**				
Peak Ankle Internal Rotation 3 (L)	F + M	15.51 ± 14.98	14.21 ± 19.81	22.17 ± 20.58	0.387			
	F	21.28 ± 7.53	18.77 ± 18.13	35.73 ± 17.12				
	M	9.73 ± 18.51	9.65 ± 21.41	8.61 ± 13.91				
	p-value	0.084	0.344	**0.002**				
Peak Knee External Rotation 1 (L)	F + M	-25.14 ± 13.78	-23.57 ± 12.82	-20.53 ± 9.38	0.340			
	F	-21.36 ± 12.92	-28.08 ± 14.89	-22.94 ± 11.26				
	M	-28.92 ± 14.23	-19.06 ± 9.06	-18.11 ± 6.88				
	p-value	0.230	0.140	0.288				
Peak Knee Internal Rotation 1 (L)	F + M	-14.74 ± 13.22	-6.11 ± 14.48	-5.10 ± 11.60	0.055			
	F	-9.75 ± 13.20	-11.33 ± 16.12	-8.88 ± 11.95				
	M	-19.54 ± 11.89	-0.88 ± 11.14	-1.33 ± 10.53				
	p-value	0.098	0.129	0.175				
Peak Knee External Rotation 3 (L)	F + M	-22.68 ± 10.90	-20.45 ± 9.32	-20.25 ± 11.43	0.685			
	F	-20.59 ± 7.84	-24.60 ± 8.78	-22.79 ± 13.74				
	M	-24.77 ± 13.40	-16.30 ± 8.29	-17.72 ± 8.64				
	p-value	0.406	0.056	0.363				
Peak Knee Internal Rotation 3 (L)	F + M	-13.92 ± 10.78	-7.65 ± 10.80	-6.21 ± 12.58	0.054			
	F	-11.20 ± 9.72	-11.52 ± 12.81	-8.00 ± 14.12				
	M	-16.65 ± 11.60	-3.78 ± 7.08	-4.42 ± 11.38				
	p-value	0.270	0.132	0.562				

Peak Hip External Rotation 1 (L)	F + M	0.16 ± 11.97	-1.03 ± 19.67	-18.84 ± 26.31	**0.008**	0.997	**0.015**	**0.029**
	F	-7.70 ± 9.85	-10.73 ± 19.54	-34.86 ± 20.60				
	M	8.03 ± 8.24	8.67 ± 15.11	-2.82 ± 21.66				
	p-value	**0.001**	**0.040**	**0.011**				
Peak Hip Internal Rotation 1 (L)	F + M	12.42 ± 12.25	13.40 ± 18.23	-1.07 ± 24.45	**0.041**	0.998	0.090	0.072
	F	4.21 ± 10.00	4.79 ± 19.35	-16.08 ± 18.82				
	M	20.63 ± 8.19	22.00 ± 12.83	13.95 ± 20.21				
	p-value	**0.001**	**0.041**	**0.005**				
Peak Hip External Rotation 3 (L)	F + M	-2.71 ± 14.74	-8.57 ± 18.94	-24.69 ± 25.60	**0.022**	1.000	**0.022**	0.160
	F	-11.87 ± 12.81	-13.96 ± 20.54	-41.58 ± 16.62				
	M	6.45 ± 10.41	-3.19 ± 16.59	-7.80 ± 21.78				
	p-value	**0.005**	0.297	**0.008**				
Peak Hip Internal Rotation 3 (L)	F + M	6.78 ± 12.15	4.28 ± 17.98	-10.27 ± 24.69	**0.016**	0.968	**0.021**	0.069
	F	-0.47 ± 9.89	-4.15 ± 17.49	-25.95 ± 19.56				
	M	14.03 ± 9.84	12.72 ± 14.87	5.42 ± 18.94				
	p-value	**0.004**	**0.043**	**0.003**				

Table 4.112. TSR Sagittal Plane Mom

Table 4.112. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (R)	F + M	-0.16 ± 0.27	-0.06 ± 0.06	-0.17 ± 0.26	0.401			
	F	-0.03 ± 0.02	-0.08 ± 0.08	-0.18 ± 0.31				
	M	-0.29 ± 0.34	-0.05 ± 0.04	-0.15 ± 0.22				
	p-value	**0.025**	0.931	0.161				
Peak Ankle Plantarflexion 1 (R)	F + M	0.75 ± 0.60	1.07 ± 0.48	0.87 ± 0.49	0.177			
	F	1.01 ± 0.47	0.97 ± 0.47	0.87 ± 0.46				
	M	0.49 ± 0.63	1.18 ± 0.48	0.87 ± 0.55				
	p-value	**0.023**	0.387	1.000				
Peak Ankle Dorsiflexion 3 (R)	F + M	-0.04 ± 0.04	-0.02 ± 0.0	-0.02 ± 0.01	**0.004**	**0.008**	**0.016**	0.991
	F	-0.05 ± 0.06	-0.02 ± 0.01	-0.01 ± 0.01				
	M	-0.03 ± 0.01	-0.02 ± 0.01	-0.02 ± 0.01				
	p-value	1.000	0.509	0.062				
Peak Ankle Plantarflexion 3 (R)	F + M	0.79 ± 0.27	0.90 ± 0.25	0.85 ± 0.16	0.339			
	F	0.81 ± 0.36	0.80 ± 0.20	0.85 ± 0.15				
	M	0.78 ± 0.14	1.01 ± 0.26	0.85 ± 0.18				
	p-value	0.817	0.059	0.948				
Peak Knee Flexion 1 (R)	F + M	-0.19 ± 0.24	-0.31 ± 0.31	-0.34 ± 0.20	**0.005**	0.249	**0.003**	0.443
	F	-0.14 ± 0.05	-0.34 ± 0.39	-0.34 ± 0.21				
	M	-0.23 ± 0.33	-0.29 ± 0.22	-0.33 ± 0.20				
	p-value	0.853	0.321	0.931				
Peak Knee Extension 1 (R)	F + M	0.55 ± 0.33	0.54 ± 0.47	0.91 ± 0.88	0.321			
	F	0.59 ± 0.37	0.64 ± 0.58	0.64 ± 0.59				
	M	0.51 ± 0.30	0.44 ± 0.32	1.18 ± 1.06				
	p-value	0.971	0.546	0.423				
Peak Knee Flexion 3 (R)	F + M	-0.16 ± 0.08	-0.23 ± 0.09	-0.31 ± 0.09	**<0.001**	**0.042**	**<0.001**	0.054
	F	-0.15 ± 0.08	-0.22 ± 0.11	-0.29 ± 0.09				
	M	-0.18 ± 0.09	-0.25 ± 0.08	-0.33 ± 0.09				
	p-value	0.420	0.568	0.390				
Peak Knee Extension 3 (R)	F + M	0.39 ± 0.21	0.45 ± 0.27	0.40 ± 0.34	0.497			
	F	0.39 ± 0.21	0.48 ± 0.25	0.30 ± 0.16				
	M	0.40 ± 0.22	0.43 ± 0.31	0.51 ± 0.44				
	p-value	0.939	0.706	0.208				

Peak Hip Flexion 1 (R)	F + M	-0.19 ± 0.14	-0.22 ± 0.31	-0.41 ± 0.79	0.543			
	F	-0.27 ± 0.13	-0.31 ± 0.41	-0.28 ± 0.30				
	M	-0.12 ± 0.09	-0.12 ± 0.13	-0.53 ± 1.10				
	p-value	**0.019**	0.481	0.423				
Peak Hip Extension 1 (R)	F + M	0.71 ± 0.74	0.73 ± 0.66	0.99 ± 0.65	0.125			
	F	0.23 ± 0.10	0.90 ± 0.79	0.86 ± 0.49				
	M	1.18 ± 0.80	0.55 ± 0.48	1.12 ± 0.79				
	p-value	**0.001**	0.546	0.546				
Peak Hip Flexion 3 (R)	F + M	-0.19 ± 0.13	-0.25 ± 0.21	-0.43 ± 0.23	**0.001**	0.641	**0.001**	**0.029**
	F	-0.25 ± 0.14	-0.29 ± 0.23	-0.48 ± 0.22				
	M	-0.12 ± 0.10	-0.22 ± 0.18	-0.37 ± 0.24				
	p-value	**0.035**	0.436	0.489				
Peak Hip Extension 3 (R)	F + M	0.22 ± 0.13	0.32 ± 0.22	0.40 ± 0.15	**0.001**	0.229	**0.001**	0.204
	F	0.23 ± 0.15	0.37 ± 0.27	0.35 ± 0.16				
	M	0.22 ± 0.13	0.28 ± 0.15	0.46 ± 0.12				
	p-value	0.912	0.796	0.190				

Table 4.113. TSR Frontal Plane Mom

Table 4.113. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (R)	F + M	-0.06 ± 0.04	-0.03 ± 0.03	-0.08 ± 0.13	0.230			
	F	-0.04 ± 0.03	-0.04 ± 0.03	-0.13 ± 0.17				
	M	-0.08 ± 0.04	-0.03 ± 0.03	-0.04 ± 0.06				
	p-value	**0.029**	0.387	0.093				
Peak Ankle Eversion 1 (R)	F + M	0.76 ± 0.62	0.50 ± 0.48	0.80 ± 0.63	0.165			
	F	0.32 ± 0.09	0.67 ± 0.45	0.61 ± 0.48				
	M	1.21 ± 0.60	0.33 ± 0.47	1.00 ± 0.72				
	p-value	**0.015**	0.094	0.190				
Peak Ankle Inversion 3 (R)	F + M	-0.10 ± 0.07	-0.08 ± 0.05	-0.07 ± 0.06	0.551			
	F	-0.05 ± 0.04	-0.06 ± 0.03	-0.04 ± 0.04				
	M	-0.15 ± 0.06	-0.09 ± 0.06	-0.10 ± 0.07				
	p-value	**<0.001**	0.127	**0.038**				
Peak Ankle Eversion 3 (R)	F + M	0.09 ± 0.07	0.13 ± 0.07	0.13 ± 0.05	0.106			
	F	0.14 ± 0.05	0.14 ± 0.07	0.15 ± 0.04				
	M	0.04 ± 0.05	0.11 ± 0.06	0.10 ± 0.04				
	p-value	**0.001**	0.489	0.063				
Peak Knee Adduction 1 (R)	F + M	-0.21 ± 0.13	-0.23 ± 0.16	-0.33 ± 0.26	0.248			
	F	-0.27 ± 0.13	-0.26 ± 0.20	-0.39 ± 0.31				
	M	-0.14 ± 0.09	-0.19 ± 0.09	-0.27 ± 0.21				
	p-value	**0.009**	0.730	0.605				
Peak Knee Abduction 1 (R)	F + M	0.74 ± 0.44	0.63 ± 0.41	0.96 ± 0.60	0.123			
	F	0.43 ± 0.16	0.70 ± 0.49	0.76 ± 0.52				
	M	1.05 ± 0.41	0.55 ± 0.34	1.17 ± 0.63				
	p-value	**0.002**	0.863	0.161				
Peak Knee Adduction 3 (R)	F + M	-0.22 ± 0.14	-0.23 ± 0.14	-0.31 ± 0.17	0.115			
	F	-0.18 ± 0.13	-0.27 ± 0.17	-0.24 ± 0.13				
	M	-0.27 ± 0.14	-0.19 ± 0.08	-0.37 ± 0.18				
	p-value	0.168	0.243	0.088				
Peak Knee Abduction 3 (R)	F + M	0.34 ± 0.16	0.42 ± 0.19	0.47 ± 0.22	0.103			
	F	0.40 ± 0.17	0.41 ± 0.24	0.57 ± 0.22				
	M	0.27 ± 0.12	0.43 ± 0.13	0.37 ± 0.19				
	p-value	0.067	0.881	0.051				

Peak Hip Adduction 1 (R)	F + M	-0.31 ± 0.16	-0.29 ± 0.20	-0.35 ± 0.28	0.915
	F	-0.33 ± 0.14	-0.17 ± 0.08	-0.33 ± 0.25	
	M	-0.28 ± 0.19	-0.41 ± 0.22	-0.36 ± 0.33	
	p-value	0.481	**0.011**	0.796	
Peak Hip Abduction 1 (R)	F + M	0.89 ± 0.20	0.87 ± 0.48	1.27 ± 0.73	0.142
	F	0.82 ± 0.18	0.97 ± 0.59	1.05 ± 0.71	
	M	0.97 ± 0.19	0.77 ± 0.35	1.50 ± 0.72	
	p-value	**0.043**	0.387	0.297	
Peak Hip Adduction 3 (R)	F + M	-0.29 ± 0.13	-0.33 ± 0.15	-0.38 ± 0.17	0.195
	F	-0.23 ± 0.13	-0.31 ± 0.13	-0.30 ± 0.15	
	M	-0.35 ± 0.12	-0.34 ± 0.17	-0.46 ± 0.16	
	p-value	0.052	0.696	0.053	
Peak Hip Abduction 3 (R)	F + M	0.70 ± 0.20	0.82 ± 0.16	0.81 ± 0.24	0.154
	F	0.79 ± 0.21	0.89 ± 0.16	0.89 ± 0.26	
	M	0.62 ± 0.17	0.75 ± 0.13	0.72 ± 0.19	
	p-value	0.056	0.056	0.127	

Table 4.114. TSR Transverse Plane Mom

Table 4.114. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (R)	F + M	-0.11 ± 0.09	-0.11 ± 0.07	-0.16 ± 0.08	0.054			
	F	-0.04 ± 0.05	-0.10 ± 0.08	-0.16 ± 0.07				
	M	-0.17 ± 0.08	-0.11 ± 0.07	-0.16 ± 0.09				
	p-value	**<0.001**	1.000	0.863				
Peak Ankle External Rotation 1 (R)	F + M	0.09 ± 0.07	0.11 ± 0.08	0.15 ± 0.15	0.648			
	F	0.12 ± 0.06	0.14 ± 0.09	0.11 ± 0.15				
	M	0.06 ± 0.07	0.09 ± 0.06	0.19 ± 0.16				
	p-value	**0.019**	0.297	0.297				
Peak Ankle Internal Rotation 3 (R)	F + M	-0.03 ± 0.02	-0.05 ± 0.04	-0.07 ± 0.05	**0.017**	1.000	**0.023**	0.120
	F	-0.02 ± 0.01	-0.05 ± 0.05	-0.05 ± 0.04				
	M	-0.04 ± 0.03	-0.05 ± 0.03	-0.09 ± 0.05				
	p-value	0.218	0.436	0.113				
Peak Ankle External Rotation 3 (R)	F + M	0.08 ± 0.04	0.10 ± 0.04	0.12 ± 0.06	**0.013**	0.339	**0.010**	0.359
	F	0.09 ± 0.04	0.11 ± 0.04	0.15 ± 0.06				
	M	0.07 ± 0.02	0.10 ± 0.04	0.10 ± 0.05				
	p-value	0.247	0.605	0.113				
Peak Knee Internal Rotation 1 (R)	F + M	-0.05 ± 0.04	-0.06 ± 0.05	-0.10 ± 0.08	0.143			
	F	-0.05 ± 0.03	-0.04 ± 0.04	-0.12 ± 0.08				
	M	-0.05 ± 0.04	-0.08 ± 0.06	-0.09 ± 0.09				
	p-value	0.912	0.161	0.387				
Peak Knee External Rotation 1 (R)	F + M	0.11 ± 0.05	0.14 ± 0.09	0.21 ± 0.16	**0.014**	0.830	**0.014**	0.107
	F	0.11 ± 0.05	0.14 ± 0.08	0.15 ± 0.12				
	M	0.11 ± 0.06	0.13 ± 0.10	0.27 ± 0.17				
	p-value	0.912	0.730	0.190				
Peak Knee Internal Rotation 3 (R)	F + M	-0.03 ± 0.02	-0.04 ± 0.04	-0.07 ± 0.04	**0.021**	1.000	**0.023**	0.120
	F	-0.03 ± 0.02	-0.05 ± 0.05	-0.06 ± 0.03				
	M	-0.04 ± 0.03	-0.04 ± 0.03	-0.07 ± 0.05				
	p-value	0.105	0.796	0.931				
Peak Knee External Rotation 3 (R)	F + M	0.07 ± 0.03	0.09 ± 0.03	0.11 ± 0.04	**0.004**	0.078	**0.004**	0.611
	F	0.08 ± 0.04	0.09 ± 0.03	0.12 ± 0.04				
	M	0.06 ± 0.01	0.10 ± 0.03	0.09 ± 0.04				
	p-value	0.218	0.387	0.222				

Peak Hip Internal Rotation 1 (R)	F + M	-0.17 ± 0.13	-0.17 ± 0.12	-0.27 ± 0.16	0.062			
	F	-0.08 ± 0.05	-0.21 ± 0.12	-0.19 ± 0.15				
	M	-0.25 ± 0.13	-0.13 ± 0.10	-0.35 ± 0.13				
	p-value	**0.004**	0.077	**0.031**				
Peak Hip External Rotation 1 (R)	F + M	0.05 ± 0.04	0.09 ± 0.05	0.15 ± 0.10	**<0.001**	**0.010**	**<0.001**	0.979
	F	0.06 ± 0.04	0.08 ± 0.04	0.15 ± 0.10				
	M	0.04 ± 0.03	0.10 ± 0.05	0.14 ± 0.11				
	p-value	0.280	0.546	0.863				
Peak Hip Internal Rotation 3 (R)	F + M	-0.04 ± 0.03	-0.07 ± 0.05	-0.04 ± 0.04	0.099			
	F	-0.05 ± 0.04	-0.08 ± 0.05	-0.02 ± 0.02				
	M	-0.04 ± 0.03	-0.06 ± 0.05	-0.05 ± 0.05				
	p-value	0.739	0.546	0.258				
Peak Hip External Rotation 3 (R)	F + M	0.05 ± 0.03	0.10 ± 0.05	0.15 ± 0.06	**<0.001**	**0.008**	**<0.001**	**0.007**
	F	0.05 ± 0.03	0.11 ± 0.05	0.13 ± 0.04				
	M	0.06 ± 0.02	0.09 ± 0.04	0.17 ± 0.06				
	p-value	0.631	0.489	0.161				

Table 4.115. TSR Sagittal Plane Angle

Table 4.115. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (R)	F + M	-11.57 ± 8.75	-5.25 ± 19.44	-4.11 ± 11.24	**0.004**	**0.005**	0.057	0.725
	F	-16.65 ± 7.30	-10.70 ± 26.37	-6.90 ± 13.40				
	M	-6.48 ± 7.14	0.20 ± 6.40	-1.32 ± 8.46				
	p-value	**0.006**	0.520	0.306				
Peak Ankle Dorsiflex-ion 1 (R)	F + M	11.93 ± 5.50	12.90 ± 3.56	12.81 ± 7.84	0.893			
	F	11.17 ± 7.02	12.53 ± 4.03	10.13 ± 8.23				
	M	12.69 ± 3.64	13.27 ± 3.23	15.50 ± 6.83				
	p-value	0.796	0.605	0.136				
Peak Ankle Plantar-flexion 3 (R)	F + M	-9.57 ± 8.50	-0.95 ± 9.58	-3.68 ± 9.58	**0.006**	**0.006**	0.069	1.000
	F	-13.68 ± 6.88	-4.95 ± 11.40	-7.91 ± 10.37				
	M	-5.45 ± 8.21	3.05 ± 5.38	0.55 ± 6.87				
	p-value	**0.026**	0.075	0.058				
Peak Ankle Dorsiflex-ion 3 (R)	F + M	10.83 ± 3.08	12.62 ± 5.88	11.57 ± 6.44	0.582			
	F	10.54 ± 3.09	12.31 ± 6.93	9.93 ± 3.40				
	M	11.12 ± 3.20	12.93 ± 5.02	13.21 ± 8.39				
	p-value	0.579	0.605	0.161				
Peak Knee Extension 1 (R)	F + M	21.17 ± 8.12	20.62 ± 10.25	24.21 ± 8.57	0.604			
	F	26.46 ± 6.12	24.29 ± 10.90	27.80 ± 9.88				
	M	15.88 ± 6.29	16.95 ± 8.60	20.63 ± 5.42				
	p-value	**0.001**	0.132	0.075				
Peak Knee Flexion 1 (R)	F + M	30.77 ± 10.10	36.72 ± 9.27	44.60 ± 11.98	**<0.001**	0.083	**<0.001**	0.293
	F	36.97 ± 9.90	41.85 ± 7.68	49.98 ± 12.81				
	M	24.58 ± 5.68	31.58 ± 8.02	39.23 ± 8.71				
	p-value	**0.001**	**0.014**	0.050				
Peak Knee Extension 3 (R)	F + M	13.89 ± 6.78	11.88 ± 8.89	12.43 ± 7.64	0.711			
	F	18.33 ± 5.81	16.56 ± 6.86	12.86 ± 10.50				
	M	9.46 ± 4.42	7.20 ± 8.45	12.00 ± 3.67				
	p-value	**0.002**	**0.024**	1.000				
Peak Knee Flexion 3 (R)	F + M	27.58 ± 7.94	32.46 ± 9.45	38.45 ± 14.16	**0.034**	0.176	**0.043**	1.000
	F	32.36 ± 6.88	39.28 ± 7.65	41.56 ± 17.58				
	M	22.80 ± 5.94	25.65 ± 6.23	35.34 ± 9.76				
	p-value	**0.005**	**0.003**	0.681				

Peak Hip Extension 1 (R)	F + M	11.39 ± 5.70	22.74 ± 9.78	20.59 ± 10.93	**<0.001**	**<0.001**	**0.008**	0.854
	F	13.70 ± 6.65	18.37 ± 9.21	20.09 ± 14.07				
	M	9.08 ± 3.54	27.10 ± 8.71	21.08 ± 7.45				
	p-value	0.068	0.056	0.854				
Peak Hip Flexion 1 (R)	F + M	26.71 ± 8.46	44.84 ± 9.57	50.90 ± 8.38	**<0.001**	**<0.001**	**<0.001**	0.125
	F	28.30 ± 10.86	45.00 ± 11.03	50.57 ± 7.03				
	M	25.13 ± 5.27	44.68 ± 8.53	51.23 ± 9.98				
	p-value	0.418	0.947	0.873				
Peak Hip Extension 3 (R)	F + M	5.40 ± 4.58	8.01 ± 8.33	3.59 ± 8.61	0.199			
	F	5.37 ± 4.76	6.88 ± 7.32	0.41 ± 6.87				
	M	5.44 ± 4.65	9.15 ± 9.54	6.77 ± 9.36				
	p-value	0.974	0.578	0.119				
Peak Hip Flexion 3 (R)	F + M	17.81 ± 4.83	32.67 ± 10.08	36.20 ± 12.02	**<0.001**	**<0.001**	**<0.001**	0.594
	F	16.84 ± 4.37	33.20 ± 11.29	32.14 ± 10.84				
	M	18.78 ± 5.29	32.14 ± 9.38	40.25 ± 12.34				
	p-value	0.382	0.831	0.158				

Table 4.116. TSR Frontal Plane Angle

Table 4.116. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (R)	F + M	-4.33 ± 2.90	-3.06 ± 4.91	-4.64 ± 3.65	**0.021**	**0.031**	1.000	0.070
	F	-5.74 ± 2.54	-5.35 ± 6.03	-3.99 ± 2.87				
	M	-2.93 ± 2.63	-0.77 ± 1.76	-5.29 ± 4.37				
	p-value	**0.043**	**0.015**	0.605				
Peak Ankle Inversion 1 (R)	F + M	-1.49 ± 2.52	-0.25 ± 3.67	-1.21 ± 2.51	0.054			
	F	-2.67 ± 2.17	-1.93 ± 3.93	-1.08 ± 1.97				
	M	-0.31 ± 2.37	1.43 ± 2.61	-1.35 ± 3.07				
	p-value	**0.033**	0.061	0.829				
Peak Ankle Eversion 3 (R)	F + M	-4.57 ± 2.85	-4.19 ± 7.39	-5.33 ± 4.22	**0.032**	0.051	1.000	0.086
	F	-5.70 ± 2.65	-6.57 ± 9.84	-5.40 ± 4.33				
	M	-3.44 ± 2.70	-1.82 ± 2.56	-5.25 ± 4.37				
	p-value	0.143	0.139	0.931				
Peak Ankle Inversion 3 (R)	F + M	-1.55 ± 2.60	-0.60 ± 4.01	-2.72 ± 2.95	**0.011**	0.104	1.000	**0.011**
	F	-2.75 ± 2.21	-2.22 ± 4.75	-2.53 ± 2.74				
	M	-0.35 ± 2.49	1.02 ± 2.39	-2.90 ± 3.30				
	p-value	0.052	0.167	1.000				
Peak Knee Abduction 1 (R)	F + M	-16.72 ± 5.01	-20.58 ± 9.34	-30.96 ± 9.01	**<0.001**	0.361	**<0.001**	**<0.001**
	F	-16.69 ± 4.38	-20.03 ± 11.35	-29.59 ± 5.00				
	M	-16.75 ± 5.81	-21.13 ± 7.47	-32.34 ± 11.98				
	p-value	0.981	0.811	0.534				
Peak Knee Adduction 1 (R)	F + M	-1.30 ± 4.35	-0.41 ± 5.71	2.40 ± 7.61	0.154			
	F	-0.61 ± 4.73	3.24 ± 4.63	1.77 ± 8.23				
	M	-1.98 ± 4.06	-4.06 ± 4.23	3.04 ± 7.38				
	p-value	0.494	**0.003**	0.735				
Peak Knee Abduction 3 (R)	F + M	-18.06 ± 4.90	-22.61 ± 8.24	-35.34 ± 7.35	**<0.001**	0.136	**<0.001**	**<0.001**
	F	-18.21 ± 5.31	-21.45 ± 10.61	-36.37 ± 4.71				
	M	-17.92 ± 4.75	-23.77 ± 5.36	-34.31 ± 9.49				
	p-value	0.899	0.566	0.569				
Peak Knee Adduction 3 (R)	F + M	-4.84 ± 5.08	-2.42 ± 4.81	-2.61 ± 9.85	0.485			
	F	-3.90 ± 5.71	-1.83 ± 5.30	-0.49 ± 9.97				
	M	-5.79 ± 4.45	-3.01 ± 4.50	-4.73 ± 9.83				
	p-value	0.481	0.436	0.605				

Peak Hip Abduction 1 (R)	F + M	-2.83 ± 5.36	-4.76 ± 13.37	-11.51 ± 10.57	**0.030**	0.913	**0.033**	0.145
	F	-5.31 ± 4.59	-11.70 ± 11.50	-15.58 ± 10.04				
	M	-0.34 ± 5.08	2.18 ± 11.80	-7.45 ± 9.98				
	p-value	**0.043**	**0.031**	0.190				
Peak Hip Adduction 1 (R)	F + M	7.77 ± 7.55	11.23 ± 13.94	7.34 ± 10.69	0.504			
	F	4.31 ± 6.54	4.03 ± 13.21	4.21 ± 5.63				
	M	11.23 ± 7.13	18.43 ± 11.02	10.47 ± 13.75				
	p-value	0.052	**0.019**	0.546				
Peak Hip Abduction 3 (R)	F + M	-3.12 ± 4.48	-7.15 ± 9.74	-11.87 ± 8.09	**0.004**	0.643	**0.003**	0.123
	F	-4.67 ± 4.13	-11.74 ± 10.03	-13.44 ± 6.43				
	M	-1.57 ± 4.47	-2.56 ± 7.31	-10.31 ± 9.59				
	p-value	0.143	0.113	0.340				
Peak Hip Adduction 3 (R)	F + M	2.00 ± 4.26	3.34 ± 7.20	1.70 ± 4.07	0.617			
	F	1.58 ± 3.24	0.02 ± 5.48	2.24 ± 3.89				
	M	2.41 ± 5.24	6.67 ± 7.43	1.17 ± 4.40				
	p-value	0.677	**0.046**	0.592				

Table 4.117. TSR Transverse Plane Angle

Table 4.117. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (R)	F + M	7.92 ± 14.29	0.23 ± 16.60	5.43 ± 12.34	0.101			
	F	14.13 ± 11.16	8.09 ± 16.80	4.12 ± 9.09				
	M	1.71 ± 14.86	-7.64 ± 12.80	6.75 ± 15.40				
	p-value	**0.043**	0.063	0.863				
Peak Ankle Internal Rotation 1 (R)	F + M	22.88 ± 14.13	15.58 ± 17.86	24.28 ± 11.71	0.173			
	F	29.21 ± 10.46	25.69 ± 18.09	22.58 ± 11.45				
	M	16.54 ± 14.92	5.48 ± 11.00	25.98 ± 12.41				
	p-value	**0.041**	**0.011**	0.554				
Peak Ankle External Rotation 3 (R)	F + M	7.83 ± 14.42	1.61 ± 17.39	13.72 ± 12.12	0.057			
	F	14.06 ± 10.95	8.99 ± 19.07	12.81 ± 11.62				
	M	1.59 ± 15.25	-5.77 ± 12.50	14.63 ± 13.24				
	p-value	0.050	0.070	0.760				
Peak Ankle Internal Rotation 3 (R)	F + M	24.17 ± 13.17	18.81 ± 17.70	27.67 ± 12.12	0.191			
	F	28.95 ± 10.26	26.42 ± 18.72	29.04 ± 11.55				
	M	19.39 ± 14.49	11.21 ± 13.60	26.30 ± 13.21				
	p-value	0.165	0.136	0.605				
Peak Knee External Rotation 1 (R)	F + M	-8.47 ± 12.46	-7.62 ± 18.92	-21.39 ± 19.23	**0.030**	0.998	0.067	0.054
	F	-14.10 ± 8.89	-15.02 ± 14.88	-23.11 ± 16.99				
	M	-2.85 ± 13.36	-0.22 ± 20.40	-19.68 ± 22.15				
	p-value	**0.029**	**0.040**	0.863				
Peak Knee Internal Rotation 1 (R)	F + M	2.69 ± 11.69	5.19 ± 16.05	-6.26 ± 19.26	0.082			
	F	-4.08 ± 7.95	-2.19 ± 14.94	-8.81 ± 13.41				
	M	9.47 ± 11.11	12.56 ± 14.20	-3.72 ± 24.37				
	p-value	**0.006**	**0.048**	0.591				
Peak Knee External Rotation 3 (R)	F + M	-10.06 ± 11.61	-10.89 ± 18.81	-27.72 ± 18.30	**0.002**	0.998	**0.005**	**0.010**
	F	-16.40 ± 7.68	-16.67 ± 17.20	-31.75 ± 17.62				
	M	-3.72 ± 11.68	-5.10 ± 19.52	-23.68 ± 19.10				
	p-value	**0.019**	0.094	0.605				
Peak Knee Internal Rotation 3 (R)	F + M	-2.15 ± 11.55	-1.26 ± 17.37	-14.31 ± 18.53	**0.028**	0.997	0.066	0.051
	F	-8.45 ± 6.48	-7.64 ± 14.34	-17.16 ± 18.95				
	M	4.15 ± 12.29	5.11 ± 18.54	-11.46 ± 18.76				
	p-value	**0.007**	0.077	0.863				

Peak Hip External Rotation 1 (R)	F + M	-23.04 ± 8.79	-19.35 ± 11.26	-22.23 ± 11.74	0.542
	F	-21.12 ± 6.65	-26.17 ± 7.75	-21.02 ± 11.13	
	M	-24.97 ± 10.52	-12.53 ± 10.24	-23.44 ± 12.88	
	p-value	0.340	**0.006**	0.676	
Peak Hip Internal Rotation 1 (R)	F + M	-12.30 ± 7.77	-7.41 ± 11.37	-9.94 ± 11.39	0.347
	F	-11.16 ± 5.58	-12.36 ± 9.07	-8.24 ± 12.35	
	M	-13.43 ± 9.67	-2.46 ± 11.73	-11.63 ± 10.79	
	p-value	0.528	0.062	0.544	
Peak Hip External Rotation 3 (R)	F + M	-20.37 ± 7.07	-21.52 ± 12.53	-24.34 ± 12.27	0.518
	F	-19.91 ± 5.90	-27.62 ± 9.63	-25.07 ± 14.26	
	M	-20.83 ± 8.38	-15.42 ± 12.54	-23.61 ± 10.75	
	p-value	0.781	**0.034**	0.809	
Peak Hip Internal Rotation 3 (R)	F + M	-11.03 ± 6.51	-9.35 ± 11.49	-10.11 ± 11.85	0.876
	F	-12.41 ± 6.05	-13.93 ± 11.74	-8.60 ± 12.31	
	M	-9.66 ± 6.97	-4.76 ± 9.78	-11.61 ± 11.90	
	p-value	0.358	0.091	0.605	

Table 4.118. TSRP Sagittal Plane Mom

Table 4.118. Comparisons of peak sagittal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Dorsiflexion 1 (R)	F + M	-0.04 ± 0.02	-0.05 ± 0.05	-0.06 ± 0.04	0.245			
	F	-0.02 ± 0.02	-0.06 ± 0.06	-0.05 ± 0.04				
	M	-0.05 ± 0.02	-0.04 ± 0.05	-0.07 ± 0.03				
	p-value	**0.009**	0.546	0.370				
Peak Ankle Plantarflexion 1 (R)	F + M	0.79 ± 0.51	1.31 ± 0.42	0.97 ± 0.54	**0.007**	**0.006**	0.622	0.111
	F	0.90 ± 0.40	1.26 ± 0.53	0.98 ± 0.56				
	M	0.68 ± 0.59	1.36 ± 0.32	0.95 ± 0.55				
	p-value	0.347	0.645	0.900				
Peak Ankle Dorsiflexion 3 (R)	F + M	-0.03 ± 0.01	-0.02 ± 0.01	-0.02 ± 0.01	**0.008**	**0.028**	**0.019**	1.000
	F	-0.03 ± 0.01	-0.01 ± 0.01	-0.01 ± 0.00				
	M	-0.03 ± 0.01	-0.02 ± 0.01	-0.02 ± 0.01				
	p-value	0.400	0.258	0.094				
Peak Ankle Plantarflexion 3 (R)	F + M	0.81 ± 0.28	0.96 ± 0.23	0.94 ± 0.15	0.059			
	F	0.79 ± 0.36	0.84 ± 0.15	0.93 ± 0.16				
	M	0.83 ± 0.20	1.08 ± 0.23	0.95 ± 0.16				
	p-value	0.763	**0.023**	0.737				
Peak Knee Flexion 1 (R)	F + M	-0.16 ± 0.18	-0.33 ± 0.30	-0.49 ± 0.40	**<0.001**	**0.016**	**<0.001**	0.665
	F	-0.11 ± 0.05	-0.46 ± 0.40	-0.46 ± 0.35				
	M	-0.21 ± 0.25	-0.22 ± 0.12	-0.51 ± 0.46				
	p-value	1.000	0.167	0.796				
Peak Knee Extension 1 (R)	F + M	0.50 ± 0.35	0.44 ± 0.35	0.59 ± 0.56	0.795			
	F	0.64 ± 0.29	0.43 ± 0.40	0.52 ± 0.69				
	M	0.36 ± 0.37	0.45 ± 0.31	0.66 ± 0.42				
	p-value	0.075	0.931	0.258				
Peak Knee Flexion 3 (R)	F + M	-0.16 ± 0.12	-0.25 ± 0.11	-0.34 ± 0.12	**<0.001**	**0.012**	**<0.001**	0.180
	F	-0.12 ± 0.04	-0.22 ± 0.05	-0.31 ± 0.08				
	M	-0.20 ± 0.16	-0.28 ± 0.15	-0.38 ± 0.15				
	p-value	0.125	0.225	0.253				
Peak Knee Extension 3 (R)	F + M	0.39 ± 0.27	0.34 ± 0.28	0.29 ± 0.28	0.262			
	F	0.38 ± 0.27	0.36 ± 0.25	0.24 ± 0.14				
	M	0.41 ± 0.29	0.32 ± 0.33	0.33 ± 0.38				
	p-value	0.831	0.760	0.526				

Peak Hip Flexion 1 (R)	F + M	-0.23 ± 0.17	-0.14 ± 0.20	-0.19 ± 0.21	0.194			
	F	-0.29 ± 0.18	-0.22 ± 0.23	-0.24 ± 0.20				
	M	-0.16 ± 0.14	-0.07 ± 0.12	-0.14 ± 0.22				
	p-value	**0.035**	0.258	0.161				
Peak Hip Extension 1 (R)	F + M	0.84 ± 0.96	1.00 ± 0.92	1.29 ± 0.89	0.094			
	F	0.19 ± 0.10	1.25 ± 1.17	1.10 ± 0.79				
	M	1.50 ± 1.00	0.75 ± 0.53	1.48 ± 0.99				
	p-value	**0.002**	0.796	0.489				
Peak Hip Flexion 3 (R)	F + M	-0.19 ± 0.15	-0.22 ± 0.21	-0.34 ± 0.26	0.071			
	F	-0.24 ± 0.18	-0.28 ± 0.25	-0.42 ± 0.29				
	M	-0.13 ± 0.10	-0.16 ± 0.15	-0.26 ± 0.22				
	p-value	0.123	0.258	0.297				
Peak Hip Extension 3 (R)	F + M	0.24 ± 0.10	0.30 ± 0.12	0.40 ± 0.15	**<0.001**	0.296	**<0.001**	**0.038**
	F	0.19 ± 0.09	0.33 ± 0.13	0.33 ± 0.10				
	M	0.28 ± 0.09	0.27 ± 0.10	0.49 ± 0.15				
	p-value	**0.029**	0.312	**0.018**				

Table 4.119. TSRP Frontal Plane Mom

Table 4.119. Comparisons of peak frontal plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Inversion 1 (R)	F + M	-0.06 ± 0.04	-0.05 ± 0.06	-0.06 ± 0.05	0.537			
	F	-0.03 ± 0.02	-0.05 ± 0.05	-0.04 ± 0.03				
	M	-0.08 ± 0.05	-0.06 ± 0.07	-0.08 ± 0.05				
	p-value	**0.003**	0.666	0.077				
Peak Ankle Eversion 1 (R)	F + M	0.70 ± 0.59	0.42 ± 0.43	1.00 ± 0.68	**0.019**	0.278	0.694	**0.015**
	F	0.34 ± 0.15	0.39 ± 0.33	0.72 ± 0.54				
	M	1.06 ± 0.65	0.44 ± 0.53	1.28 ± 0.72				
	p-value	0.052	1.000	0.113				
Peak Ankle Inversion 3 (R)	F + M	-0.10 ± 0.07	-0.08 ± 0.05	-0.06 ± 0.07	0.148			
	F	-0.05 ± 0.03	-0.05 ± 0.03	-0.04 ± 0.05				
	M	-0.14 ± 0.08	-0.11 ± 0.06	-0.09 ± 0.08				
	p-value	**0.003**	**0.021**	0.097				
Peak Ankle Eversion 3 (R)	F + M	0.09 ± 0.07	0.11 ± 0.07	0.14 ± 0.04	**0.028**	0.404	**0.024**	0.482
	F	0.13 ± 0.04	0.13 ± 0.08	0.15 ± 0.04				
	M	0.05 ± 0.06	0.10 ± 0.06	0.13 ± 0.05				
	p-value	**0.002**	0.427	0.500				
Peak Knee Adduction 1 (R)	F + M	-0.25 ± 0.17	-0.26 ± 0.13	-0.25 ± 0.19	0.621			
	F	-0.33 ± 0.15	-0.29 ± 0.15	-0.24 ± 0.19				
	M	-0.17 ± 0.16	-0.24 ± 0.11	-0.26 ± 0.19				
	p-value	**0.019**	0.730	0.340				
Peak Knee Abduction 1 (R)	F + M	0.74 ± 0.48	0.70 ± 0.37	1.17 ± 0.65	**0.040**	1.000	0.087	0.078
	F	0.45 ± 0.20	0.69 ± 0.36	0.92 ± 0.46				
	M	1.03 ± 0.51	0.72 ± 0.39	1.43 ± 0.73				
	p-value	**0.004**	0.861	0.098				
Peak Knee Adduction 3 (R)	F + M	-0.22 ± 0.11	-0.21 ± 0.11	-0.28 ± 0.13	0.170			
	F	-0.21 ± 0.13	-0.22 ± 0.14	-0.25 ± 0.12				
	M	-0.24 ± 0.09	-0.20 ± 0.09	-0.31 ± 0.15				
	p-value	0.615	0.736	0.354				
Peak Knee Abduction 3 (R)	F + M	0.36 ± 0.15	0.45 ± 0.17	0.50 ± 0.22	0.054			
	F	0.37 ± 0.17	0.46 ± 0.21	0.56 ± 0.20				
	M	0.35 ± 0.14	0.44 ± 0.13	0.44 ± 0.23				
	p-value	0.729	0.852	0.232				

Peak Hip Adduction 1 (R)	F + M	-0.36 ± 0.25	-0.40 ± 0.23	-0.31 ± 0.21	0.477			
	F	-0.39 ± 0.16	-0.34 ± 0.23	-0.27 ± 0.20				
	M	-0.33 ± 0.32	-0.45 ± 0.23	-0.36 ± 0.23				
	p-value	0.190	0.258	0.297				
Peak Hip Abduction 1 (R)	F + M	0.88 ± 0.24	0.95 ± 0.39	1.35 ± 0.69	**0.008**	0.968	**0.010**	**0.037**
	F	0.88 ± 0.21	0.96 ± 0.45	1.21 ± 0.54				
	M	0.89 ± 0.29	0.93 ± 0.33	1.49 ± 0.82				
	p-value	0.912	1.000	0.605				
Peak Hip Adduction 3 (R)	F + M	-0.29 ± 0.14	-0.28 ± 0.12	-0.38 ± 0.16	0.083			
	F	-0.27 ± 0.15	-0.26 ± 0.08	-0.31 ± 0.16				
	M	-0.32 ± 0.14	-0.30 ± 0.15	-0.45 ± 0.14				
	p-value	0.393	0.666	0.077				
Peak Hip Abduction 3 (R)	F + M	0.73 ± 0.20	0.83 ± 0.13	0.80 ± 0.22	0.271			
	F	0.75 ± 0.23	0.88 ± 0.13	0.82 ± 0.16				
	M	0.71 ± 0.18	0.77 ± 0.13	0.77 ± 0.27				
	p-value	0.690	0.098	0.642				

Table 4.120. TSRP Transverse Plane Mom

Table 4.120. Comparisons of peak transverse plane joint moments (in mean ± standard deviation and Nm/ kg) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Internal Rotation 1 (R)	F + M	-0.10 ± 0.09	-0.10 ± 0.08	-0.20 ± 0.09	**0.003**	1.000	**0.008**	**0.008**
	F	-0.04 ± 0.03	-0.09 ± 0.08	-0.18 ± 0.09				
	M	-0.17 ± 0.09	-0.10 ± 0.09	-0.21 ± 0.08				
	p-value	**0.002**	1.000	0.297				
Peak Ankle External Rotation 1 (R)	F + M	0.10 ± 0.07	0.16 ± 0.11	0.14 ± 0.17	0.122			
	F	0.14 ± 0.08	0.17 ± 0.12	0.11 ± 0.13				
	M	0.06 ± 0.05	0.16 ± 0.11	0.17 ± 0.20				
	p-value	**0.043**	0.863	0.796				
Peak Ankle Internal Rotation 3 (R)	F + M	-0.02 ± 0.02	-0.04 ± 0.05	-0.06 ± 0.04	**0.002**	0.113	**0.002**	0.567
	F	-0.02 ± 0.01	-0.05 ± 0.06	0.04 ± 0.04				
	M	-0.02 ± 0.02	-0.04 ± 0.04	-0.08 ± 0.04				
	p-value	0.353	0.546	**0.040**				
Peak Ankle External Rotation 3 (R)	F + M	0.10 ± 0.04	0.13 ± 0.04	0.15 ± 0.06	**0.004**	**0.038**	**0.005**	1.000
	F	0.10 ± 0.04	0.14 ± 0.04	0.16 ± 0.05				
	M	0.10 ± 0.04	0.13 ± 0.04	0.14 ± 0.07				
	p-value	0.697	0.745	0.652				
Peak Knee Internal Rotation 1 (R)	F + M	-0.05 ± 0.03	-0.09 ± 0.09	-0.11 ± 0.08	0.105			
	F	-0.05 ± 0.02	-0.11 ± 0.10	-0.11 ± 0.06				
	M	-0.06 ± 0.04	-0.08 ± 0.07	-0.10 ± 0.10				
	p-value	0.853	0.546	0.605				
Peak Knee External Rotation 1 (R)	F + M	0.12 ± 0.06	0.18 ± 0.09	0.18 ± 0.13	0.099			
	F	0.12 ± 0.05	0.16 ± 0.09	0.16 ± 0.09				
	M	0.12 ± 0.08	0.20 ± 0.10	0.21 ± 0.16				
	p-value	0.856	0.446	0.504				
Peak Knee Internal Rotation 3 (R)	F + M	-0.03 ± 0.02	-0.04 ± 0.04	-0.07 ± 0.04	**0.001**	1.000	**0.001**	**0.025**
	F	-0.03 ± 0.02	-0.05 ± 0.05	-0.06 ± 0.03				
	M	-0.03 ± 0.02	-0.04 ± 0.04	-0.08 ± 0.05				
	p-value	0.796	0.666	0.340				
Peak Knee External Rotation 3 (R)	F + M	0.09 ± 0.03	0.13 ± 0.04	0.13 ± 0.04	**<0.001**	**0.001**	**<0.001**	0.999
	F	0.08 ± 0.03	0.12 ± 0.03	0.13 ± 0.02				
	M	0.09 ± 0.03	0.14 ± 0.04	0.13 ± 0.05				
	p-value	0.598	0.434	0.963				

Peak Hip Internal Rotation 1 (R)	F + M	-0.18 ± 0.16	-0.17 ± 0.13	-0.33 ± 0.22	**0.022**	1.000	**0.045**	0.053
	F	-0.09 ± 0.06	-0.15 ± 0.12	-0.21 ± 0.14				
	M	-0.28 ± 0.17	-0.18 ± 0.14	-0.45 ± 0.22				
	p-value	**0.011**	0.730	**0.014**				
Peak Hip External Rotation 1 (R)	F + M	0.06 ± 0.06	0.10 ± 0.04	0.13 ± 0.09	**<0.001**	**0.005**	**0.002**	1.000
	F	0.06 ± 0.05	0.09 ± 0.02	0.10 ± 0.06				
	M	0.05 ± 0.07	0.11 ± 0.05	0.15 ± 0.11				
	p-value	0.280	0.200	0.340				
Peak Hip Internal Rotation 3 (R)	F + M	-0.04 ± 0.03	-0.05 ± 0.05	-0.03 ± 0.03	0.569			
	F	-0.04 ± 0.04	-0.05 ± 0.04	-0.03 ± 0.02				
	M	-0.04 ± 0.03	-0.05 ± 0.05	-0.04 ± 0.04				
	p-value	1.000	1.000	1.000				
Peak Hip External Rotation 3 (R)	F + M	0.06 ± 0.02	0.11 ± 0.03	0.14 ± 0.06	**<0.001**	**0.005**	**<0.001**	**0.020**
	F	0.05 ± 0.02	0.11 ± 0.02	0.13 ± 0.06				
	M	0.07 ± 0.02	0.10 ± 0.03	0.15 ± 0.06				
	p-value	0.075	0.931	0.546				

Table 4.121. TSRP Sagittal Plane Angle

Table 4.121. Comparisons of peak sagittal plane joint angles (in mean ± standard deviation and degrees) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Plantar-flexion 1 (R)	F + M	-10.38 ± 10.40	-1.33 ± 12.25	-2.51 ± 10.89	**0.010**	**0.011**	0.091	1.000
	F	-17.09 ± 7.81	-4.45 ± 16.00	-5.97 ± 11.56				
	M	-3.68 ± 8.21	1.79 ± 6.38	0.94 ± 9.57				
	p-value	**0.001**	0.293	0.186				
Peak Ankle Dorsiflex-ion 1 (R)	F + M	12.10 ± 4.37	12.06 ± 5.21	14.48 ± 7.90	0.379			
	F	10.75 ± 4.57	10.68 ± 5.94	11.82 ± 8.48				
	M	13.46 ± 3.91	13.43 ± 4.26	17.14 ± 6.69				
	p-value	0.353	0.387	0.222				
Peak Ankle Plantar-flexion 3 (R)	F + M	-6.93 ± 9.19	0.13 ± 10.38	-5.41 ± 10.10	**0.016**	**0.017**	1.000	0.120
	F	-12.67 ± 7.94	-4.12 ± 12.97	-8.95 ± 11.16				
	M	-1.19 ± 6.49	4.38 ± 4.47	-1.87 ± 7.99				
	p-value	**0.002**	0.082	0.141				
Peak Ankle Dorsiflex-ion 3 (R)	F + M	10.75 ± 3.55	11.88 ± 6.30	9.15 ± 5.95	0.313			
	F	10.56 ± 2.63	11.99 ± 8.02	7.75 ± 3.58				
	M	10.95 ± 4.43	11.76 ± 4.46	10.54 ± 7.62				
	p-value	0.810	0.942	0.336				
Peak Knee Extension 1 (R)	F + M	20.08 ± 7.20	19.05 ± 9.74	23.10 ± 8.03	0.325			
	F	24.53 ± 5.05	22.60 ± 9.66	25.70 ± 10.62				
	M	15.63 ± 6.30	15.50 ± 8.92	20.49 ± 3.01				
	p-value	**0.002**	0.190	0.161				
Peak Knee Flexion 1 (R)	F + M	28.20 ± 8.15	33.29 ± 8.94	42.21 ± 12.32	**<0.001**	0.315	**<0.001**	**0.027**
	F	32.86 ± 7.47	37.89 ± 5.35	47.67 ± 12.67				
	M	23.55 ± 6.01	28.69 ± 9.68	36.74 ± 9.74				
	p-value	**0.011**	0.063	**0.024**				
Peak Knee Extension 3 (R)	F + M	14.30 ± 7.38	11.60 ± 9.74	13.24 ± 7.90	0.610			
	F	17.62 ± 7.87	16.71 ± 8.64	14.69 ± 10.01				
	M	10.99 ± 5.34	6.48 ± 8.24	11.78 ± 5.28				
	p-value	**0.041**	**0.021**	0.452				
Peak Knee Flexion 3 (R)	F + M	25.29 ± 7.43	30.39 ± 10.95	37.07 ± 11.98	**0.002**	0.200	**0.002**	0.326
	F	29.78 ± 6.31	37.80 ± 8.10	41.21 ± 13.41				
	M	20.79 ± 5.65	22.98 ± 8.11	32.93 ± 9.31				
	p-value	**0.009**	**0.002**	0.190				

Peak Hip Extension 1 (R)	F + M	12.76 ± 4.99	23.49 ± 9.63	20.16 ± 9.76	**<0.001**	**<0.001**	**0.025**	0.550
	F	13.79 ± 6.02	20.36 ± 8.82	18.28 ± 10.86				
	M	11.73 ± 3.73	26.61 ± 9.86	22.05 ± 8.73				
	p-value	0.370	0.175	0.429				
Peak Hip Flexion 1 (R)	F + M	28.86 ± 6.16	44.15 ± 9.00	48.17 ± 8.87	**<0.001**	**<0.001**	**<0.001**	0.361
	F	29.42 ± 7.64	44.21 ± 9.92	50.56 ± 5.89				
	M	28.31 ± 4.60	44.10 ± 8.57	45.79 ± 10.94				
	p-value	0.698	0.979	0.266				
Peak Hip Extension 3 (R)	F + M	6.44 ± 4.86	7.24 ± 8.74	3.44 ± 9.57	0.320			
	F	5.85 ± 4.42	5.75 ± 7.37	-0.09 ± 7.66				
	M	7.04 ± 5.44	8.72 ± 10.16	6.97 ± 10.39				
	p-value	0.597	0.487	0.120				
Peak Hip Flexion 3 (R)	F + M	18.68 ± 5.59	31.06 ± 9.27	31.77 ± 10.09	**<0.001**	**<0.001**	**<0.001**	0.992
	F	18.42 ± 5.62	30.31 ± 10.67	28.83 ± 10.15				
	M	18.94 ± 5.86	31.81 ± 8.21	34.71 ± 9.69				
	p-value	0.841	0.742	0.227				

Table 4.122. TSRP Frontal Plane Angle

Table 4.122. Comparisons of peak frontal plane joint angles (in mean ± standard deviation and degrees) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle Eversion 1 (R)	F + M	-4.00 ± 3.11	-2.24 ± 2.55	-4.83 ± 4.47	0.099			
	F	-5.58 ± 2.95	-3.58 ± 2.38	-4.65 ± 4.83				
	M	-2.42 ± 2.48	-1.06 ± 2.17	-5.01 ± 4.36				
	p-value	**0.029**	**0.036**	1.000				
Peak Ankle Inversion 1 (R)	F + M	-1.18 ± 2.78	-0.31 ± 3.82	-1.21 ± 2.70	0.393			
	F	-2.76 ± 2.21	-2.07 ± 4.05	-1.29 ± 2.25				
	M	0.40 ± 2.43	1.44 ± 2.77	-1.14 ± 3.22				
	p-value	**0.009**	0.050	0.730				
Peak Ankle Eversion 3 (R)	F + M	-4.31 ± 3.11	-2.42 ± 2.40	-4.62 ± 3.24	0.062			
	F	-5.47 ± 2.95	-3.38 ± 1.93	-3.80 ± 1.65				
	M	-3.15 ± 2.95	-1.56 ± 2.55	-5.34 ± 4.17				
	p-value	0.089	0.059	0.743				
Peak Ankle Inversion 3 (R)	F + M	-1.42 ± 3.02	-0.16 ± 2.36	-2.66 ± 2.47	**0.036**	0.495	0.610	**0.030**
	F	-2.99 ± 2.69	-1.14 ± 2.08	-2.50 ± 2.02				
	M	0.14 ± 2.57	0.71 ± 2.34	-2.83 ± 2.97				
	p-value	**0.029**	0.074	0.796				
Peak Knee Abduction 1 (R)	F + M	-19.54 ± 5.51	-22.96 ± 6.09	-31.46 ± 7.62	**<0.001**	0.288	**<0.001**	**<0.001**
	F	-20.30 ± 5.03	-21.82 ± 5.19	-30.24 ± 6.17				
	M	-18.78 ± 6.11	-24.09 ± 7.00	-32.67 ± 9.06				
	p-value	0.551	0.445	0.515				
Peak Knee Adduction 1 (R)	F + M	-2.75 ± 5.85	-0.90 ± 6.50	3.59 ± 6.78	**0.011**	0.751	**0.010**	0.112
	F	-1.69 ± 6.30	2.65 ± 5.51	2.07 ± 6.41				
	M	-3.82 ± 5.47	-4.44 ± 5.58	5.10 ± 7.17				
	p-value	0.430	**0.015**	0.359				
Peak Knee Abduction 3 (R)	F + M	-20.58 ± 5.27	-24.50 ± 7.63	-34.52 ± 6.98	**<0.001**	0.207	**<0.001**	**<0.001**
	F	-20.94 ± 5.47	-23.66 ± 9.00	-34.47 ± 3.89				
	M	-20.22 ± 5.34	-25.34 ± 6.41	-34.58 ± 9.40				
	p-value	0.768	0.655	0.975				
Peak Knee Adduction 3 (R)	F + M	-5.52 ± 6.02	-2.07 ± 4.43	-3.79 ± 9.86	0.334			
	F	-4.91 ± 5.62	-0.59 ± 4.77	-1.57 ± 8.71				
	M	-6.14 ± 6.64	-3.55 ± 3.75	-6.02 ± 10.84				
	p-value	0.662	0.162	0.354				

Peak Hip Abduction 1 (R)	F + M	-2.17 ± 6.79	-4.58 ± 12.73	-11.70 ± 9.72	**0.014**	0.839	**0.014**	0.104
	F	-5.64 ± 5.98	-11.40 ± 11.13	-13.71 ± 10.56				
	M	1.30 ± 5.91	2.24 ± 10.77	-9.69 ± 8.95				
	p-value	**0.035**	**0.031**	0.546				
Peak Hip Adduction 1 (R)	F + M	9.30 ± 9.15	12.61 ± 13.87	7.98 ± 11.03	0.461			
	F	5.11 ± 7.48	4.85 ± 12.52	5.77 ± 5.56				
	M	13.49 ± 9.05	20.37 ± 10.81	10.20 ± 14.71				
	p-value	0.063	**0.019**	0.605				
Peak Hip Abduction 3 (R)	F + M	-2.24 ± 5.45	-6.39 ± 9.13	-10.13 ± 6.96	**0.007**	0.671	**0.005**	0.176
	F	-4.37 ± 3.61	-10.79 ± 9.44	-11.40 ± 6.84				
	M	-0.11 ± 6.28	-1.98 ± 6.66	-8.86 ± 7.25				
	p-value	0.105	0.050	0.546				
Peak Hip Adduction 3 (R)	F + M	2.57 ± 5.50	3.51 ± 7.71	1.54 ± 4.24	0.623			
	F	1.24 ± 3.45	0.01 ± 5.76	2.44 ± 4.53				
	M	3.89 ± 6.94	7.02 ± 8.09	0.65 ± 3.98				
	p-value	0.293	0.050	0.386				

Table 4.123. TSRP Transverse Plane Angle

Table 4.123. Comparisons of peak transverse plane joint angles (in mean ± standard deviation and degrees) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were conducted by Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Peak Ankle External Rotation 1 (R)	F + M	5.93 ± 15.10	0.50 ± 17.45	5.30 ± 13.22	0.506			
	F	14.36 ± 11.07	8.96 ± 17.29	5.67 ± 10.52				
	M	-2.50 ± 14.18	-7.96 ± 13.68	4.92 ± 16.14				
	p-value	**0.008**	**0.035**	0.909				
Peak Ankle Internal Rotation 1 (R)	F + M	21.02 ± 14.60	16.53 ± 17.97	24.32 ± 13.89	0.328			
	F	28.11 ± 11.92	26.29 ± 18.08	23.56 ± 13.93				
	M	13.94 ± 14.02	6.76 ± 12.05	25.07 ± 14.65				
	p-value	**0.025**	**0.016**	0.825				
Peak Ankle External Rotation 3 (R)	F + M	7.13 ± 16.46	3.76 ± 18.60	14.47 ± 10.10	0.116			
	F	15.52 ± 12.75	11.83 ± 20.72	14.31 ± 8.56				
	M	-1.27 ± 15.90	-4.30 ± 12.63	14.63 ± 11.98				
	p-value	**0.018**	0.063	0.949				
Peak Ankle Internal Rotation 3 (R)	F + M	22.75 ± 14.69	17.74 ± 17.21	27.49 ± 11.96	0.151			
	F	27.73 ± 11.59	25.97 ± 17.05	27.59 ± 11.54				
	M	17.78 ± 16.32	9.51 ± 13.65	27.39 ± 13.06				
	p-value	0.133	**0.038**	0.973				
Peak Knee External Rotation 1 (R)	F + M	-9.75 ± 12.32	-8.35 ± 18.07	-21.69 ± 17.70	**0.029**	0.991	0.077	**0.047**
	F	-15.32 ± 8.97	-15.01 ± 15.72	-23.49 ± 15.77				
	M	-4.17 ± 13.07	-1.69 ± 18.63	-19.89 ± 20.25				
	p-value	**0.039**	0.121	0.680				
Peak Knee Internal Rotation 1 (R)	F + M	0.90 ± 12.20	3.60 ± 16.49	-6.50 ± 18.86	0.153			
	F	-5.56 ± 8.57	-2.44 ± 16.12	-9.31 ± 14.51				
	M	7.36 ± 12.16	9.64 ± 15.36	-3.69 ± 22.96				
	p-value	**0.015**	0.077	0.863				
Peak Knee External Rotation 3 (R)	F + M	-10.78 ± 12.69	-11.96 ± 16.90	-27.60 ± 18.79	**0.004**	0.994	**0.007**	**0.016**
	F	-16.97 ± 8.65	-16.82 ± 16.44	-29.76 ± 17.96				
	M	-4.60 ± 13.43	-7.10 ± 16.84	-25.43 ± 20.42				
	p-value	**0.025**	0.233	0.640				
Peak Knee Internal Rotation 3 (R)	F + M	-3.29 ± 11.52	-2.94 ± 17.05	-14.90 ± 18.83	**0.044**	1.000	0.085	0.083
	F	-9.47 ± 7.27	-8.96 ± 15.02	-16.49 ± 16.32				
	M	2.88 ± 11.95	3.08 ± 17.62	-13.30 ± 21.94				
	p-value	**0.012**	0.138	0.731				

Peak Hip External Rotation 1 (R)	F + M	-21.38 ± 8.55	-19.60 ± 11.29	-24.49 ± 14.12	0.436
	F	-19.13 ± 6.49	-25.97 ± 6.75	-24.03 ± 14.23	
	M	-23.62 ± 10.05	-13.23 ± 11.58	-24.96 ± 14.85	
	p-value	0.251	**0.012**	0.894	
Peak Hip Internal Rotation 1 (R)	F + M	-11.57 ± 8.13	-7.92 ± 10.79	-9.92 ± 13.16	0.586
	F	-11.37 ± 6.50	-12.77 ± 8.85	-8.89 ± 15.02	
	M	-11.76 ± 9.86	-3.08 ± 10.78	-10.95 ± 11.82	
	p-value	0.920	0.053	0.751	
Peak Hip External Rotation 3 (R)	F + M	-20.08 ± 7.60	-20.59 ± 11.95	-23.96 ± 14.46	0.567
	F	-18.99 ± 5.17	-26.61 ± 9.54	-25.61 ± 19.15	
	M	-21.18 ± 9.61	-14.57 ± 11.45	-22.32 ± 11.61	
	p-value	0.579	**0.031**	0.730	
Peak Hip Internal Rotation 3 (R)	F + M	-10.57 ± 7.30	-9.73 ± 11.65	-11.28 ± 12.27	0.907
	F	-11.79 ± 5.70	-14.17 ± 12.26	-10.57 ± 13.19	
	M	-9.35 ± 8.75	-5.30 ± 9.68	-12.00 ± 12.04	
	p-value	0.469	0.108	0.814	

Table 4.124. BSR EMG Activity

Table 4.124. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the BSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.50 ± 0.20	0.76 ± 0.32	0.59 ± 0.19	**0.015**	**0.012**	0.636	0.197
	F	0.51 ± 0.19	0.80 ± 0.34	0.64 ± 0.20				
	M	0.50 ± 0.21	0.71 ± 0.33	0.51 ± 0.17				
	p-value	0.796	0.710	0.145				
Medial Gastrocnemius	F + M	1.43 ± 1.50	2.18 ± 1.99	1.55 ± 0.93	0.162			
	F	1.68 ± 1.60	1.78 ± 1.71	1.84 ± 1.08				
	M	1.17 ± 1.42	2.40 ± 2.23	1.12 ± 0.40				
	p-value	0.247	1.000	0.145				
Vastus Lateralis	F + M	0.19 ± 0.08	0.38 ± 0.22	0.44 ± 0.22	**<0.001**	**0.007**	**<0.001**	0.768
	F	0.19 ± 0.10	0.48 ± 0.21	0.42 ± 0.21				
	M	0.18 ± 0.06	0.28 ± 0.19	0.46 ± 0.23				
	p-value	0.796	0.097	0.758				
Biceps Femoris	F + M	0.27 ± 0.17	0.50 ± 0.41	0.54 ± 0.22	**0.007**	0.295	**0.005**	0.622
	F	0.34 ± 0.20	0.69 ± 0.51	0.58 ± 0.24				
	M	0.21 ± 0.12	0.34 ± 0.23	0.51 ± 0.22				
	p-value	0.143	0.366	0.613				
Gluteus Medius	F + M	0.43 ± 0.23	0.54 ± 0.32	0.29 ± 0.15	**0.026**	0.548	0.244	**0.023**
	F	0.45 ± 0.25	0.51 ± 0.41	0.26 ± 0.11				
	M	0.42 ± 0.22	0.57 ± 0.23	0.33 ± 0.19				
	p-value	1.000	0.536	0.536				

Table 4.125. BSRP EMG Activity

Table 4.125. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the BSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.36 ± 0.15	0.51 ± 0.19	0.51 ± 0.23	0.055			
	F	0.39 ± 0.18	0.46 ± 0.22	0.50 ± 0.17				
	M	0.33 ± 0.11	0.60 ± 0.10	0.51 ± 0.33				
	p-value	0.436	0.164	0.607				
Medial Gastrocnemius	F + M	1.25 ± 1.07	2.10 ± 1.65	1.60 ± 0.98	0.081			
	F	1.12 ± 0.74	2.50 ± 2.02	1.74 ± 1.13				
	M	1.37 ± 1.36	1.59 ± 1.11	1.40 ± 0.74				
	p-value	0.931	0.730	0.955				
Vastus Lateralis	F + M	0.14 ± 0.08	0.29 ± 0.17	0.44 ± 0.21	**<0.001**	0.067	**<0.001**	**0.049**
	F	0.14 ± 0.09	0.31 ± 0.12	0.39 ± 0.20				
	M	0.15 ± 0.07	0.24 ± 0.25	0.52 ± 0.23				
	p-value	0.730	0.230	0.388				
Biceps Femoris	F + M	0.24 ± 0.16	0.47 ± 0.39	0.55 ± 0.36	**0.039**	0.634	**0.034**	0.912
	F	0.26 ± 0.20	0.62 ± 0.41	0.58 ± 0.42				
	M	0.22 ± 0.11	0.21 ± 0.17	0.53 ± 0.31				
	p-value	1.000	0.164	0.867				
Gluteus Medius	F + M	0.35 ± 0.17	0.29 ± 0.15	0.27 ± 0.14	0.406			
	F	0.37 ± 0.20	0.23 ± 0.10	0.30 ± 0.16				
	M	0.32 ± 0.13	0.40 ± 0.19	0.24 ± 0.12				
	p-value	0.547	0.081	0.498				

Table 4.126. FSL EMG Activity

Table 4.126. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the FSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.39 ± 0.22	0.62 ± 0.43	0.75 ± 0.54	**0.017**	0.254	**0.016**	1.000
	F	0.44 ± 0.15	0.81 ± 0.55	0.58 ± 0.33				
	M	0.35 ± 0.27	0.43 ± 0.14	0.93 ± 0.68				
	p-value	0.133	0.165	0.200				
Medial Gastrocnemius	F + M	1.14 ± 1.05	1.94 ± 1.41	1.22 ± 0.90	0.141			
	F	1.37 ± 1.28	2.37 ± 1.68	0.83 ± 0.43				
	M	0.93 ± 0.82	1.58 ± 1.14	1.73 ± 1.12				
	p-value	0.400	0.445	**0.031**				
Vastus Lateralis	F + M	0.16 ± 0.09	0.64 ± 0.99	0.44 ± 0.27	**<0.001**	**0.002**	**0.001**	1.000
	F	0.15 ± 0.10	0.98 ± 1.34	0.39 ± 0.30				
	M	0.17 ± 0.08	0.31 ± 0.21	0.49 ± 0.25				
	p-value	0.356	0.209	0.423				
Biceps Femoris	F + M	0.17 ± 0.11	0.26 ± 0.28	0.40 ± 0.24	**0.004**	1.000	**0.004**	**0.046**
	F	0.18 ± 0.09	0.34 ± 0.34	0.30 ± 0.12				
	M	0.17 ± 0.14	0.19 ± 0.20	0.50 ± 0.29				
	p-value	0.604	0.318	0.328				
Gluteus Medius	F + M	0.24 ± 0.15	0.24 ± 0.15	0.19 ± 0.10	0.489			
	F	0.29 ± 0.18	0.23 ± 0.18	0.21 ± 0.11				
	M	0.20 ± 0.09	0.25 ± 0.11	0.17 ± 0.10				
	p-value	0.211	0.397	0.397				

Table 4.127. FSLP EMG Activity

Table 4.127. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the FSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.37 ± 0.19	0.58 ± 0.44	0.47 ± 0.24	0.219			
	F	0.39 ± 0.19	0.76 ± 0.55	0.43 ± 0.24				
	M	0.34 ± 0.21	0.40 ± 0.20	0.53 ± 0.25				
	p-value	0.529	0.209	0.351				
Medial Gastrocnemius	F + M	0.88 ± 0.58	2.21 ± 1.72	1.32 ± 1.07	**0.026**	**0.020**	0.751	0.381
	F	0.82 ± 0.42	2.83 ± 2.11	0.98 ± 0.84				
	M	0.94 ± 0.73	1.59 ± 1.02	1.76 ± 1.23				
	p-value	1.000	0.456	0.142				
Vastus Lateralis	F + M	0.16 ± 0.07	0.38 ± 0.26	0.35 ± 0.23	**0.003**	**0.008**	**0.014**	0.967
	F	0.14 ± 0.07	0.46 ± 0.26	0.32 ± 0.25				
	M	0.17 ± 0.06	0.30 ± 0.27	0.38 ± 0.21				
	p-value	0.190	0.366	0.370				
Biceps Femoris	F + M	0.18 ± 0.12	0.32 ± 0.32	0.56 ± 0.53	**0.002**	0.503	**0.001**	0.142
	F	0.17 ± 0.07	0.42 ± 0.40	0.59 ± 0.69				
	M	0.19 ± 0.16	0.21 ± 0.17	0.53 ± 0.29				
	p-value	0.631	0.281	0.370				
Gluteus Medius	F + M	0.24 ± 0.12	0.24 ± 0.15	0.17 ± 0.13	0.163			
	F	0.26 ± 0.15	0.16 ± 0.06	0.17 ± 0.08				
	M	0.22 ± 0.07	0.32 ± 0.17	0.17 ± 0.17				
	p-value	0.853	0.053	0.536				

Table 4.128. RSBR EMG Activity

Table 4.128. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the RSBR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (R)	F + M	0.53 ± 0.26	0.62 ± 0.20	0.75 ± 0.31	0.054			
	F	0.61 ± 0.27	0.61 ± 0.25	0.73 ± 0.26				
	M	0.45 ± 0.23	0.64 ± 0.15	0.77 ± 0.38				
	p-value	0.143	1.000	0.918				
Tibialis Anterior 2 (L)	F + M	0.44 ± 0.26	0.61 ± 0.37	0.62 ± 0.31	0.226			
	F	0.48 ± 0.19	0.74 ± 0.45	0.56 ± 0.29				
	M	0.41 ± 0.32	0.47 ± 0.21	0.69 ± 0.34				
	p-value	0.353	0.259	0.277				
Medial Gastrocnemius 1 (R)	F + M	2.06 ± 1.91	6.15 ± 4.98	3.28 ± 2.81	**0.010**	**0.009**	0.203	0.787
	F	2.10 ± 1.76	7.59 ± 5.35	2.86 ± 1.48				
	M	2.03 ± 2.14	4.51 ± 4.30	3.81 ± 4.03				
	p-value	0.481	0.152	0.758				
Medial Gastrocnemius 2 (L)	F + M	0.89 ± 0.67	1.48 ± 1.20	1.05 ± 0.60	0.201			
	F	1.06 ± 0.84	1.45 ± 1.32	0.91 ± 0.64				
	M	0.72 ± 0.45	1.51 ± 1.19	1.22 ± 0.55				
	p-value	0.436	1.000	0.252				
Vastus Lateralis 1 (R)	F + M	0.17 ± 0.08	0.43 ± 0.32	0.52 ± 0.19	**<0.001**	**0.006**	**<0.001**	0.405
	F	0.20 ± 0.09	0.60 ± 0.36	0.53 ± 0.22				
	M	0.15 ± 0.07	0.27 ± 0.18	0.50 ± 0.14				
	p-value	0.280	0.053	0.758				
Vastus Lateralis 2 (L)	F + M	0.17 ± 0.07	0.37 ± 0.20	0.54 ± 0.33	**<0.001**	**0.049**	**<0.001**	0.116
	F	0.16 ± 0.08	0.43 ± 0.19	0.47 ± 0.26				
	M	0.18 ± 0.07	0.32 ± 0.22	0.63 ± 0.41				
	p-value	0.684	0.534	0.541				
Biceps Femoris 1 (R)	F + M	0.43 ± 0.21	0.72 ± 0.49	1.15 ± 0.80	**0.002**	0.304	**0.001**	0.267
	F	0.48 ± 0.19	1.05 ± 0.48	1.22 ± 0.87				
	M	0.38 ± 0.23	0.39 ± 0.19	1.07 ± 0.77				
	p-value	0.218	**0.004**	0.673				
Biceps Femoris 2 (L)	F + M	0.19 ± 0.12	0.34 ± 0.33	0.52 ± 0.45	**0.009**	0.868	**0.007**	0.223
	F	0.24 ± 0.14	0.42 ± 0.40	0.47 ± 0.50				
	M	0.14 ± 0.08	0.27 ± 0.25	0.57 ± 0.42				
	p-value	0.075	0.710	0.645				

Gluteus Medius 1 (R)	F + M	0.45 ± 0.23	0.42 ± 0.24	0.30 ± 0.19	0.060
	F	0.52 ± 0.28	0.44 ± 0.32	0.31 ± 0.21	
	M	0.38 ± 0.16	0.39 ± 0.10	0.28 ± 0.18	
	p-value	0.105	0.694	0.963	
Gluteus Medius 2 (L)	F + M	0.27 ± 0.17	0.29 ± 0.13	0.21 ± 0.11	0.226
	F	0.34 ± 0.20	0.29 ± 0.15	0.26 ± 0.12	
	M	0.20 ± 0.10	0.29 ± 0.10	0.17 ± 0.08	
	p-value	0.165	0.779	0.152	

Table 4.129. RSBRP EMG Activity

Table 4.129. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the RSBRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (R)	F + M	0.44 ± 0.23	0.47 ± 0.18	0.53 ± 0.24	0.596			
	F	0.51 ± 0.31	0.44 ± 0.21	0.47 ± 0.17				
	M	0.38 ± 0.15	0.51 ± 0.15	0.61 ± 0.32				
	p-value	0.661	0.366	0.529				
Tibialis Anterior 2 (L)	F + M	0.40 ± 0.23	0.60 ± 0.37	0.50 ± 0.30	0.262			
	F	0.40 ± 0.23	0.71 ± 0.48	0.44 ± 0.25				
	M	0.40 ± 0.24	0.47 ± 0.15	0.59 ± 0.35				
	p-value	0.842	0.534	0.470				
Medial Gastrocnemius 1 (R)	F + M	1.47 ± 1.12	5.13 ± 4.29	3.11 ± 3.08	**0.009**	**0.011**	0.101	1.000
	F	1.38 ± 0.82	6.04 ± 4.88	2.69 ± 1.68				
	M	1.55 ± 1.38	4.07 ± 3.62	3.65 ± 4.41				
	p-value	0.661	0.534	0.681				
Medial Gastrocnemius 2 (L)	F + M	0.93 ± 0.52	2.49 ± 2.09	1.23 ± 0.96	0.071			
	F	0.83 ± 0.47	2.32 ± 1.75	1.00 ± 0.65				
	M	1.01 ± 0.57	2.69 ± 2.60	1.52 ± 1.26				
	p-value	0.400	0.836	0.470				
Vastus Lateralis 1 (R)	F + M	0.16 ± 0.09	0.32 ± 0.21	0.43 ± 0.17	**<0.001**	0.066	**<0.001**	0.233
	F	0.19 ± 0.11	0.43 ± 0.21	0.42 ± 0.18				
	M	0.13 ± 0.07	0.18 ± 0.11	0.45 ± 0.17				
	p-value	0.243	**0.014**	0.606				
Vastus Lateralis 2 (L)	F + M	0.15 ± 0.08	0.29 ± 0.17	0.37 ± 0.21	**<0.001**	**0.031**	**<0.001**	1.000
	F	0.14 ± 0.09	0.33 ± 0.21	0.40 ± 0.26				
	M	0.15 ± 0.08	0.24 ± 0.10	0.34 ± 0.16				
	p-value	0.447	0.485	0.743				
Biceps Femoris 1 (R)	F + M	0.44 ± 0.21	0.64 ± 0.49	0.92 ± 0.61	**0.043**	1.000	**0.039**	0.394
	F	0.54 ± 0.21	0.88 ± 0.54	0.84 ± 0.54				
	M	0.34 ± 0.18	0.36 ± 0.19	1.00 ± 0.71				
	p-value	**0.035**	0.101	0.721				
Biceps Femoris 2 (L)	F + M	0.18 ± 0.13	0.33 ± 0.28	0.56 ± 0.61	**0.017**	0.492	**0.014**	0.646
	F	0.19 ± 0.14	0.38 ± 0.35	0.52 ± 0.65				
	M	0.17 ± 0.12	0.27 ± 0.18	0.60 ± 0.60				
	p-value	0.720	0.945	0.574				

Gluteus Medius 1 (R)	F + M	0.37 ± 0.17	0.34 ± 0.20	0.30 ± 0.22	0.183
	F	0.40 ± 0.20	0.38 ± 0.25	0.31 ± 0.23	
	M	0.34 ± 0.14	0.29 ± 0.08	0.29 ± 0.22	
	p-value	0.497	0.573	0.815	
Gluteus Medius 2 (L)	F + M	0.21 ± 0.10	0.25 ± 0.12	0.19 ± 0.09	0.264
	F	0.23 ± 0.13	0.21 ± 0.13	0.23 ± 0.08	
	M	0.20 ± 0.08	0.31 ± 0.09	0.14 ± 0.07	
	p-value	0.720	0.059	**0.029**	

Table 4.130. RSFL EMG Activity

Table 4.130. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the RSFL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (L)	F + M	0.30 ± 0.12	0.45 ± 0.25	0.44 ± 0.25	0.101			
	F	0.30 ± 0.13	0.58 ± 0.21	0.39 ± 0.17				
	M	0.31 ± 0.11	0.33 ± 0.24	0.51 ± 0.33				
	p-value	1.000	0.097	0.351				
Tibialis Anterior 2 (R)	F + M	0.50 ± 0.20	0.70 ± 0.27	0.65 ± 0.33	0.048	0.051	0.351	1.000
	F	0.53 ± 0.15	0.81 ± 0.30	0.55 ± 0.19				
	M	0.46 ± 0.24	0.60 ± 0.20	0.77 ± 0.44				
	p-value	0.190	0.165	0.252				
Medial Gastrocnemius 1 (L)	F + M	1.46 ± 1.34	3.06 ± 2.62	1.76 ± 1.29	0.101			
	F	1.38 ± 0.83	3.31 ± 2.61	1.69 ± 1.54				
	M	1.55 ± 1.75	2.85 ± 2.81	1.86 ± 0.92				
	p-value	0.684	0.445	0.388				
Medial Gastrocnemius 2 (R)	F + M	1.32 ± 1.41	2.73 ± 2.50	2.07 ± 2.08	0.042	0.150	0.073	1.000
	F	1.50 ± 1.23	3.12 ± 2.46	1.76 ± 1.33				
	M	1.15 ± 1.61	2.38 ± 2.68	2.46 ± 2.86				
	p-value	0.123	0.445	0.758				
Vastus Lateralis 1 (L)	F + M	0.19 ± 0.07	0.37 ± 0.22	0.36 ± 0.19	**0.001**	**0.010**	**0.004**	1.000
	F	0.17 ± 0.07	0.43 ± 0.25	0.32 ± 0.20				
	M	0.21 ± 0.08	0.31 ± 0.18	0.40 ± 0.18				
	p-value	0.247	0.234	0.321				
Vastus Lateralis 2 (R)	F + M	0.18 ± 0.09	0.37 ± 0.20	0.46 ± 0.25	**<0.001**	**0.012**	**<0.001**	0.451
	F	0.18 ± 0.10	0.47 ± 0.19	0.40 ± 0.25				
	M	0.18 ± 0.08	0.27 ± 0.17	0.54 ± 0.25				
	p-value	0.796	0.053	0.252				
Biceps Femoris 1 (L)	F + M	0.19 ± 0.11	0.41 ± 0.48	0.65 ± 0.57	**0.005**	0.861	**0.004**	0.158
	F	0.21 ± 0.10	0.54 ± 0.63	0.60 ± 0.66				
	M	0.16 ± 0.12	0.28 ± 0.24	0.70 ± 0.51				
	p-value	0.353	0.710	0.574				
Biceps Femoris 2 (R)	F + M	0.24 ± 0.15	0.45 ± 0.48	0.61 ± 0.36	**0.011**	1.000	**0.009**	0.180
	F	0.29 ± 0.18	0.72 ± 0.60	0.70 ± 0.43				
	M	0.20 ± 0.09	0.22 ± 0.17	0.52 ± 0.28				
	p-value	0.436	0.234	0.328				

Gluteus Medius 1 (L)	F + M	0.22 ± 0.16	0.27 ± 0.18	0.26 ± 0.19	0.522
	F	0.30 ± 0.20	0.28 ± 0.19	0.24 ± 0.14	
	M	0.15 ± 0.06	0.26 ± 0.17	0.28 ± 0.23	
	p-value	0.063	0.755	1.000	
Gluteus Medius 2 (R)	F + M	0.44 ± 0.25	0.45 ± 0.23	0.34 ± 0.25	0.176
	F	0.47 ± 0.26	0.49 ± 0.29	0.25 ± 0.11	
	M	0.42 ± 0.24	0.41 ± 0.13	0.45 ± 0.32	
	p-value	0.739	0.779	0.167	

Table 4.131. RSFLP EMG Activity

Table 4.131. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the RSFLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (L)	F + M	0.30 ± 0.15	0.45 ± 0.27	0.35 ± 0.20	0.327			
	F	0.35 ± 0.20	0.56 ± 0.31	0.34 ± 0.24				
	M	0.25 ± 0.08	0.32 ± 0.14	0.36 ± 0.14				
	p-value	0.497	0.181	0.252				
Tibialis Anterior 2 (R)	F + M	0.41 ± 0.21	0.49 ± 0.19	0.45 ± 0.19	0.328			
	F	0.42 ± 0.23	0.46 ± 0.24	0.40 ± 0.16				
	M	0.39 ± 0.21	0.52 ± 0.12	0.54 ± 0.22				
	p-value	0.802	0.616	0.178				
Medial Gastrocnemius 1 (L)	F + M	1.40 ± 1.15	2.63 ± 1.69	2.14 ± 2.08	**0.029**	**0.027**	0.422	0.587
	F	1.24 ± 0.80	3.19 ± 1.98	1.81 ± 1.68				
	M	1.54 ± 1.42	1.80 ± 0.75	2.56 ± 2.58				
	p-value	0.905	0.476	0.408				
Medial Gastrocnemius 2 (R)	F + M	1.22 ± 1.04	2.57 ± 2.12	1.55 ± 1.02	0.087			
	F	1.12 ± 0.66	2.13 ± 1.65	1.65 ± 1.24				
	M	1.32 ± 1.32	2.94 ± 2.54	1.41 ± 0.65				
	p-value	0.720	0.662	1.000				
Vastus Lateralis 1 (L)	F + M	0.15 ± 0.08	0.28 ± 0.18	0.28 ± 0.18	**0.008**	0.062	**0.014**	1.000
	F	0.14 ± 0.05	0.37 ± 0.20	0.29 ± 0.22				
	M	0.16 ± 0.10	0.19 ± 0.10	0.28 ± 0.13				
	p-value	0.497	0.132	0.606				
Vastus Lateralis 2 (R)	F + M	0.15 ± 0.09	0.24 ± 0.09	0.35 ± 0.18	**<0.001**	0.171	**<0.001**	0.057
	F	0.15 ± 0.10	0.27 ± 0.09	0.34 ± 0.19				
	M	0.14 ± 0.07	0.20 ± 0.08	0.36 ± 0.17				
	p-value	0.842	0.310	0.837				
Biceps Femoris 1 (L)	F + M	0.18 ± 0.12	0.45 ± 0.49	0.62 ± 0.42	**<0.001**	0.410	**<0.001**	0.125
	F	0.20 ± 0.10	0.56 ± 0.59	0.54 ± 0.45				
	M	0.17 ± 0.14	0.32 ± 0.35	0.71 ± 0.40				
	p-value	0.315	0.366	0.234				
Biceps Femoris 2 (R)	F + M	0.24 ± 0.14	0.43 ± 0.34	0.56 ± 0.39	**0.034**	0.571	**0.028**	0.852
	F	0.27 ± 0.15	0.57 ± 0.40	0.62 ± 0.48				
	M	0.21 ± 0.13	0.26 ± 0.17	0.49 ± 0.26				
	p-value	0.278	0.181	0.606				

Gluteus Medius 1 (L)	F + M	0.20 ± 0.14	0.25 ± 0.14	0.18 ± 0.12	0.304
	F	0.25 ± 0.18	0.23 ± 0.14	0.20 ± 0.07	
	M	0.16 ± 0.06	0.28 ± 0.14	0.16 ± 0.17	
	p-value	0.315	0.491	0.072	
Gluteus Medius 2 (R)	F + M	0.37 ± 0.16	0.37 ± 0.18	0.29 ± 0.20	0.062
	F	0.40 ± 0.19	0.39 ± 0.24	0.31 ± 0.14	
	M	0.33 ± 0.13	0.35 ± 0.09	0.28 ± 0.26	
	p-value	0.356	0.573	0.167	

Table 4.132. SSL EMG Activity

Table 4.132. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the SSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.51 ± 0.23	0.66 ± 0.39	0.62 ± 0.30	0.285			
	F	0.55 ± 0.20	0.88 ± 0.39	0.60 ± 0.31				
	M	0.46 ± 0.26	0.45 ± 0.27	0.65 ± 0.30				
	p-value	0.384	**0.036**	0.737				
Medial Gastrocnemius	F + M	1.16 ± 0.91	1.63 ± 1.58	1.15 ± 0.85	0.735			
	F	1.24 ± 0.77	1.43 ± 1.32	0.98 ± 0.70				
	M	1.08 ± 1.06	1.80 ± 1.86	1.37 ± 1.03				
	p-value	0.631	0.836	0.408				
Vastus Lateralis	F + M	0.22 ± 0.09	0.33 ± 0.17	0.40 ± 0.18	**0.003**	0.144	**0.002**	0.484
	F	0.23 ± 0.10	0.43 ± 0.18	0.35 ± 0.16				
	M	0.22 ± 0.09	0.25 ± 0.12	0.45 ± 0.19				
	p-value	0.837	0.053	0.233				
Biceps Femoris	F + M	0.18 ± 0.12	0.26 ± 0.30	0.38 ± 0.27	**0.027**	1.000	**0.042**	0.100
	F	0.20 ± 0.10	0.36 ± 0.42	0.30 ± 0.23				
	M	0.16 ± 0.14	0.18 ± 0.12	0.47 ± 0.29				
	p-value	0.280	0.534	0.200				
Gluteus Medius	F + M	0.34 ± 0.21	0.40 ± 0.23	0.40 ± 0.21	0.307			
	F	0.44 ± 0.25	0.44 ± 0.28	0.39 ± 0.23				
	M	0.24 ± 0.10	0.35 ± 0.17	0.41 ± 0.21				
	p-value	0.063	0.694	0.694				

Table 4.133. SSLP EMG Activity

Table 4.133. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the SSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.42 ± 0.23	0.57 ± 0.31	0.55 ± 0.32	0.217			
	F	0.42 ± 0.19	0.68 ± 0.36	0.47 ± 0.24				
	M	0.41 ± 0.27	0.45 ± 0.20	0.65 ± 0.39				
	p-value	0.684	0.259	0.142				
Medial Gastrocnemius	F + M	0.98 ± 0.68	1.61 ± 1.31	1.13 ± 0.85	0.275			
	F	1.00 ± 0.70	1.56 ± 1.33	0.87 ± 0.51				
	M	0.97 ± 0.70	1.65 ± 1.42	1.46 ± 1.11				
	p-value	0.853	0.792	0.210				
Vastus Lateralis	F + M	0.18 ± 0.08	0.23 ± 0.09	0.29 ± 0.16	**0.032**	0.307	**0.032**	1.000
	F	0.17 ± 0.07	0.27 ± 0.08	0.21 ± 0.11				
	M	0.19 ± 0.09	0.19 ± 0.09	0.37 ± 0.15				
	p-value	0.631	0.234	**0.010**				
Biceps Femoris	F + M	0.17 ± 0.15	0.39 ± 0.40	0.45 ± 0.52	**0.025**	0.240	**0.025**	1.000
	F	0.19 ± 0.13	0.56 ± 0.48	0.51 ± 0.68				
	M	0.15 ± 0.18	0.20 ± 0.17	0.38 ± 0.25				
	p-value	0.280	0.121	0.888				
Gluteus Medius	F + M	0.30 ± 0.16	0.36 ± 0.20	0.33 ± 0.13	0.398			
	F	0.32 ± 0.18	0.36 ± 0.15	0.30 ± 0.13				
	M	0.27 ± 0.13	0.37 ± 0.26	0.36 ± 0.13				
	p-value	0.684	0.613	0.336				

Table 4.134. SSR EMG Activity

Table 4.134. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the SSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.40 ± 0.17	0.60 ± 0.24	0.53 ± 0.19	**0.013**	**0.014**	0.129	0.758
	F	0.46 ± 0.16	0.71 ± 0.28	0.53 ± 0.20				
	M	0.34 ± 0.17	0.49 ± 0.13	0.53 ± 0.18				
	p-value	0.119	0.088	0.992				
Medial Gastrocnemius	F + M	1.23 ± 1.03	2.29 ± 1.85	1.53 ± 1.12	0.077			
	F	1.35 ± 0.98	2.07 ± 1.52	1.56 ± 1.08				
	M	1.12 ± 1.12	2.44 ± 2.16	1.50 ± 1.27				
	p-value	0.247	1.000	0.606				
Vastus Lateralis	F + M	0.14 ± 0.06	0.28 ± 0.16	0.38 ± 0.15	**<0.001**	**0.006**	**<0.001**	0.100
	F	0.13 ± 0.07	0.35 ± 0.16	0.35 ± 0.15				
	M	0.14 ± 0.04	0.22 ± 0.15	0.42 ± 0.15				
	p-value	0.481	0.097	0.370				
Biceps Femoris	F + M	0.15 ± 0.11	0.37 ± 0.35	0.42 ± 0.26	**0.004**	0.149	**0.003**	0.797
	F	0.20 ± 0.11	0.57 ± 0.41	0.47 ± 0.26				
	M	0.10 ± 0.08	0.17 ± 0.08	0.37 ± 0.26				
	p-value	**0.023**	0.165	0.673				
Gluteus Medius	F + M	0.43 ± 0.26	0.53 ± 0.36	0.57 ± 0.30	0.138			
	F	0.45 ± 0.33	0.60 ± 0.51	0.52 ± 0.27				
	M	0.40 ± 0.17	0.46 ± 0.13	0.63 ± 0.35				
	p-value	0.631	0.805	0.606				

Table 4.135. SSRP EMG Activity

Table 4.135. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the SSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.35 ± 0.25	0.51 ± 0.23	0.36 ± 0.14	**0.029**	**0.026**	1.000	0.232
	F	0.41 ± 0.33	0.54 ± 0.32	0.35 ± 0.14				
	M	0.29 ± 0.15	0.48 ± 0.11	0.38 ± 0.15				
	p-value	0.529	0.902	0.689				
Medial Gastrocnemius	F + M	1.17 ± 1.12	2.71 ± 2.49	1.65 ± 1.35	**0.034**	**0.037**	0.264	1.000
	F	1.28 ± 1.24	2.74 ± 2.63	1.36 ± 0.92				
	M	1.05 ± 1.04	2.68 ± 2.58	2.01 ± 1.76				
	p-value	0.218	1.000	0.681				
Vastus Lateralis	F + M	0.15 ± 0.08	0.24 ± 0.16	0.29 ± 0.19	**0.007**	0.105	**0.007**	1.000
	F	0.13 ± 0.09	0.31 ± 0.18	0.22 ± 0.08				
	M	0.16 ± 0.06	0.18 ± 0.10	0.36 ± 0.24				
	p-value	0.089	0.165	0.167				
Biceps Femoris	F + M	0.13 ± 0.07	0.30 ± 0.30	0.32 ± 0.23	**0.042**	0.295	**0.046**	1.000
	F	0.14 ± 0.07	0.44 ± 0.38	0.35 ± 0.27				
	M	0.11 ± 0.08	0.15 ± 0.08	0.29 ± 0.19				
	p-value	0.315	0.209	0.878				
Gluteus Medius	F + M	0.36 ± 0.16	0.43 ± 0.20	0.47 ± 0.27	0.420			
	F	0.37 ± 0.17	0.47 ± 0.28	0.41 ± 0.28				
	M	0.35 ± 0.14	0.39 ± 0.04	0.53 ± 0.26				
	p-value	1.000	0.779	0.277				

Table 4.136. ST EMG Activity

Table 4.136. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the ST between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.38 ± 0.19	0.50 ± 0.35	0.40 ± 0.21	0.362			
	F	0.47 ± 0.19	0.65 ± 0.37	0.39 ± 0.20				
	M	0.29 ± 0.14	0.35 ± 0.29	0.42 ± 0.23				
	p-value	0.075	0.128	0.681				
Medial Gastrocnemius	F + M	2.17 ± 1.63	3.25 ± 3.21	2.46 ± 2.07	0.845			
	F	2.30 ± 1.36	2.90 ± 2.42	2.22 ± 1.43				
	M	2.04 ± 1.93	3.60 ± 4.02	2.77 ± 2.78				
	p-value	0.353	1.000	1.000				
Vastus Lateralis	F + M	0.16 ± 0.12	0.26 ± 0.15	0.31 ± 0.18	**0.003**	0.051	**0.005**	1.000
	F	0.19 ± 0.17	0.31 ± 0.17	0.30 ± 0.22				
	M	0.12 ± 0.03	0.22 ± 0.13	0.31 ± 0.14				
	p-value	0.165	0.534	0.481				
Biceps Femoris	F + M	0.85 ± 0.57	0.54 ± 0.46	0.95 ± 0.72	0.081			
	F	0.75 ± 0.41	0.67 ± 0.53	0.74 ± 0.63				
	M	0.95 ± 0.71	0.41 ± 0.38	1.17 ± 0.78				
	p-value	0.796	0.165	0.130				
Gluteus Medius	F + M	0.26 ± 0.15	0.38 ± 0.22	0.35 ± 0.28	0.156			
	F	0.29 ± 0.19	0.35 ± 0.23	0.25 ± 0.15				
	M	0.22 ± 0.09	0.41 ± 0.21	0.45 ± 0.34				
	p-value	0.796	0.536	0.234				

Table 4.137. STP EMG Activity

Table 4.137. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the STP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior	F + M	0.38 ± 0.22	0.44 ± 0.33	0.46 ± 0.29	0.801			
	F	0.49 ± 0.25	0.57 ± 0.35	0.38 ± 0.19				
	M	0.27 ± 0.12	0.30 ± 0.26	0.56 ± 0.38				
	p-value	**0.019**	0.128	0.536				
Medial Gastrocnemius	F + M	2.23 ± 1.77	3.76 ± 3.26	2.34 ± 2.02	0.534			
	F	2.32 ± 1.81	3.53 ± 2.51	2.07 ± 1.59				
	M	2.14 ± 1.82	3.99 ± 4.07	2.69 ± 2.57				
	p-value	0.684	1.000	1.000				
Vastus Lateralis	F + M	0.15 ± 0.07	0.23 ± 0.12	0.28 ± 0.21	**0.009**	0.119	**0.010**	1.000
	F	0.15 ± 0.07	0.26 ± 0.17	0.30 ± 0.26				
	M	0.14 ± 0.07	0.20 ± 0.07	0.25 ± 0.11				
	p-value	0.631	0.731	0.681				
Biceps Femoris	F + M	0.75 ± 0.48	0.56 ± 0.55	0.88 ± 0.69	0.173			
	F	0.67 ± 0.28	0.70 ± 0.74	0.84 ± 0.77				
	M	0.82 ± 0.63	0.42 ± 0.26	0.93 ± 0.63				
	p-value	1.000	0.535	0.673				
Gluteus Medius	F + M	0.28 ± 0.20	0.40 ± 0.25	0.39 ± 0.29	0.108			
	F	0.27 ± 0.20	0.36 ± 0.31	0.27 ± 0.12				
	M	0.29 ± 0.21	0.45 ± 0.16	0.50 ± 0.36				
	p-value	0.529	0.121	0.195				

Table 4.138. TSL EMG Activity

Table 4.138. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the TSL between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (L)	F + M	0.36 ± 0.16	0.49 ± 0.29	0.60 ± 0.33	0.094			
	F	0.44 ± 0.14	0.57 ± 0.31	0.55 ± 0.34				
	M	0.28 ± 0.15	0.40 ± 0.27	0.66 ± 0.32				
	p-value	**0.009**	0.318	0.536				
Tibialis Anterior 3 (L)	F + M	0.47 ± 0.20	0.57 ± 0.31	0.61 ± 0.32	0.690			
	F	0.53 ± 0.16	0.74 ± 0.35	0.59 ± 0.35				
	M	0.42 ± 0.24	0.41 ± 0.15	0.64 ± 0.30				
	p-value	0.315	**0.038**	0.210				
Medial Gastrocnemius 1 (L)	F + M	1.15 ± 0.90	1.11 ± 0.75	1.38 ± 0.87	0.543			
	F	1.28 ± 0.57	1.13 ± 1.00	1.25 ± 0.72				
	M	1.00 ± 1.19	1.09 ± 0.41	1.55 ± 1.07				
	p-value	0.133	1.000	0.470				
Medial Gastrocnemius 3 (L)	F + M	1.30 ± 1.22	1.71 ± 1.65	1.36 ± 0.99	0.664			
	F	1.38 ± 0.96	1.60 ± 1.54	1.15 ± 0.72				
	M	1.21 ± 1.48	1.80 ± 1.86	1.63 ± 1.28				
	p-value	0.436	1.000	0.606				
Vastus Lateralis 1 (L)	F + M	0.25 ± 0.16	0.35 ± 0.21	0.52 ± 0.24	**0.005**	0.628	**0.004**	0.257
	F	0.24 ± 0.20	0.42 ± 0.18	0.47 ± 0.28				
	M	0.25 ± 0.12	0.29 ± 0.22	0.57 ± 0.20				
	p-value	0.481	0.295	0.382				
Vastus Lateralis 3 (L)	F + M	0.28 ± 0.14	0.39 ± 0.24	0.61 ± 0.48	**0.016**	0.552	**0.013**	0.602
	F	0.26 ± 0.10	0.50 ± 0.23	0.57 ± 0.56				
	M	0.31 ± 0.18	0.29 ± 0.21	0.64 ± 0.42				
	p-value	0.631	0.138	0.370				
Biceps Femoris 1 (L)	F + M	0.20 ± 0.17	0.39 ± 0.49	0.42 ± 0.27	**0.046**	1.000	**0.041**	0.439
	F	0.21 ± 0.09	0.59 ± 0.65	0.34 ± 0.25				
	M	0.20 ± 0.22	0.20 ± 0.11	0.49 ± 0.28				
	p-value	0.280	0.620	0.382				
Biceps Femoris 3 (L)	F + M	0.23 ± 0.27	0.32 ± 0.35	0.40 ± 0.30	0.052			
	F	0.30 ± 0.35	0.46 ± 0.45	0.39 ± 0.25				
	M	0.16 ± 0.13	0.17 ± 0.11	0.40 ± 0.35				
	p-value	0.218	0.456	0.878				

Gluteus Medius 1 (L)	F + M	0.24 ± 0.18	0.34 ± 0.19	0.40 ± 0.22	**0.009**	0.070	**0.012**	1.000
	F	0.33 ± 0.22	0.38 ± 0.23	0.36 ± 0.16				
	M	0.16 ± 0.04	0.29 ± 0.14	0.43 ± 0.27				
	p-value	**0.029**	0.463	1.000				
Gluteus Medius 3 (L)	F + M	0.36 ± 0.20	0.46 ± 0.20	0.44 ± 0.25	0.261			
	F	0.47 ± 0.22	0.44 ± 0.11	0.38 ± 0.21				
	M	0.25 ± 0.10	0.48 ± 0.27	0.50 ± 0.30				
	p-value	**0.019**	0.710	0.536				

Table 4.139. TSLP EMG Activity

Table 4.139. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the TSLP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (L)	F + M	0.35 ± 0.22	0.42 ± 0.30	0.56 ± 0.31	**0.027**	1.000	**0.025**	0.229
	F	0.42 ± 0.24	0.57 ± 0.34	0.48 ± 0.33				
	M	0.28 ± 0.18	0.26 ± 0.14	0.65 ± 0.29				
	p-value	0.123	0.053	0.091				
Tibialis Anterior 3 (L)	F + M	0.36 ± 0.20	0.60 ± 0.38	0.55 ± 0.34	0.088			
	F	0.35 ± 0.20	0.78 ± 0.44	0.51 ± 0.34				
	M	0.38 ± 0.20	0.42 ± 0.19	0.61 ± 0.35				
	p-value	1.000	0.128	0.408				
Medial Gastrocnemius 1 (L)	F + M	1.18 ± 0.80	2.16 ± 1.79	1.24 ± 0.82	0.142			
	F	1.20 ± 0.52	2.49 ± 1.82	0.97 ± 0.59				
	M	1.17 ± 1.04	1.84 ± 1.87	1.60 ± 0.98				
	p-value	0.436	0.818	0.174				
Medial Gastrocnemius 3 (L)	F + M	1.17 ± 0.99	2.18 ± 1.76	1.34 ± 1.09	0.152			
	F	1.14 ± 0.96	2.50 ± 1.91	0.94 ± 0.51				
	M	1.20 ± 1.08	1.91 ± 1.73	1.85 ± 1.45				
	p-value	1.000	0.445	0.174				
Vastus Lateralis 1 (L)	F + M	0.22 ± 0.11	0.38 ± 0.20	0.45 ± 0.26	**0.004**	0.086	**0.004**	1.000
	F	0.21 ± 0.14	0.43 ± 0.20	0.49 ± 0.33				
	M	0.22 ± 0.08	0.32 ± 0.20	0.42 ± 0.18				
	p-value	0.280	0.259	1.000				
Vastus Lateralis 3 (L)	F + M	0.21 ± 0.08	0.40 ± 0.26	0.41 ± 0.23	**0.009**	0.054	**0.017**	1.000
	F	0.16 ± 0.05	0.54 ± 0.28	0.42 ± 0.28				
	M	0.26 ± 0.08	0.25 ± 0.13	0.38 ± 0.17				
	p-value	**0.009**	**0.026**	1.000				
Biceps Femoris 1 (L)	F + M	0.23 ± 0.16	0.33 ± 0.43	0.37 ± 0.23	0.141			
	F	0.23 ± 0.13	0.52 ± 0.60	0.27 ± 0.19				
	M	0.22 ± 0.19	0.17 ± 0.07	0.45 ± 0.24				
	p-value	0.436	0.181	0.152				
Biceps Femoris 3 (L)	F + M	0.15 ± 0.11	0.24 ± 0.22	0.36 ± 0.25	**0.003**	0.571	**0.002**	0.214
	F	0.15 ± 0.08	0.30 ± 0.25	0.29 ± 0.15				
	M	0.16 ± 0.14	0.20 ± 0.19	0.42 ± 0.31				
	p-value	0.631	0.534	0.536				

Gluteus Medius 1 (L)	F + M	0.23 ± 0.16	0.34 ± 0.17	0.37 ± 0.20	**0.014**	0.095	**0.020**	1.000
	F	0.28 ± 0.20	0.33 ± 0.18	0.34 ± 0.14				
	M	0.17 ± 0.06	0.34 ± 0.17	0.40 ± 0.26				
	p-value	0.315	0.779	1.000				
Gluteus Medius 3 (L)	F + M	0.34 ± 0.21	0.51 ± 0.31	0.41 ± 0.21	0.105			
	F	0.42 ± 0.26	0.53 ± 0.30	0.36 ± 0.15				
	M	0.26 ± 0.09	0.48 ± 0.35	0.46 ± 0.27				
	p-value	0.315	0.613	0.613				

Table 4.140. TSR EMG Activity

Table 4.140. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the TSR between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (R)	F + M	0.48 ± 0.17	1.16 ± 2.37	0.75 ± 0.75	0.377			
	F	0.54 ± 0.20	1.75 ± 3.21	0.51 ± 0.23				
	M	0.42 ± 0.10	0.50 ± 0.25	1.02 ± 1.04				
	p-value	0.247	0.073	0.681				
Tibialis Anterior 3 (R)	F + M	0.45 ± 0.15	1.40 ± 2.84	0.95 ± 1.41	**0.045**	**0.039**	0.634	0.714
	F	0.53 ± 0.17	2.18 ± 3.83	0.58 ± 0.19				
	M	0.37 ± 0.08	0.51 ± 0.16	1.36 ± 2.04				
	p-value	**0.019**	0.073	0.224				
Medial Gastrocnemius 1 (R)	F + M	1.73 ± 1.53	4.79 ± 6.25	2.52 ± 3.56	0.731			
	F	1.91 ± 1.48	6.73 ± 7.93	1.44 ± 0.89				
	M	1.55 ± 1.64	2.57 ± 2.67	3.73 ± 4.99				
	p-value	0.165	1.000	0.606				
Medial Gastrocnemius 3 (R)	F + M	1.36 ± 1.24	4.84 ± 5.49	3.04 ± 5.24	0.130			
	F	1.45 ± 1.10	6.77 ± 6.74	1.63 ± 0.98				
	M	1.26 ± 1.42	2.63 ± 2.57	4.64 ± 7.50				
	p-value	0.165	0.429	1.000				
Vastus Lateralis 1 (R)	F + M	0.27 ± 0.38	0.96 ± 2.00	0.54 ± 0.37	**<0.001**	**0.026**	**0.001**	1.000
	F	0.38 ± 0.52	1.55 ± 2.67	0.43 ± 0.19				
	M	0.16 ± 0.09	0.29 ± 0.22	0.66 ± 0.49				
	p-value	0.436	0.165	0.200				
Vastus Lateralis 3 (R)	F + M	0.19 ± 0.07	0.80 ± 1.72	0.66 ± 0.73	**<0.001**	**0.041**	**<0.001**	**0.046**
	F	0.19 ± 0.09	1.30 ± 2.30	0.44 ± 0.21				
	M	0.18 ± 0.06	0.22 ± 0.19	0.91 ± 1.02				
	p-value	0.971	**0.026**	0.236				
Biceps Femoris 1 (R)	F + M	0.20 ± 0.22	1.20 ± 3.43	0.39 ± 0.21	**0.011**	0.325	**0.008**	0.708
	F	0.27 ± 0.30	2.06 ± 4.65	0.36 ± 0.21				
	M	0.14 ± 0.08	0.22 ± 0.14	0.42 ± 0.23				
	p-value	0.218	0.383	0.606				
Biceps Femoris 3 (R)	F + M	0.15 ± 0.09	1.00 ± 2.59	0.44 ± 0.29	**<0.001**	1.000	**0.002**	**0.009**
	F	0.21 ± 0.08	1.77 ± 3.45	0.46 ± 0.33				
	M	0.09 ± 0.06	0.11 ± 0.06	0.40 ± 0.26				
	p-value	**0.003**	0.138	0.815				

Gluteus Medius 1 (R)	F + M	0.31 ± 0.20	0.43 ± 0.24	0.47 ± 0.28	0.050
	F	0.37 ± 0.24	0.52 ± 0.30	0.42 ± 0.23	
	M	0.24 ± 0.11	0.34 ± 0.09	0.53 ± 0.33	
	p-value	0.218	0.152	0.673	
Gluteus Medius 3 (R)	F + M	0.48 ± 0.27	0.59 ± 0.35	0.61 ± 0.32	0.146
	F	0.56 ± 0.35	0.67 ± 0.48	0.58 ± 0.32	
	M	0.40 ± 0.14	0.51 ± 0.11	0.64 ± 0.34	
	p-value	0.661	0.902	0.681	

Table 4.141. TSRP EMG Activity

Table 4.141. Comparisons of peak EMG activity (in mean ± standard deviation and % of MVIC) during the TSRP between genders and among experience levels (NEW vs. REC vs. PRO). The former comparisons were conducted by Mann-Whitney/independent *t*-tests and the latter ones were based on Kruskal-Wallis/one-way ANOVA tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Gender	NEW	REC	PRO	*p*-value	Post-hoc *p*-value		
						NEW v. REC	NEW v. PRO	REC v. PRO
Tibialis Anterior 1 (R)	F + M	0.44 ± 0.15	0.47 ± 0.18	0.51 ± 0.31	0.969			
	F	0.50 ± 0.18	0.54 ± 0.17	0.40 ± 0.16				
	M	0.38 ± 0.06	0.41 ± 0.17	0.66 ± 0.41				
	p-value	0.190	0.259	0.252				
Tibialis Anterior 3 (R)	F + M	0.32 ± 0.17	0.57 ± 0.23	0.43 ± 0.17	**0.002**	**0.002**	0.285	0.157
	F	0.35 ± 0.19	0.57 ± 0.28	0.42 ± 0.18				
	M	0.30 ± 0.14	0.57 ± 0.20	0.45 ± 0.18				
	p-value	0.853	0.902	0.776				
Medial Gastrocnemius 1 (R)	F + M	1.36 ± 1.05	1.49 ± 1.06	1.24 ± 0.69	0.929			
	F	1.58 ± 0.96	1.96 ± 1.29	1.36 ± 0.74				
	M	1.14 ± 1.15	1.02 ± 0.59	1.06 ± 0.62				
	p-value	0.190	0.310	0.388				
Medial Gastrocnemius 3 (R)	F + M	1.22 ± 1.09	2.50 ± 2.25	2.06 ± 1.92	**0.038**	0.090	0.101	1.000
	F	1.34 ± 1.06	2.12 ± 1.45	1.69 ± 1.14				
	M	1.11 ± 1.17	2.78 ± 2.77	2.52 ± 2.65				
	p-value	0.123	0.876	0.758				
Vastus Lateralis 1 (R)	F + M	0.18 ± 0.12	0.38 ± 0.24	0.42 ± 0.22	**<0.001**	**0.011**	**<0.001**	1.000
	F	0.21 ± 0.16	0.46 ± 0.26	0.40 ± 0.19				
	M	0.15 ± 0.05	0.30 ± 0.21	0.45 ± 0.27				
	p-value	0.796	0.259	0.837				
Vastus Lateralis 3 (R)	F + M	0.15 ± 0.05	0.35 ± 0.21	0.41 ± 0.24	**<0.001**	**0.007**	**<0.001**	0.734
	F	0.14 ± 0.06	0.46 ± 0.21	0.37 ± 0.16				
	M	0.16 ± 0.05	0.24 ± 0.16	0.47 ± 0.33				
	p-value	0.218	**0.038**	0.918				
Biceps Femoris 1 (R)	F + M	0.20 ± 0.21	0.28 ± 0.13	0.38 ± 0.29	**0.028**	0.114	**0.048**	1.000
	F	0.25 ± 0.27	0.31 ± 0.14	0.32 ± 0.23				
	M	0.16 ± 0.11	0.24 ± 0.13	0.44 ± 0.34				
	p-value	0.393	0.318	0.279				
Biceps Femoris 3 (R)	F + M	0.14 ± 0.10	0.24 ± 0.28	0.33 ± 0.21	**0.005**	1.000	**0.004**	0.105
	F	0.18 ± 0.12	0.36 ± 0.38	0.33 ± 0.24				
	M	0.11 ± 0.06	0.14 ± 0.09	0.34 ± 0.19				
	p-value	0.247	0.234	0.721				

Gluteus Medius 1 (R)	F + M	0.28 ± 0.15	0.35 ± 0.13	0.43 ± 0.23	**0.038**	0.354	**0.037**	1.000
	F	0.34 ± 0.17	0.36 ± 0.17	0.40 ± 0.22				
	M	0.22 ± 0.08	0.34 ± 0.08	0.47 ± 0.25				
	p-value	0.075	1.000	0.423				
Gluteus Medius 3 (R)	F + M	0.39 ± 0.20	0.48 ± 0.21	0.49 ± 0.20	0.312			
	F	0.44 ± 0.24	0.53 ± 0.27	0.47 ± 0.23				
	M	0.35 ± 0.15	0.43 ± 0.10	0.51 ± 0.18				
	p-value	0.853	0.694	0.606				

5 DISCUSSION

The primary purpose of this study was to fill the knowledge gap regarding the movement patterns associated with ballroom dance. A better understanding of the movement patterns in rhythm ballroom dances may improve performance and provide insight into the possible mechanism of ballroom dance as an intervention to improve body balance and reduce fall risk from the biomechanical perspective.

To fulfill the aim of this study, a group of professional dancers was recruited, with the expectation that they would portray the most desirable movement patterns, and their lower extremity kinematics/kinetics were compared to a group of recreational and inexperienced dancers during five key rhythm ballroom dance elements. There were two specific research questions posed: 1) what kinetics, kinematics, and muscle activity levels are present in the basic rhythm ballroom dance steps and how do they change among experience levels, and 2) are the mechanics and muscle activity different between males and females. It was hypothesized that professional dancers would exhibit lower forces, decreased joint loading, greater joint angles, and decreased muscle activity during the selected dance elements relative to non-professional levels. It was also hypothesized that males and females would exhibit different movement patterns during the dance elements.

The first hypothesis was partially supported when analyzing comparisons among ballroom dance experience levels. Specifically, the professional dancers generally demonstrated lower peak GRFs and loading rates, but greater lower extremity joint power absorption and propulsion compared to the less experienced dancers. In addition, the professional level also typically illustrated greater lower extremity joint moments, and greater extension and flexion joint angles in all three planes of motion, compared to the inexperienced level. Although the recreational level displayed patterns of motion that were between the professional and inexperienced levels for most of the movements and measurements, some measurements of dancers in the recreational level were beyond the range of the other two levels and showed the most inconsistent patterns of movement. It is possible that this reflects the wide range of abilities in the recreational group. In addition, the professional level tended to exhibit significantly greater muscle activity compared to the inexperienced level, and the recreational level demonstrated muscle activity that was comparable, and even greater, to the professional level, which partially supports the first hypothesis.

Results from the comparison between males and females partially supported the second hypothesis. A portion of the analyzed variables showed significant differences between genders. When significant differences were observed, males often exhibited greater power absorption and propulsion and greater joint moments. Males tended to exhibit less joint flexion and greater joint extension, as well as decreased external rotation and increased internal rotation. However, there were minimal differences in peak muscle activity between males and females. When there were differences, males generally illustrated lower levels of peak muscle activity compared to females.

5.1 Primary Outcome Measures: Force, Loading Rate and Joint Power

5.1.1 Ground Reaction Force and Loading Rate

Results for the primary outcome measures did not fully support the first hypothesis. In most cases, the peak vertical GRF and the loading rate were significantly lower in the professional level compared to the inexperienced level, with the recreational level most commonly falling in-between (Tables 4.2 – 4.18). This trend was particularly apparent during steps that involved moving backward. The inexperienced level not only demonstrated a significantly greater peak GRF and loading rate compared to the recreational and professional levels during most movements, but their peak GRF and loading rate during the BSR/BSRP (Table 4.2-3), the backward step of the RSBR/RSBRP (Table 4.5-6), and the backward step of the RSFL/RSFLP (Table 4.7-8) were substantially greater than was displayed in the FSL (Table 4.4) and the forward step of the RSFL (Table 4.7) and RSBR (Table 4.5) compared to the recreational and professional levels. This could be attributable to the more experienced dancers having better balance and greater body control, allowing them to better control their forces and rate of weight transfer from one foot to the next regardless of the direction they are moving in.

When moving in the forward direction during the FSL and the first step of the RSFL, the inexperienced level displayed a similar GRF, but a greater loading rate compared to the recreational and professional levels. Rhythm dances are performed with toe-leads, regardless of step direction, which is how all the professional and most of the recreational dancers moved. However, the inexperienced dancers typically danced heel-toe when moving in the forward direction. Landing on the forefoot has a tendency to produce a lower GRF and a decreased loading rate (Kulmala et al. 2013), which is likely why the recreational and professional levels demonstrated lower loading rates compared to the inexperienced level. When moving sideways during the SSL/SSLP and SSR/SSRP, the peak GRF was more similar among the three levels, but the loading rate remained greater in the inexperienced level. All participants stepped sideways with toe-leads, so the increased loading rate seen in the inexperienced level could be another illustration of the greater ability of the more experienced dancers to control their movements and thus the rate of loading when performing the dance movements.

Analysis of the ST/STP, which involves stepping and spinning 360-degrees, revealed that the inexperienced level portrayed a lower GRF, and a similar loading rate compared to the other two levels. Though unexpected, it is possible that this is because the professionals and most of the recreational dancers stepped forward, fully transferred their weight onto the stepping foot, and pivoted before completing the spot turn. Meaning the experienced dancers almost did two 180-degree rotations. In contrast, the inexperienced dancers appeared to step forward but did not fully shift their weight forward before pushing off the ground with the stepping foot and completing a full 360-degree spin on the supporting foot.

When moving sideways during the TSL/TSLP and TSR/TSRP, the inexperienced level illustrated a significantly greater peak GRF during the first and third steps and a larger loading rate during the third step compared to the other two levels. This could be due to the professional dancers performing the triple steps in a smoother manner without a flight phase, as would be illustrated during the Cha-Cha, while the less experienced dancers generally performed the triple steps with more bounce. In contrast, a similar study analyzing the triple step in recreational swing dancers (Wells and Yang 2021b) found slightly different results. The swing dancers illustrated much greater GRFs and loading rates compared to the professional and recreational ballroom dancers in this study. The inexperienced level in the present study elicited the most similar forces and loading rates compared to the swing dancers. The triple step in swing dancing is performed with more bounce and tends to include a brief flight phase between steps one and two, while that flight phase is not present during the triple step in the Cha-Cha because dancers are expected to close their feet together between steps one and two before taking the third step. This key difference in how the triple step is performed in swing versus Cha-Cha is likely the reason for the different outcomes observed in the forces between the two studies.

The second hypothesis was not fully supported by results from this study in regards to the peak GRF and loading rate. There were significant differences in GRF and loading rate between males and females, though the movements and levels in which the differences occurred were inconsistent. Intriguingly, when differences were observed, they illustrated greater forces for the females when the steps were performed individually but greater forces for the males when the steps were completed with a partner. Though forces appeared to decrease slightly when executing the steps with a partner in general, this occurred more significantly for females. One candidate explanation for this is that forces and loading rates decrease when dancing with a partner because the partner aids in balance, which helps control the weight transfer when stepping. A second possible explanation is that males always led and females always followed. Therefore, it is possible that the act of following itself results in decreased forces because the leader helps to guide the follower to her destination, and followers do not always know where they are going, which may result in more hesitant steps.

Further analysis of the peak GRF and loading rates revealed that the inexperienced level displayed forces that are like those typically seen in walking (Keller et al. 1996), while the recreational and professional levels displayed lower forces. This implies that ballroom dance training could reduce the peak vertical GRF. This is desirable given the increased use of ballroom dance protocols with older and clinical populations (Hackney and Earhart 2010; Merom et al. 2013; Gomes da Silva Borges et al. 2018; Ng et al. 2019). If ballroom dance can improve body balance and control while experiencing low external forces, as was indicated by the differences in peak GRF and loading rates seen in this study, then this activity may be recommended for populations that struggle with balance and/or have difficulty with typical weight-bearing activities.

5.1.2 Joint Power

The professional level demonstrated joint power absorption and propulsion that varied depending on the dance movements, but was significantly greater than was demonstrated by the inexperienced level across all three joints in nearly all movements. The recreational level displayed joint power that was inconsistently different from the inexperienced and professional levels (Tables 4.2 – 4.18).

Notably, the inexperienced level exhibited substantially greater joint power absorption and propulsion at the ankle during many of the dance movements relative to the knee and hip joints. In comparison, the recreational and professional levels showed a greater distribution of power across the ankle, knee, and hip. Between genders, very few differences were observed and primarily occurred in the inexperienced level. Where differences occurred within the inexperienced level, males were generally observed to display greater joint power absorption and propulsion at the knee and hip, while females often displayed greater joint power absorption and propulsion at the ankle.

The significantly greater power absorption and propulsion exhibited by the professional dance level across steps is likely a function of how the movements were intended to be danced. Although professional dancers exhibited lower GRF and loading rates, they interact with the floor more through the articulation of their feet, and will fully transfer their weight onto each foot before proceeding to the next step, which may be the reason for the greater joint power absorption. Professionals also demonstrated greater joint flexion, which may have led to the greater distribution of power absorption across the ankle, knee, and hip joints. Similarly, the stiffer movements of the inexperienced participants may be the reason most of the power absorption and propulsion was contained at the ankle in this participant group. Additionally, professional dancers roll through their feet - absorbing more energy from the floor - and use the floor to push off by extending through the joints, before sliding their foot to the next position rather than picking their foot up and stepping. The greater range of motion and increased use of the floor is a probable explanation for the greater power propulsion observed in the professional level and, to a lesser extent, the recreational level.

Prior research analyzing the triple step in swing dancers (Wells and Yang 2021b), illustrated significantly greater ankle power absorption and propulsion than what was observed in this study. However, the knee and hip power absorption and propulsion demonstrated in this study were significantly greater than was previously reported for the triple step (Wells and Yang 2021b). This, again, could be a function of how the triple step is performed between different dances. The triple step in swing dance is performed with more spring, and there is often a slight hop or flight phase between the first and second steps. Conversely, the triple step in the Cha-Cha is performed with smoother transitions between steps and there is no flight phase. The bounce that is characteristic of the triple step in swing dancing could be the reason for the greater power at the ankle, and decreased power at the knee and hip, dissimilar to the power exhibited in the triple step performed in the Cha-Cha. This is supported by research analyzing differences in squat jumps versus countermovement jumps (Mackala et al. 2013). The squat jump, which involves greater joint flexion and a greater time for force development exhibited greater joint power at the ankle, knee and hip in this study compared to the countermovement jump. Thus, it is reasonable to expect greater joint power during the triple step when performed in the Cha-Cha because of the greater joint flexion. This would also explain some of the differences between the inexperienced level and the professional level, as the inexperienced level tended to perform the triple steps with more of a bounce in the step, similar to the swing dancers.

5.2 Secondary Outcomes Measures: Joint Moments and Joint Angles

5.2.1 Sagittal Plane Joint Angles and Moments

The most consistent differences in the three-dimensional joint angles and moments in this study occurred between the inexperienced and professional levels. In the sagittal plane, the professional level consistently exhibited greater peak joint flexion compared to the other two levels, most commonly at the knee and hip across all dance movements. In addition, either there were no differences in peak knee and hip joint extension, or there was greater extension in the professional level. Together, this indicates that the professional level generally moved through a greater range of motion at the knee and hip during stance compared to the other two levels.

At the ankle, the inexperienced level exhibited significantly less peak plantarflexion during the BSR/BSRP (Tables 4.22 and 4.28) and FSLP (Table 4.37), and the RSBR/RSBRP (Tables 4.43 and 4.49) and RSFL/RSFLP (Tables 4.55 and 4.61) movements, while the professional level displayed much greater peak plantarflexion angles. This is sensible due to the typical toe-leads that are observed in rhythm dancing. However, when moving sideways in the SSL/SSLP (Tables 4.67 and 4.73), SSR/SSRP (Tables 4.79 and 4.85), TSL/TSLP (Tables 4.103 and 4.109), and TSR/TSRP (Tables 4.115 and 4.121) the inexperienced level displayed significantly greater peak ankle plantarflexion than the other two levels. This is reasonable given the way in which the inexperienced level bounced as they stepped, leading them to remain on the ball of their foot more. This is in line with the decreased joint power that was observed in the inexperienced level as well. The increased joint flexion at all three joints also explains the increased absorption in the professional level across the lower extremity joints compared to the inexperienced level.

Interestingly, during the ST/STP (Tables 4.91 and 4.97), the inexperienced level displayed significantly less peak ankle dorsiflexion compared to the professional level, but there were no differences in peak ankle plantarflexion. The differences in dorsiflexion are likely because the professional dancers shifted their weight over their foot completely when they stepped forward, leading to greater ankle joint flexion, while the inexperienced participants remained more over their supporting limb.

Where differences occurred between males and females in peak sagittal plane ankle angles, males were observed to exhibit significantly less peak ankle plantarflexion compared to females. Though males did display plantarflexion, the females exhibited significantly more, which could be the result of females, especially female ballroom dancers, being more accustomed to heels, lending them towards a more naturally plantarflexed foot when stepping. Female ballroom dancers tend to practice and perform in heels, which would require them to be in greater plantarflexion, while males tend to wear much flatter shoes, thereby reducing the amount of ankle plantarflexion they are accustomed to (Pilar et al. 2020). At the knee and hip, however, males were more likely to illustrate greater peak joint extension and less peak joint flexion than females. The increase in joint extension and decrease in joint flexion demonstrated by the males implies that they executed the dance movements with straighter legs than females. Additionally, more differences occurred between genders in the inexperienced and recreational levels, leading to the notion that as experience increases, sagittal plane kinematic differences between males and females decrease, likely due to training.

There were a few significant differences in peak sagittal plane moments, and no significant differences in sagittal plane joint moments during the BSR (Table 4.19) and SSL/SSLP (Table 4.64 and 4.70) were detected. Most of the differences in peak sagittal plane joint moments were observed at the knee and hip joints, with the professional level generally displaying greater peak moments which are correlated with the increased excursion seen at the knee and hip joints in the professional level. At the ankle, the inexperienced level displayed significantly greater peak ankle dorsiflexion moments during the FSL (Table 4.31), SSR (Table 4.76), RSBR (Table 4.40), RSFL (Table 4.52), and TSR/TSRP (Tables 4.112 and 4.118).

A previous study examining the kinetics of the triple step element in swing dance (Wells and Yang 2021b) reported sagittal plane joint moments during the first step of the triple step that were different from what was observed in this study, but the third step of the triple step resulted in similar results (Wells and Yang 2021b). In the present study, the ankle dorsiflexion moment was greater, but the ankle plantarflexion moment was smaller during the first step of the triple step than in the prior study. However, during the third step the ankle moments were similar between the two studies. The knee and hip flexion moments in the present study were much greater during both steps, while the knee and hip extension moments were greater in the present study during the first step but similar across the two studies during the third step. The differences in joint moments during the first step could be due to the observed differences in the element characteristics between Swing and Cha-Cha. As previously discussed, the triple step element in swing dance is typically performed with an element of springiness to it as well as a flight phase. The flight phase requires a greater force to clear the ground between steps one and two. In the Cha-Cha, the triple step is performed in such a way that the feet are closed together between steps one and two so no flight phase occurs. The similarities during the third step are likely because participants were asked to stop moving following the completion of the third step in both studies. This shows that the triple step in the Cha-Cha and the triple step in Swing dance can result in different kinetic patterns, despite theoretically being the same dance element, highlighting the importance of examining specific dance elements from various dances.

When between-gender differences in peak sagittal plane joint moments occurred, males typically exhibited greater moments compared to their female counterparts. Nevertheless, this pattern was not always consistent. Interestingly, the most differences between genders occurred in the inexperienced level, followed by the professional level, with the fewest differences between genders occurring in the recreational level. It is possible that differences in the inexperienced level are due to anatomical differences, while differences in the professional level are trained. Males and females are anatomically different (Horton and Hall 1989), which can lead to differences in kinematics (Mizuno et al. 2001), therefore, it is logical that there would be differences in joint forces between males and females as well. Conversely, the professionals in this study were highly trained, leading to the belief that differences in sagittal plane moments between males and females in the professional level may be the result of how males and females are instructed to perform the dance elements.

5.2.2 Frontal Plane Joint Angles and Moments

In the frontal plane, the movements that elicited differences among levels at the ankle were the SSR/SSRP (Tables 4.80 and 4.86), the ST/STP (Tables 4.92 and 4.98), and the TSR/TSRP (Tables 4.116 and 4.122) with the professional level exhibiting the greatest amount of eversion and the least amount of inversion in comparison to the other two groups. All other differences in frontal plane joint angles occurred at the knee and hip. The FSL/FSLP (Table 4.35 and 4.38) and SSL/SSLP (Table 4.68 and 4.74) showed differences among levels in the peak hip abduction angles, with the inexperienced level displaying the least amount of abduction compared to the other levels. Additionally, in all movements except the ST/STP, the differences in peak knee and hip abduction and adduction were always greatest in the professional level indicating a greater range of motion at the knee and hip in the frontal plane in the professional level compared to the non-professional levels. This could be because professional dancers close their feet together after each step, and completely shift their weight over each limb when they step. Such feet positioning and weight shifting strategies in the professional level likely resulted in the increased abduction and adduction angles of the knee and hip. The ST/STP was the only movement where the peak hip abduction angle was greater in the inexperienced level compared to the recreational level.

Males demonstrated significantly greater peak ankle inversion and knee and hip adduction, and females exhibited larger peak ankle eversion and knee and hip abduction. This could be related to the anatomical differences between genders - females generally have wider hips (Horton and Hall 1989). Therefore, it is possible that this led to greater relative abduction angles compared to males for a similar step width. Conversely, most of the differences that occurred were at the ankle and knee joints rather than the hip, however, differences in hip anatomy could affect knee and ankle joint angles as well (Mizuno et al. 2001).

Interestingly, when initiating steps with the right limb, there were no significant differences between genders in the professional level – meaning the BSR/BSRP (Table 4.23 and 4.29), SSR/SSRP (Tables 4.80 and 4.86), TSR/TSRP (Table 4.116 and 4.122), and the right step with the RSBR/RSBRP (Table 4.44 and 4.50) and RSFL/RSFLP (Table 4.56 and 4.62) revealed no significant differences in peak frontal plane joint angles between genders in the professional level. All except one of the participants in the professional level were right-side dominant, so there is potential for this finding to be related to limb dominance. It is possible that males and females are able to demonstrate more accurate and consistent joint angles when stepping with the dominant limb rather than the non-dominant limb.

There were few differences in frontal plane joint moments among experience levels. During the ST/STP (Table 4.89 and 4.95), the inexperienced level displayed the greatest knee and hip adduction moment and the smallest knee and hip abduction moment compared to the other two levels. In all other movements, the professional level illustrated significantly greater frontal plane joint moments, regardless of the joint or movement. Of note, the frontal plane moments during the third step of the triple step in the present study were similar to those reported during the third step of the triple step in a prior study that analyzed recreational swing dancers. However, the frontal plane joint moments observed during the first step of the triple step in the present study were greater than those reported in the previous study which could again be the result of characteristic differences in how the triple step element is performed (Wells and Yang 2021b).

Between genders, males most frequently demonstrated significantly greater peak ankle inversion and knee and hip adduction moments. Females generally illustrated greater peak ankle eversion and knee and hip abduction moments. This coincides with the findings in the peak frontal plane angles where males demonstrated larger peak ankle inversion and knee and hip adduction, and females presented greater peak ankle eversion and knee and hip abduction. Additionally, most of the gender-associated differences happened in the inexperienced level, with very few differences observed between genders in the other two levels. This further embeds the idea that as experience increases, the variances between genders decrease, possibly due to training. Rhythm dances typically display a great deal of lower extremity movement for both genders, and it is possible that males may be naturally more rigid when initially learning to dance, thus, the gender-related differences would be expected to decrease as the males learn to increase joint excursion in the lower extremity joints.

5.2.3 Transverse Plane Joint Angles and Moments

When looking across experience levels, there were only two differences that occurred at the ankle in the transverse plane, which were in the BSR (Table 4.24) and SSR (Table 4.81) movements. In both dance movements, the professional level showed significantly greater peak ankle internal rotation compared to the recreational level. This was unexpected given the increased foot turnout that professional dances have been seen to exhibit. When stepping with the right limb, significant differences were seen in the peak internal and external rotation at the knee, with the professional dancers typically exhibiting greater external rotation and less internal rotation compared to the other levels. This was observed during the BSR/BSRP (Table 4.24 and 4.30), SSR/SSRP (Table 4.81 and 4.87), the first step of the RSBR/RSBRP (Table 4.45 and 4.51), the second step of the RSFL/RSFLP (Table 4.57 and 4.63), and the TSR/TSRP (Table 4.114 and 4.120). When stepping with the left limb, significant differences were seen in the peak internal and external rotation at the hip, with the professional dancers again exhibiting greater external rotation and less internal rotation compared to the other levels. This was the case during the FSL/FSLP (Table 4.36 and 4.39), SSL/SSLP (Table 4.69 and 4.75), ST (Table 4.93), the second step of the RSBR/RSBRP (Table 4.45 and 4.51), and the first step of the RSFL/RSFLP (Table 4.57 and 4.63). There were no differences among levels during the STP. The increased external rotation in the professional level is logical given the greater foot turn-out that is often observed. However, it is unclear why the differences were seen in different joints when stepping to different sides.

In most cases of the between-gender comparisons, male participants demonstrated a greater external rotation and less internal rotation of the ankle compared to females, but less external rotation and greater internal rotation at the hip compared to females. These differences were seen in the professional level during the FSL/FSLP (Table 4.36 and 4.39), SSL/SSLP (Table 4.69 and 4.75), ST/STP (Table 4.93 and 4.99), the second step of the RSBR/RSBRP (Table 4.45 and 4.51), the first step of the RSFL/RSFLP (Table 4.57 and 4.63), and the TSL/TSLP (Table 4.105 and 4.111). Interestingly, these are all the steps taken with the left foot. However, females have been previously shown to illustrate significantly greater hip rotation, particularly internal hip rotation, compared to males due to hip position, making the increased internal hip rotation exhibited by the males surprising (Simoneau et al. 1998). There were no differences in the professional level at any joint during the movements in which steps were initiated with the right foot, which means males and females in the professional level demonstrated no differences in peak internal or external rotation at the knee joint during any of the movements. The other two levels, on the other hand, showed a less consistent pattern of differences between genders with differences that occurred at all three lower extremity joints during all of the dance movements. This solidifies the idea that fewer differences between males and females exist in the professional level than their non-professional counterparts due to training.

Among experience levels, peak transverse plane joint moments were significantly different across levels in all movements, with more differences occurring in the movements that involved multiple steps. For example, when differences were revealed, the professional level generally displayed a significantly greater peak joint internal and/or external rotation moment. This indicates that the professional level overall exhibited significantly greater joint rotation forces compared to the other two levels. Such a difference could be because of the increased rotational excursion typically displayed by professional dancers in rhythm dances. Additionally, transverse plane moments exhibited during the triple step in this study were similar to those exhibited by swing dancers (Wells and Yang 2021b).

Among the three planes of motion, peak joints moments in the transverse plane showed the fewest differences between genders, and when differences did occur, they were almost exclusively in the inexperienced level. The dance movements with the greatest number of differences between genders were the ST/STP (Table 4.90 and 4.96), and those did occur in the recreational and professional levels. When differences were observed between genders, males almost always executed the steps with greater peak internal and external rotation moments compared to females. The only movements in which males exhibited a smaller peak moment than females were the ST/STP (Table 4.90 and 4.96), and the TSR/TSRP (Table 4.114 and 4.120), where males displayed a smaller peak ankle external rotation moment compared to females in the inexperienced level during the triple steps to the right, and in the recreational level during the spot turns.

5.3 Tertiary Outcome Measure: Muscle Activity

It was anticipated that professional dancers would portray the least amount of muscle activity compared to the inexperienced and recreational levels. This was hypothesized because professional dancers are the most experienced and the most practiced, so it was expected that the steps chosen would be the easiest to perform for the professional dancers and would take less effort, thus resulting in less muscle activity. However, the results did not support this hypothesis. Instead, the inexperienced level displayed the lowest level of muscle activity across almost all of the selected muscles (Tables 4.124 –141). There is potential for this to be due to the inexperienced dancers performing the dance movements incorrectly and potentially activating the wrong muscles for the chosen dance movements.

The recreational and professional dancers generally performed the selected dance movements with greater precision and tended to display an increased joint range of motion, such as is often observed in rhythm dances. In contrast, the inexperienced participants were observed to move in a stiffer manner, with a smaller range of motion at each joint, and in a less dance-like manner. In fact, the inexperienced participants appeared to step, such as would be seen in walking, rather than dance the movements. However, the muscle activity observed in all three levels of dancers was still significantly greater than the muscle activity that has been observed while walking overground (Jafarnezhadgero et al. 2019). This indicates that ballroom dance steps in and of themselves require greater muscle activity than normal walking in the forward direction, regardless of how precisely the movements may be performed. This is supported by the study done by Cepeda and colleagues (2015), which determined that 24 rhythm dance sessions over eight weeks resulted in increased muscle mass (Cepeda et al. 2015). The increased muscle activation during rhythm dance elements may also be a contributing factor in the high energy expenditure, increased heart rates, and greater VO_2 maxes that have been found for those that participate in ballroom dance (Blanksby and Reidy 1988; Lankford et al. 2014; Liiv et al. 2014; Gomes da Cruz et al. 2017; Huang et al. 2012).

Of the five muscles analyzed bilaterally, the MG was the muscle that demonstrated the greatest muscle activity across all three levels. Rhythm ballroom dance movements are supposed to be performed with all toe leads – regardless of the direction the dancer is moving in. Therefore, the required plantarflexion, particularly when moving backwards, is likely responsible for the great MG activity observed in this study. Though not always statistically significant, the recreational and professional dancers often exhibited greater MG activity than the inexperienced level, which could also be a function of the greater foot articulation against the ground that is typical of more experienced dancers.

Notably, the MG was the only muscle that elicited greater muscle activity during the dance movements than during the MVICs. Though unexpected, this result has been observed in jumping studies as well (Mackala et al. 2013). It is possible that this is related to the position of the foot. It has been reported that the MG is more active in the toe-out position, while the lateral gastrocnemius is more active in the toe-in position (Cibulka et al. 2017). Rhythm ballroom dance steps are performed with a slight turnout of the foot, while the plantarflexion MVIC was performed with the foot in a neutral position, which potentially resulted in a lower MVIC in the MG than would have been achieved in a toed-out position, thereby leading to a peak MG result of greater than 100 percent of the activity recorded during the MVIC. It is also possible that the greater MG activity during the dance elements compared to the MG MVIC is a result of the knee joint interfering in accurate collection of the MG MVIC as the MG does span both the ankle and the knee joint. However, participants were instructed to only use their ankle when performing the MVIC trials.

Among all monitored muscles, the GM, which was expected to be highly active due to its role in hip frontal plane stability (Conneely, Sullivan, and Edmondston 2006), was only moderately active for the inexperienced and recreational dancers, and was one of the least active muscles in the professional dancers. However, the GM became significantly more active in the professional level during the steps involving sideways movement, which would be expected due to its role in hip abduction (Conneely, Sullivan, and Edmondston 2006). However, the GM maintained approximately the same level of activity in the other two dance levels. This is an indication that the professional dancers may be better at activating only the specific muscles needed for particular movements, while less experienced dancers may be activating more muscles than necessary. It is also reasonable that the professional dancers use their core muscles to help aid in stability and control rather than needing to activate the GM muscle.

Of the three dance levels, the recreational dancers demonstrated the least consistent pattern of muscle activity, often with greater muscle activity illustrated than in the professional level, though non-significant. This could be accounted for by the most loosely-defined inclusion criteria for the recreational level, with the minimum requirement being that they had participated in at least 50 rhythm dance exposures in the prior two years and there being no maximum experience cut-off unless they had competed professionally. This led to the recreational category of dancers encompassing dance experiences ranging from approximately six months to seven years (Table 3.1). While the professional dance level did have an even wider range of experience (28 years), their performance level was likely more similar due to the inclusion criteria requiring that they must have competed professionally within the prior two years. Though recreational dancers had more knowledge about how to perform the dance movements than the inexperienced level, their execution of the movements and activation of the appropriate muscles likely was not as efficient as the professional level. Thus, the inconsistent pattern of EMG activity in the recreational level is hypothesized to be the result of recreational dancers trying to perform the dance elements like the professionals, but not being as effective, which led to greater muscle activity in the recreational level compared to the professional level in many elements, despite not being statistically different. Further, the inexperienced level tended to step rather than dance the elements, leading to a consistently low level of muscle activity compared to the recreational and professional dance levels.

Additionally, there were very few differences in peak muscle activity observed between males and females within each dance level. This is likely the result of similar dance experience between males and females within each dance level. However, it is possible that if the dance elements were performed consecutively, as in a complete dance, that more differences in muscle activity would emerge. In the occasions where males and females did illustrate significant differences in peak muscle activity, the males exhibited lower activity levels in all except two instances. It should be noted that the majority of the differences that occurred between males and females occurred in the inexperienced and recreational levels, leading to the impression that muscle activation should not exhibit many differences between males and females, as demonstrated by the dancers in the professional level.

5.4 Conclusions

Overall, professional dancers appeared to exhibit lower GRFs and loading rates, which was anticipated due to the expectation that professional ballroom dancers would have better balance and greater bodily control. In addition, professional dancers barely lift their feet off the floor when taking steps, allowing them to further limit the forces produced. Contrary to what was expected, professional ballroom dancers generally illustrated much greater joint power absorption and propulsion at all three lower extremity joints. Though originally unexpected, the increased joint power is reasonable given the greater articulation of the foot and interaction that professional dancers have with the dance floor, as well as the greater range of motion at the lower extremity joints. This interaction also occurs because professional ballroom dancers will use the floor to push-off rather than picking their foot up and stepping, in addition to immediately getting over their stepping limb and executing a complete weight change with each step.

In terms of joint angles and moments, professionals demonstrated a greater joint range of motion at the ankle, knee, and hip during most of the movements. This was anticipated due to the greater exaggeration of movements that professional dancers typically display when training and performing. However, there were fewer differences between males and females in the professional level than were expected, since female movements tend to appear much flashier and more exaggerated compared to males. It is possible that this is the illusion that professional dancers tend to create when performing because of the dresses worn and the styling that is incorporated. In addition, when differences were observed, the professional level, and sometimes the recreational level, tended to exhibit greater joint moments at the lower extremity joints compared to the inexperienced level. It is possible that this resulted from the inexperienced level stepping in different directions, rather than dancing the movements, because they did not know how to. It has been reported that experienced and less experienced dancers execute movements differently, as was reported previously in the Cha-Cha (Chang et al. 2019). Therefore, these results support the idea that there are key differences in the execution of ballroom dance elements by dancers with different levels of experience. These results also indicate that, although ballroom dance appears to be gentle and graceful, there is greater joint loading that occurs at high levels, and professional dancers are simply excellent at making the dances look easy and effortless (Koutedakis and Jamurtas 2004).

Further, recreational and professional dancers demonstrated significantly greater muscle activity compared to the inexperienced level, which could be due to differences in stepping versus dancing the elements, as well as the differences in joint range of motion among the levels. Nevertheless, all three levels displayed muscle activity that was greater than is typically observed in walking, illustrating the benefits of ballroom dance on muscle activation.

5.5 Implications and Future Directions

These results illustrate several differences among experience levels that may be taken into account when considering the training and performance of dancers. The results also imply the safe, and potentially very beneficial, implementation of ballroom dance in different populations that may struggle with traditional forms of exercise due to the potential to decrease GRFs and increase muscle activity.

Compared to other forms of dance, ballroom dance is unique due to the partnership involved, as well as the wide variety of different dance forms within the genre. With this understanding, it can be challenging to relate the biomechanics of ballroom dance to the biomechanics of other forms of dance. For example, a study analyzing the leap over in Irish dance found joint moments that were significantly greater than the moments illustrated in this study (Wild, Grealish, and Hopper 2017). Though ballroom dance does have more advanced moves than those analyzed in this study, the partnership would greatly affect the execution of such a leap. On the other hand, moments discovered in a tap dance study were more similar to those observed in the present study, however, ballroom dance elements travel while tap steps are generally performed in place (Mayers et al. 2010). This makes it essential to conduct biomechanical research that will further our understanding of the ballroom dance genre. This knowledge is fundamental for improving ballroom dance performance and teaching, preventing ballroom dance-related injuries, and implementing ballroom dance as an intervention in the rehabilitation field.

This study presents the pioneer step to analyze ballroom dance from the biomechanical perspective. However, it provides us with a limited portion of the information we need to comprehensively understand the biomechanics associated with ballroom dance. Future studies analyzing different ballroom dance elements are essential in order to understand the biomechanics involved in different ballroom dance forms and the various ballroom dance elements that are incorporated into those dance forms. In addition, this study focused on healthy, young adults. Future studies should incorporate healthy older adults, as they make up a large portion of the recreational ballroom dance population. Additionally, individuals with neurological, motor, or physical ailments should be studied in order to determine how ballroom dance training may provide benefits that could improve health, mobility, and/or quality of life. Further, it is essential that we collect more information regarding injuries associated with ballroom dance, such as the location of the injury, the cause of the injury, and the type of injury that occurred. In this manner, it may be possible to better target the biomechanical factors related to ballroom dance injuries. This information is critical in order to learn how to train dancers efficiently and deploy ballroom dance in rehabilitative settings while avoiding potential injuries.

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APPENDICES

Appendix A: Health and Dancing Experience Forms

Georgia State University – Biomechanics Laboratory
Health/Dance Information

Subject ID ____________

Gender: Male ___ Female ____

Age: _____ Height: _________ Weight: _________ Dominant leg:_______

Whom to contact in a case of emergency ____________________________ Ph# ________________

<u>Health Information</u>

1. Have you ever been diagnosed as having any of the following conditions?

Yes_________ No_________ If yes, please put approximate year of onset in space provided.

Neuropathies ______________ *Other neurological conditions* _____________

Osteoporosis_______________ Other movement disorders ________________

Rheumatoid arthritis_______________ Other arthritic conditions _________________

2. Have you ever been diagnosed as having any of the following conditions?

Yes_________ No_________ If yes, please describe what kind.

Joint replacement ____

Uncorrected visual problems ____

3. Do you currently suffer any of the following symptoms in your legs or feet? Please check the space of all that apply.

Numbness __________ Tingling __________ Arthritis __________ Swelling __________

4. How would you describe your health?

Excellent ____ Very good ____ Good ____ Fair ____ Poor_________

Dance History

1. How many days per week do you exercise?
One ___ Two ___ Three ___ Four ___ Five ___ Six ___ Seven ___

2. How many days per week do you dance?
One ___ Two ___ Three ___ Four ___ Five ___ Six ___ Seven ___

3. How many hours do you dance each day?_____________

4. How many hours do you dance each week? ___________________

6. How long have you been dancing at this volume?_____________

7. How many months have you been dancing? ____________________

8. Do you have any experience with rhythm dances (Swing, Rumba, Cha Cha, Salsa, etc.)?
Yes_________ No__________

If yes, explain____

9. Have you ever competed as a professional dancer? Yes________ No________

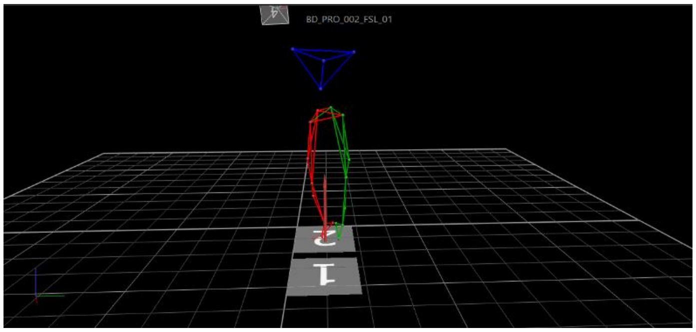
If yes, explain____

10. Have you had a lower extremity injury in the past 2 years? Yes______ No________

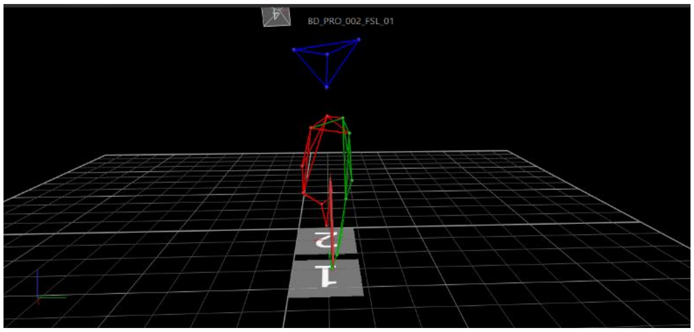
If yes, please list when this occurred and briefly explain condition or injury________________
____
____

Appendix B: Illustration of the five rhythm ballroom dance steps

Step 1.1 Forward Step

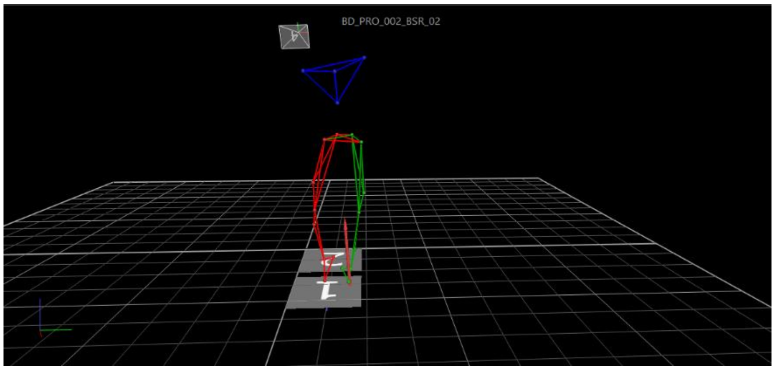


The participant prepares to push off the right foot on force plate 2.

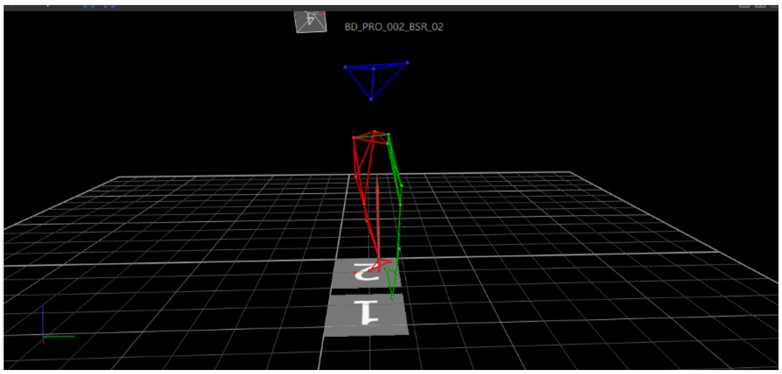


The participant lands on the left foot on force plate 1 and hovers the right foot off the ground.

Step 1.2 Backward Step

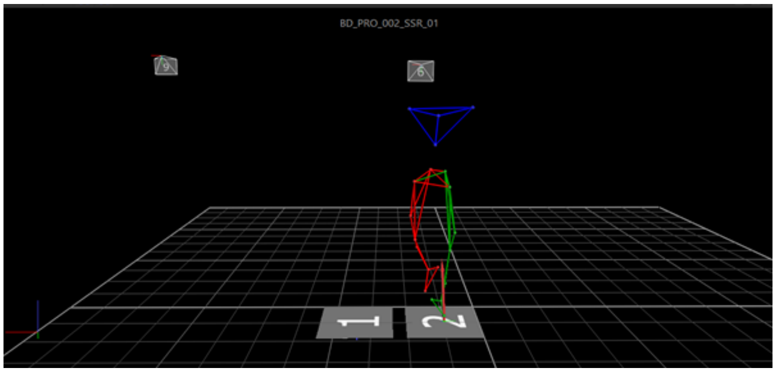


The participant prepares to push off the left foot on force plate 1.

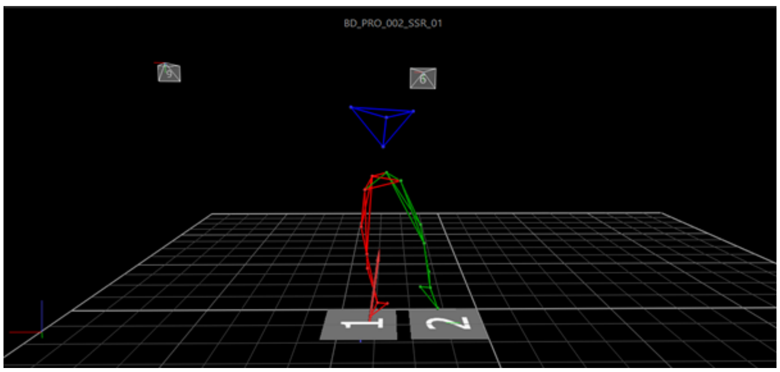


The participant lands on the right foot on force plate 2 and hovers the left foot off the ground.

Step 2.1 Side Step to the Right

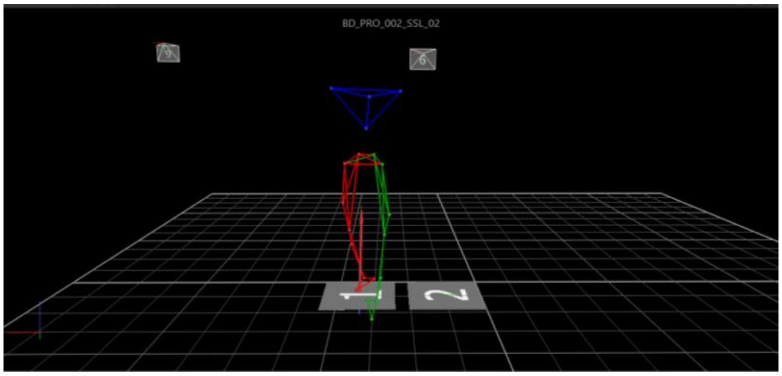


The participant prepares to push off the left foot on force plate 2.

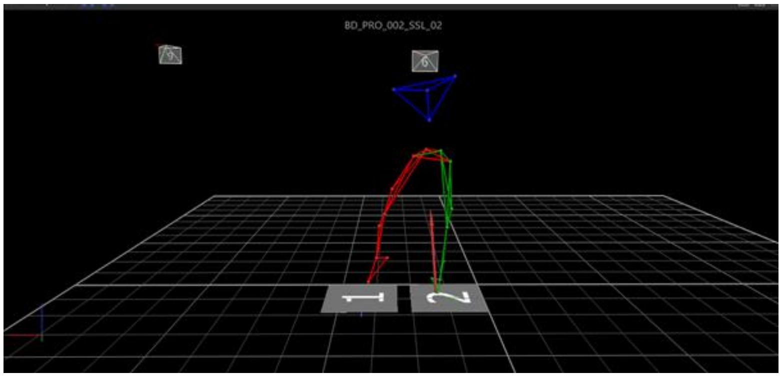


The participant lands on the right foot on force plate 1 and hovers the left foot off the ground.

Step 2.2 Side Step to the Left

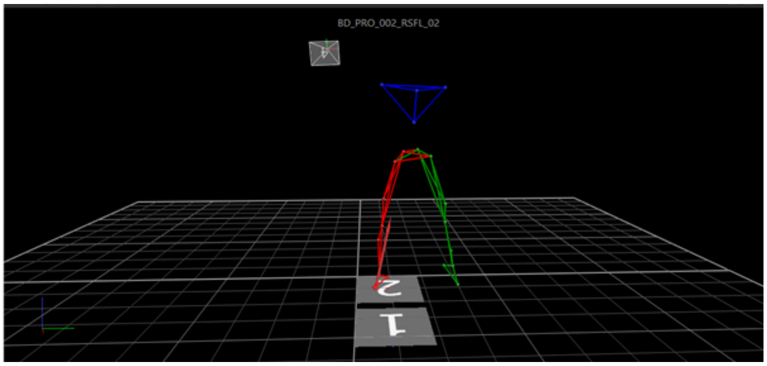


The participant prepares to push off the right foot on force plate 1.

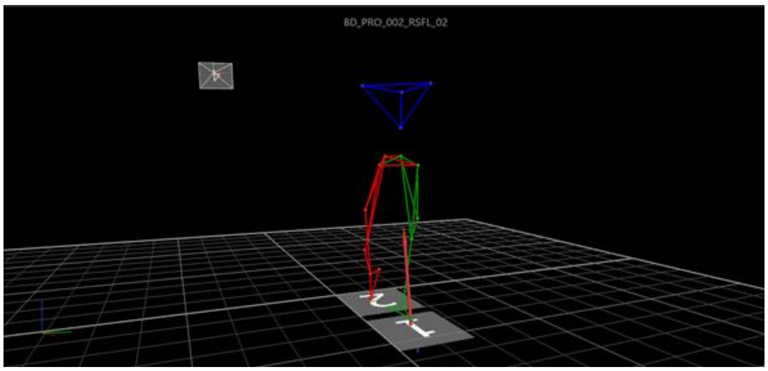


The participant lands on the left foot on force plate 2 and hovers the right foot off the ground.

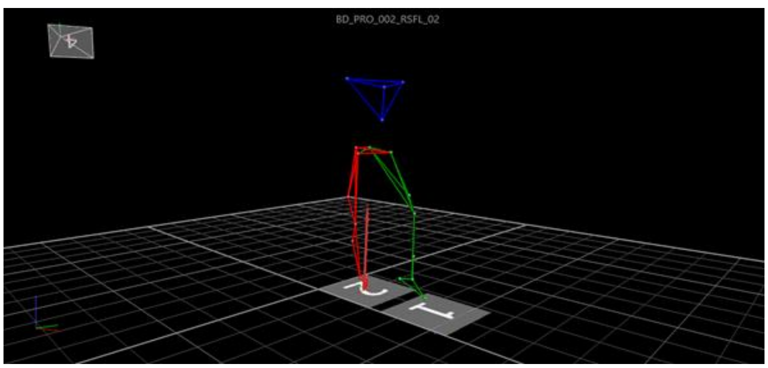
Step 3.1 Rock Step Forward



The participant prepares to push off the right foot on force plate 2 and rock forward.

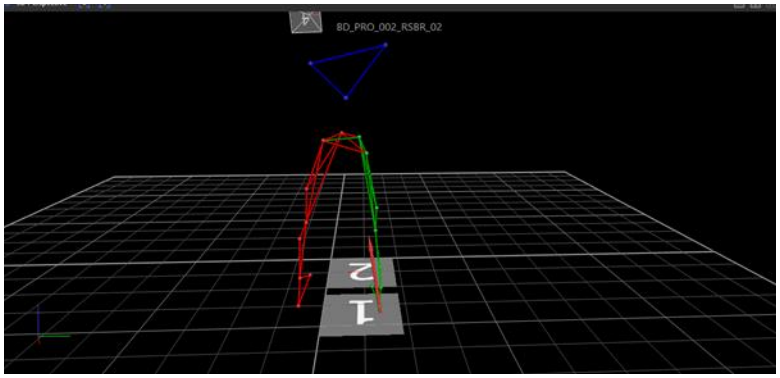


The participant rocks forward and lands on the left foot on force plate 1 and prepares to push off again.

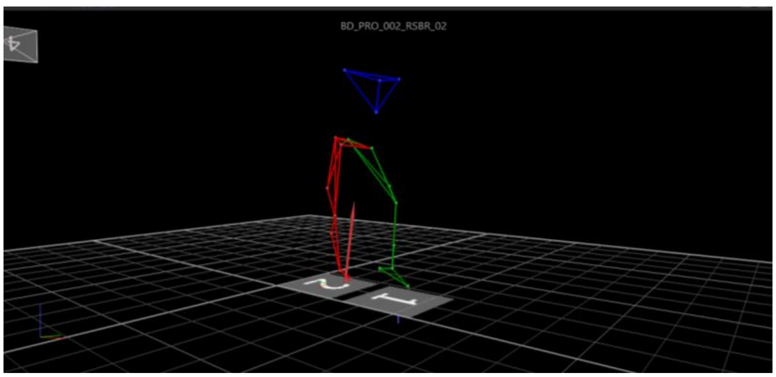


The participant lands on the right foot on force plate 2 and hovers the left foot off the ground.

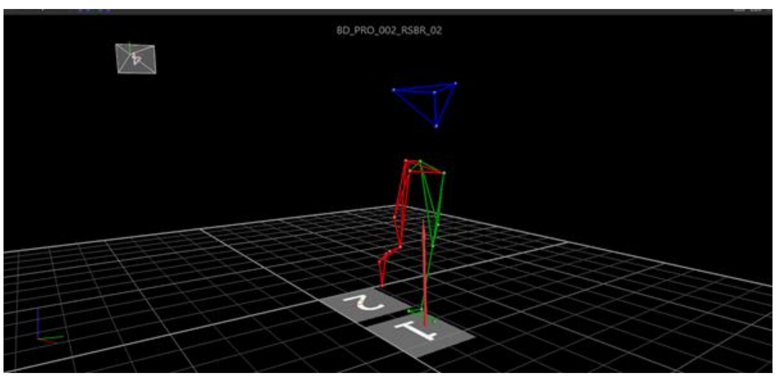
Step 3.2 Rock Step Backward



The participant prepares to push off the left foot on force plate 1 and rock back.

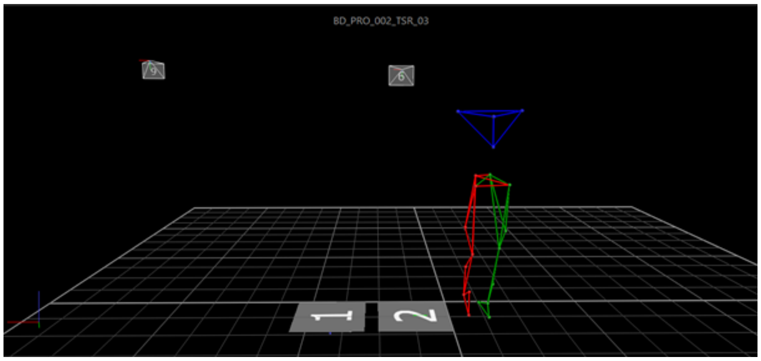


The participant rocks back and lands on the right foot on force plate 2 and prepares to push off again.

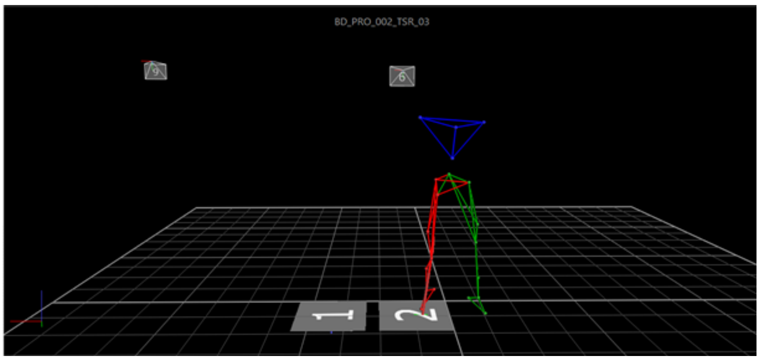


The participant lands on the left foot on force plate 1 and hovers the right foot off the ground.

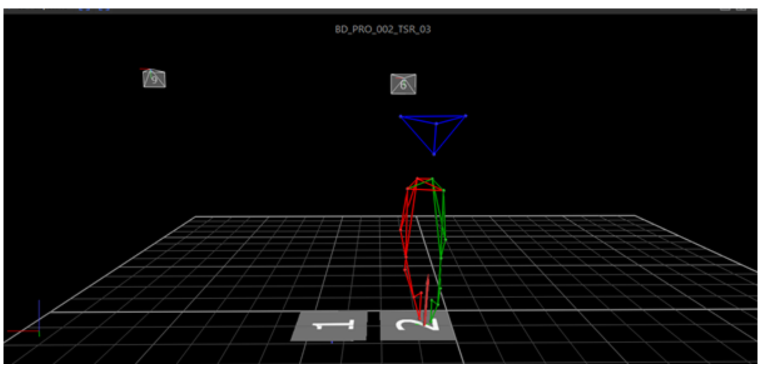
Step 4.1 Triple Step to the Right



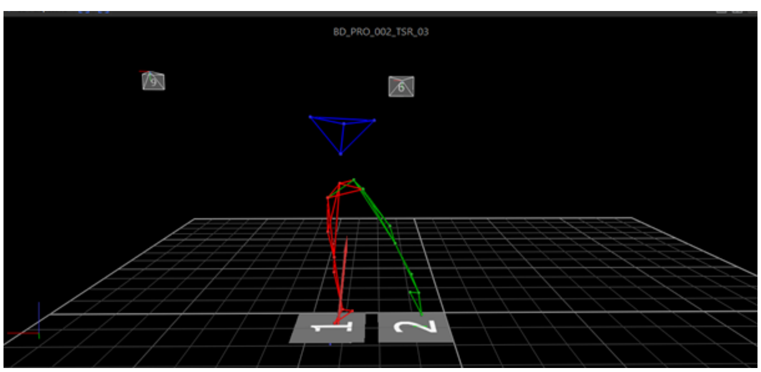
The participant prepares to initiate the first of the three steps to the right.



The participant steps with the first foot and lands on force plate 2 with the right foot.

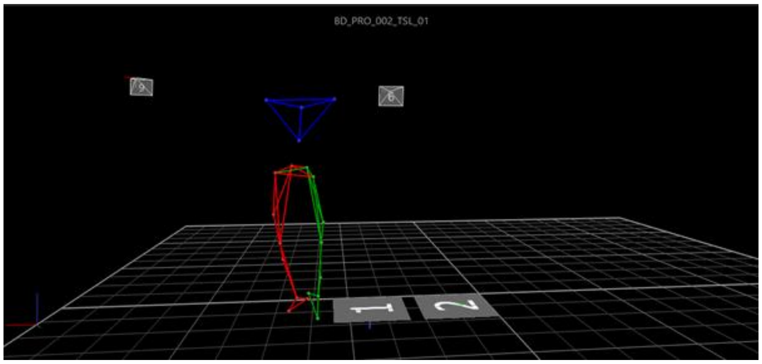


The participant brings the left foot to meet the right foot on force plate 2 and changes weight.

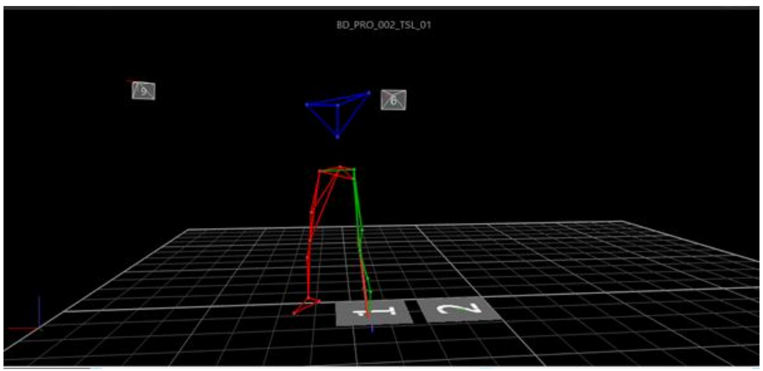


The participant takes the third step to the right and lands on force plate 1 with the right foot and hovers the left foot off the ground.

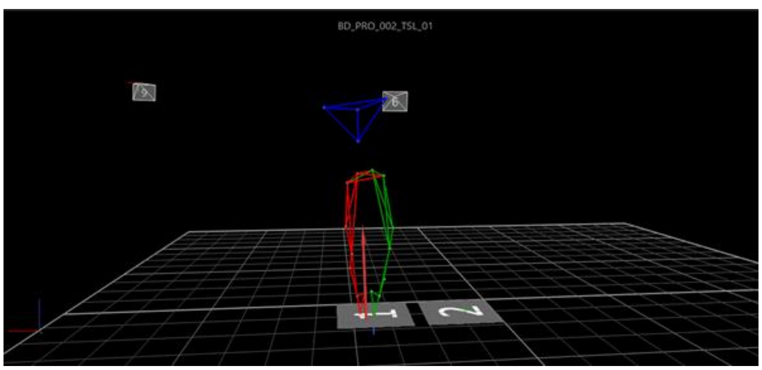
Step 4.2 Triple Step to the Left



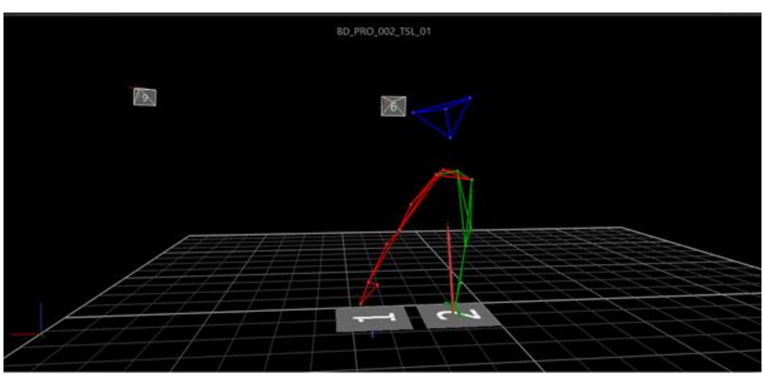
The participant prepares to initiate the first of the three steps to the left.



The participant steps with the first foot and lands on force plate 1 with the left foot.

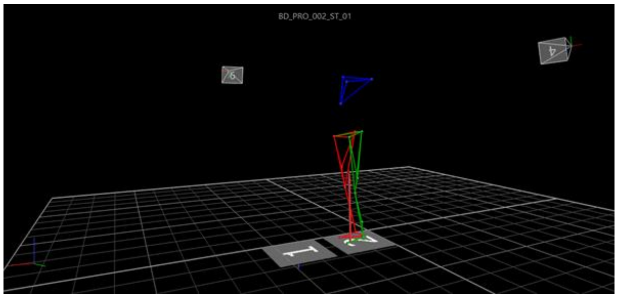


The participant brings the right foot to meet the left foot on force plate 1 and changes weight.

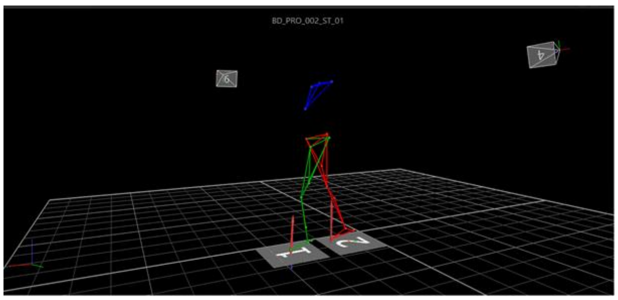


The participant takes the third step to the left and lands on force plate 2 with the left foot and hovers the right foot off the ground.

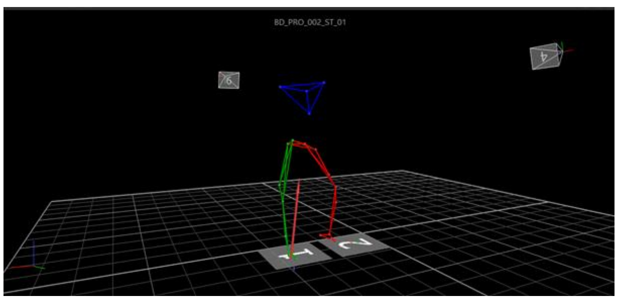
Step 5. Spot Turn



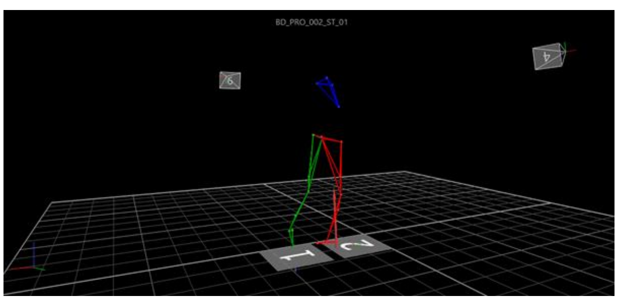
The participant prepares to initiate the spot turn with both feet on force plate 2.



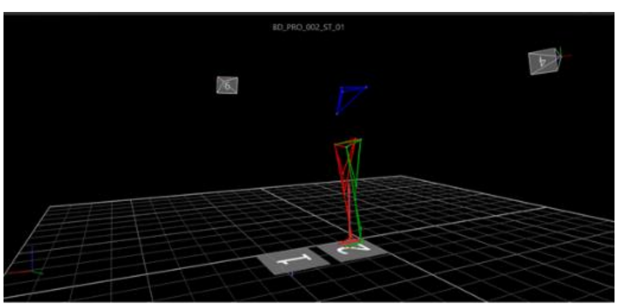
The participant steps forward with the left foot and lands on force plate 1.



The participant transfers weight to the left foot and pivots 180 degrees.



The participant transfers weight back to the right foot on force plate 2.



The participant pivots 180 degrees again and replaces the left foot on force plate 2, returning to the initial starting position.

Appendix C: Normality Violations

Appendix C: Outcome measures which violate the normal distribution assumption and were analyzed by non-parametric approaches (Kruskal-Wallis for between level comparisons and Mann-Whitney for between gender comparisons).

Movement	Primary	Secondary	Tertiary
Backward step on the right (BSR)	**Force** GRF Loading rate **Joint Power** Ankle absorption Ankle propulsion Knee absorption Knee propulsion Hip absorption Hip propulsion	**Joint Moment** Ankle dorsiflexion Ankle plantarflexion Knee flexion Knee extension Hip flexion Hip extension Ankle inversion Ankle eversion Knee adduction Knee abduction Hip adduction Hip abduction Ankle internal rotation Ankle external rotation Knee internal rotation Hip internal rotation Hip external rotation **Joint Angle** Ankle plantarflexion Ankle dorsiflexion Knee extension Hip extension Ankle eversion Knee abduction Hip abduction Hip adduction Knee internal rotation Hip external rotation	**EMG** Tibialis Anterior Medial Gastrocnemius Vastus Lateralis Biceps Femoris Gluteus Medius
Backward step on the right with a partner (BSRP)	**Force** GRF Loading rate **Joint Power**	**Joint Moment** Ankle dorsiflexion Ankle plantarflexion Knee flexion	**EMG** Tibialis Anterior Medial Gastrocnemius Vastus Lateralis

	Ankle absorption	Knee extension	Biceps Femoris
	Ankle propulsion	Hip flexion	
	Knee absorption	Hip extension	
	Knee propulsion	Ankle inversion	
	Hip propulsion	Ankle eversion	
		Knee adduction	
		Knee abduction	
		Hip adduction	
		Ankle internal rotation	
		Ankle external rotation	
		Knee internal rotation	
		Knee external rotation	
		Hip internal rotation	
		Hip external rotation	
		Joint Angle	
		Ankle plantarflexion	
		Ankle dorsiflexion	
		Knee extension	
		Knee flexion	
		Hip flexion	
		Ankle eversion	
		Knee abduction	
		Hip abduction	
		Hip adduction	
		Ankle external rotation	
		Ankle internal rotation	
		Knee external rotation	
		Knee internal rotation	
Forward step on the left (FSL)	**Force**	**Joint Moment**	**EMG**
	Loading rate	Ankle dorsiflexion	Tibialis Anterior
	Joint Power	Ankle plantarflexion	Medial Gastrocnemius
	Ankle absorption	Knee flexion	Vastus Lateralis
	Ankle propulsion	Knee extension	Biceps Femoris
	Knee absorption	Hip flexion	Gluteus Medius
	Knee propulsion	Ankle inversion	
	Hip absorption	Knee adduction	
	Hip propulsion	Knee abduction	
		Ankle internal rotation	
		Ankle external rotation	
		Knee internal rotation	

		Knee external rotation Hip internal rotation **Joint Angle** Knee flexion Ankle eversion Knee abduction Hip abduction Ankle external rotation Ankle internal rotation Knee internal rotation Hip external rotation	
Forward step on the left with a partner (FSLP)	**Force** NA **Joint Power** NA	**Joint Moment** NA **Joint Angle** Ankle plantarflexion Ankle eversion Knee abduction Knee adduction Hip abduction Ankle external rotation Knee external rotation Knee internal rotation Hip external rotation	**EMG** Tibialis Anterior Medial Gastrocnemius Vastus Lateralis Biceps Femoris Gluteus Medius
Rock step back on the right (RSBR)	**Force** GRF 1 GRF 2 Loading rate 1 Loading rate 2 **Joint Power** Ankle absorption 1 Ankle propulsion 1 Ankle absorption 2 Ankle propulsion 2 Knee absorption 1 Knee propulsion 1 Knee absorption 2 Knee propulsion 2 Hip absorption 1 Hip propulsion 1 Hip absorption 2	**Joint Moment** Ankle dorsiflexion 1 Ankle plantarflexion 1 Ankle dorsiflexion 2 Knee flexion 1 Knee extension 1 Knee flexion 2 Knee extension 2 Hip flexion 1 Hip extension 1 Hip flexion 2 Hip extension 2 Ankle inversion 1 Ankle eversion 1 Ankle inversion 2 Knee adduction 1 Knee abduction 1	**EMG** Tibialis Anterior 1 Tibialis Anterior 2 Medial Gastrocnemius 1 Medial Gastrocnemius 2 Vastus Lateralis 1 Vastus Lateralis 2 Biceps Femoris 1 Biceps Femoris 2 Gluteus Medius 1 Gluteus Medius 2

	Hip propulsion 2	Knee adduction 2 Hip adduction 1 Hip abduction 1 Ankle internal rotation 1 Ankle external rotation 1 Ankle internal rotation 2 Knee internal rotation 1 Knee external rotation 1 Knee internal rotation 2 Hip internal rotation 1 Hip external rotation 1 Hip internal rotation 2 Hip external rotation 2 **Joint Angle** Ankle plantarflexion 1 Knee flexion 2 Ankle eversion 1 Ankle inversion 1 Ankle eversion 2 Knee abduction 1 Knee abduction 2 Knee adduction 2 Hip abduction 1 Hip adduction 1 Hip abduction 2 Ankle external rotation 1 Ankle internal rotation 1 Ankle external rotation 2 Ankle internal rotation 2 Knee external rotation 1 Knee internal rotation 1 Knee external rotation 2 Knee internal rotation 2	
Rock step back on the right with a partner (RSBRP)	**Force** GRF 1 Loading rate 1 **Joint Power** Ankle absorption 1 Ankle propulsion 1 Knee absorption 1	**Joint Moment** Ankle dorsiflexion 1 Ankle plantarflexion 1 Knee flexion 1 Knee extension 1 Hip flexion 1 Hip extension 1	**EMG** Tibialis Anterior 1 Tibialis Anterior 2 Medial Gastrocnemius 1 Medial Gastrocnemius 2 Vastus Lateralis 1 Vastus Lateralis 2

	Knee propulsion 1 Hip absorption 1 Hip propulsion 1	Ankle inversion 1 Ankle eversion 1 Knee adduction 1 Knee abduction 1 Hip adduction 1 Hip abduction 1 Ankle internal rotation 1 Ankle external rotation 1 Knee internal rotation 1 Knee external rotation 1 Hip internal rotation 1 Hip external rotation 1 **Joint Angle** Ankle plantarflexion 1 Ankle plantarflexion 2 Knee flexion 2 Hip extension 1 Hip flexion 1 Ankle eversion 1 Ankle eversion 2 Knee abduction 1 Knee adduction 2 Hip abduction 1 Hip adduction 1 Hip abduction 2 Hip adduction 2 Ankle external rotation 1 Ankle external rotation 2 Knee external rotation 1 Knee internal rotation 1 Knee external rotation 2 Knee internal rotation 2 Hip external rotation 2	Biceps Femoris 1 Biceps Femoris 2 Gluteus Medius 1 Gluteus Medius 2
Rock step forward on the left (RSFL)	**Force** GRF 1 GRF 2 Loading rate 1 Loading rate 2 **Joint Power** Ankle absorption 1	**Joint Moment** Ankle dorsiflexion 1 Ankle dorsiflexion 2 Ankle plantarflexion 2 Knee flexion 1 Knee extension 1 Knee flexion 2	**EMG** Tibialis Anterior 1 Tibialis Anterior 2 Medial Gastrocnemius 1 Medial Gastrocnemius 2 Vastus Lateralis 1 Vastus Lateralis 2

	Ankle propulsion 1	Knee extension 2	Biceps Femoris 1
	Ankle absorption 2	Hip flexion 1	Biceps Femoris 2
	Ankle propulsion 2	Hip extension 1	Gluteus Medius 1
	Knee absorption 1	Hip flexion 2	Gluteus Medius 2
	Knee propulsion 1	Hip extension 2	
	Knee absorption 2	Ankle inversion 1	
	Knee propulsion 2	Ankle eversion 1	
	Hip absorption 1	Ankle inversion 2	
	Hip propulsion 1	Ankle eversion 2	
	Hip absorption 2	Knee adduction 1	
	Hip propulsion 2	Knee adduction 2	
		Knee abduction 2	
		Hip adduction 1	
		Hip adduction 2	
		Ankle internal rotation 1	
		Ankle external rotation 1	
		Ankle internal rotation 2	
		Ankle external rotation 2	
		Knee internal rotation 1	
		Knee external rotation 1	
		Knee internal rotation 2	
		Knee external rotation 2	
		Hip internal rotation 1	
		Hip external rotation 1	
		Hip internal rotation 2	
		Hip external rotation 2	
		Joint Angle	
		Ankle plantarflexion 2	
		Knee flexion 1	
		Knee extension 2	
		Hip extension 1	
		Ankle eversion 1	
		Ankle eversion 2	
		Knee abduction 1	
		Knee abduction 2	
		Knee adduction 2	
		Hip abduction 1	
		Hip abduction 2	
		Hip adduction 2	
		Ankle external rotation 1	

		Ankle internal rotation 1 Ankle external rotation 2 Ankle internal rotation 2 Knee internal rotation 1 Knee internal rotation 2 Hip external rotation 1 Hip external rotation 2	
Rock step forward on the left with a partner (RSFLP)	**Force** GRF 2 Loading rate 1 **Joint Power** Ankle absorption 2 Ankle propulsion 2 Knee absorption 2 Knee propulsion 2 Hip absorption 2 Hip propulsion 2	**Joint Moment** Ankle dorsiflexion 2 Ankle plantarflexion 2 Knee flexion 2 Knee extension 2 Hip flexion 2 Hip extension 2 Ankle inversion 2 Ankle eversion 2 Knee adduction 2 Knee abduction 2 Hip adduction 2 Hip abduction 2 Ankle internal rotation 2 Ankle external rotation 2 Knee internal rotation 2 Knee external rotation 2 Hip internal rotation 2 Hip external rotation 2 **Joint Angle** Ankle plantarflexion 1 Ankle plantarflexion 2 Knee extension 2 Hip extension 2 Ankle eversion 1 Ankle eversion 2 Ankle inversion 2 Knee abduction 1 Knee adduction 1 Knee abduction 2 Knee adduction 2 Hip abduction 1 Hip abduction 2	**EMG** Tibialis Anterior 1 Tibialis Anterior 2 Medial Gastrocnemius 1 Medial Gastrocnemius 2 Vastus Lateralis 1 Vastus Lateralis 2 Biceps Femoris 1 Biceps Femoris 2 Gluteus Medius 1 Gluteus Medius 2

		Hip adduction 2 Ankle external rotation 1 Ankle external rotation 2 Ankle internal rotation 2 Knee internal rotation 1 Knee external rotation 2 Knee internal rotation 2 Hip internal rotation 1 Hip external rotation 2	
Side step to the left (SSL)	**Force** GRF Loading rate **Joint Power** Ankle absorption Ankle propulsion Knee absorption Knee propulsion Hip absorption Hip propulsion	**Joint Moment** Ankle dorsiflexion Ankle plantarflexion Knee flexion Knee extension Hip flexion Hip extension Ankle inversion Ankle eversion Knee adduction Knee abduction Hip adduction Ankle internal rotation Ankle external rotation Knee internal rotation Knee external rotation Hip internal rotation Hip external rotation **Joint Angle** Ankle eversion Knee abduction Knee adduction Hip adduction Ankle external rotation Ankle internal rotation Hip external rotation	**EMG** Medial Gastrocnemius Biceps Femoris Gluteus Medius
Side step to the left with a partner (SSLP)	**Force** GRF Loading rate **Joint Power** Ankle absorption	**Joint Moment** Ankle dorsiflexion Knee flexion Knee extension Hip flexion	**EMG** Tibialis Anterior Medial Gastrocnemius Vastus Lateralis Biceps Femoris

	Ankle propulsion Knee absorption Knee propulsion Hip absorption Hip propulsion	Hip extension Ankle inversion Ankle eversion Knee adduction Hip adduction Hip abduction Ankle internal rotation Knee internal rotation Hip internal rotation Hip external rotation **Joint Angle** Knee flexion Hip extension Hip flexion Ankle eversion Ankle external rotation Ankle internal rotation Knee external rotation Knee internal rotation Hip external rotation Hip internal rotation	Gluteus Medius
Side step to the right (SSR)	**Force** GRF Loading rate **Joint Power** Ankle absorption Ankle propulsion Knee absorption Knee propulsion Hip absorption Hip propulsion	**Joint Moment** Ankle dorsiflexion Ankle plantarflexion Knee flexion Knee extension Hip flexion Hip extension Ankle inversion Knee adduction Ankle internal rotation Ankle external rotation Knee internal rotation Hip internal rotation Hip external rotation **Joint Angle** Ankle plantarflexion Ankle dorsiflexion Hip extension Ankle eversion	**EMG** Medial Gastrocnemius Vastus Lateralis Biceps Femoris Gluteus Medius

		Hip abduction	
		Ankle internal rotation	
		Knee external rotation	
Side step to the right with a partner (SSRP)	**Force**	**Joint Moment**	**EMG**
	GRF	Ankle dorsiflexion	Tibialis Anterior
	Loading rate	Ankle plantarflexion	Medial Gastrocnemius
	Joint Power	Knee flexion	Vastus Lateralis
	Ankle absorption	Hip extension	Biceps Femoris
	Ankle propulsion	Ankle inversion	Gluteus Medius
	Knee absorption	Hip adduction	
	Knee propulsion	Ankle internal rotation	
	Hip absorption	Ankle external rotation	
	Hip propulsion	Knee internal rotation	
		Knee external rotation	
		Hip internal rotation	
		Hip external rotation	
		Joint Angle	
		Ankle eversion	
		Hip adduction	
		Ankle external rotation	
		Ankle internal rotation	
		Knee external rotation	
Spot turn (ST)	**Force**	**Joint Moment**	**EMG**
	GRF	Ankle dorsiflexion	Tibialis Anterior
	Loading rate	Knee extension	Medial Gastrocnemius
	Joint Power	Hip extension	Vastus Lateralis
	Ankle absorption	Ankle inversion	Biceps Femoris
	Ankle propulsion	Knee abduction	Gluteus Medius
	Knee absorption	Hip abduction	
	Knee propulsion	Ankle external rotation	
	Hip absorption	Knee internal rotation	
	Hip propulsion	Knee external rotation	
		Hip internal rotation	
		Hip external rotation	
		Joint Angle	
		Ankle plantarflexion	
		Knee flexion	
		Ankle eversion	
		Knee abduction	
		Hip external rotation	

Spot turn with a partner (STP)	**Force**	**Joint Moment**	**EMG**
	Loading rate	Ankle dorsiflexion	Tibialis Anterior
	Joint Power	Ankle plantarflexion	Medial Gastrocnemius
	Ankle absorption	Knee flexion	Vastus Lateralis
	Knee absorption	Knee extension	Biceps Femoris
	Knee propulsion	Hip flexion	Gluteus Medius
	Hip absorption	Ankle inversion	
	Hip propulsion	Knee adduction	
		Hip adduction	
		Hip abduction	
		Ankle internal rotation	
		Ankle external rotation	
		Knee external rotation	
		Hip internal rotation	
		Joint Angle	
		Ankle dorsiflexion	
		Knee flexion	
		Ankle eversion	
		Knee abduction	
		Hip abduction	
		Knee external rotation	
		Hip external rotation	
Triple step to the left (TSL)	**Force**	**Joint Moment**	**EMG**
	GRF 3	Ankle dorsiflexion 1	Tibialis Anterior 1
	Loading rate 1	Ankle dorsiflexion 3	Tibialis Anterior 3
	Loading rate 3	Knee flexion 1	Medial Gastrocnemius 1
	Joint Power	Knee flexion 3	Medial Gastrocnemius 3
	Ankle absorption 1	Knee extension 3	Vastus Lateralis 1
	Ankle propulsion 1	Hip flexion 1	Vastus Lateralis 3
	Ankle absorption 3	Hip extension 1	Biceps Femoris 1
	Ankle propulsion 3	Hip flexion 3	Biceps Femoris 3
	Knee absorption 1	Hip extension 3	Gluteus Medius 1
	Knee propulsion 1	Ankle inversion 1	Gluteus Medius 3
	Knee absorption 3	Ankle eversion 1	
	Knee propulsion 3	Ankle inversion 3	
	Hip absorption 1	Ankle eversion 3	
	Hip propulsion 1	Knee adduction 3	
	Hip propulsion 3	Hip adduction 1	
		Hip adduction 3	
		Ankle internal rotation 1	

		Ankle external rotation 1	
		Ankle internal rotation 3	
		Ankle external rotation 3	
		Knee internal rotation 1	
		Knee external rotation 1	
		Knee internal rotation 3	
		Knee external rotation 3	
		Hip internal rotation 1	
		Hip external rotation 1	
		Hip internal rotation 3	
		Hip external rotation 3	
		Joint Angle	
		Ankle plantarflexion 1	
		Ankle plantarflexion 3	
		Ankle dorsiflexion 3	
		Knee extension 3	
		Hip flexion 1	
		Ankle eversion 1	
		Ankle eversion 3	
		Knee abduction 1	
		Hip abduction 1	
		Hip adduction 1	
		Hip abduction 3	
		Ankle external rotation 1	
		Ankle internal rotation 1	
		Ankle external rotation 3	
		Ankle internal rotation 3	
		Knee external rotation 1	
		Knee external rotation 3	
		Hip external rotation 1	
		Hip external rotation 3	
Triple step to the left with a partner (TSLP)	**Force**	**Joint Moment**	**EMG**
	GRF 1	Ankle dorsiflexion 1	Tibialis Anterior 1
	GRF 3	Ankle dorsiflexion 3	Tibialis Anterior 3
	Loading rate 1	Knee flexion 1	Medial Gastrocnemius 1
	Loading rate 3	Knee flexion 3	Medial Gastrocnemius 3
	Joint Power	Knee extension 3	Vastus Lateralis 1
	Ankle propulsion 1	Hip flexion 1	Vastus Lateralis 3
	Ankle absorption 3	Hip extension 1	Biceps Femoris 1
	Ankle propulsion 3	Hip flexion 3	Biceps Femoris 3

	Knee absorption 1 Knee propulsion 1 Knee absorption 3 Knee propulsion 3 Hip absorption 1 Hip propulsion 1 Hip absorption 3 Hip propulsion 3	Hip extension 3 Ankle inversion 1 Ankle eversion 1 Ankle inversion 3 Ankle eversion 3 Knee adduction 1 Knee adduction 3 Knee abduction 3 Hip adduction 1 Hip adduction 3 Ankle internal rotation 1 Ankle external rotation 1 Ankle internal rotation 3 Ankle external rotation 3 Knee internal rotation 1 Knee external rotation 1 Knee internal rotation 3 Knee external rotation 3 Hip internal rotation 1 Hip external rotation 1 Hip internal rotation 3 Hip external rotation 3 **Joint Angle** Ankle plantarflexion 1 Ankle dorsiflexion 1 Ankle plantarflexion 3 Knee flexion 3 Ankle eversion 1 Ankle inversion 1 Ankle eversion 3 Hip abduction 3 Ankle external rotation 1 Ankle internal rotation 1 Ankle external rotation 3 Knee external rotation 1 Knee external rotation 3 Knee internal rotation 3 Hip external rotation 1 Hip external rotation 3	Gluteus Medius 1 Gluteus Medius 3
Triple step to the right (TSR)	**Force**	**Joint Moment**	**EMG**

	GRF 1	Ankle dorsiflexion 1	Tibialis Anterior 1
	GRF 3	Ankle plantarflexion 1	Tibialis Anterior 3
	Loading rate 1	Knee flexion 1	Medial Gastrocnemius 1
	Loading rate 3	Knee extension 1	Medial Gastrocnemius 3
	Joint Power	Knee extension 3	Vastus Lateralis 1
	Ankle absorption 1	Hip flexion 1	Vastus Lateralis 3
	Ankle propulsion 1	Hip extension 1	Biceps Femoris 1
	Ankle absorption 3	Hip flexion 3	Biceps Femoris 3
	Ankle propulsion 3	Hip extension 3	Gluteus Medius 1
	Knee absorption 1	Ankle inversion 1	Gluteus Medius 3
	Knee propulsion 1	Ankle eversion 1	
	Knee absorption 3	Ankle inversion 3	
	Knee propulsion 3	Ankle eversion 3	
	Hip absorption 1	Knee adduction 1	
	Hip propulsion 1	Knee abduction 1	
	Hip absorption 3	Knee adduction 3	
	Hip propulsion 3	Hip adduction 1	
		Hip abduction 1	
		Hip abduction 3	
		Ankle internal rotation 1	
		Ankle external rotation 1	
		Ankle internal rotation 3	
		Ankle external rotation 3	
		Knee internal rotation 1	
		Knee external rotation 1	
		Knee internal rotation 3	
		Knee external rotation 3	
		Hip internal rotation 1	
		Hip external rotation 1	
		Hip internal rotation 3	
		Hip external rotation 3	
		Joint Angle	
		Ankle dorsiflexion 1	
		Ankle plantarflexion 3	
		Ankle dorsiflexion 3	
		Knee extension 1	
		Knee flexion 1	
		Knee extension 3	
		Knee flexion 3	
		Ankle eversion 1	

		Ankle eversion 3 Ankle inversion 3 Knee adduction 3 Hip abduction 1 Hip adduction 1 Hip abduction 3 Ankle external rotation 1 Ankle internal rotation 3 Knee external rotation 1 Knee external rotation 3 Knee internal rotation 3	
Triple step to the right with a partner (TSRP)	**Force** GRF 1 GRF 3 Loading rate 3 **Joint Power** Ankle absorption 1 Ankle propulsion 1 Ankle absorption 3 Ankle propulsion 3 Knee absorption 1 Knee propulsion 1 Knee absorption 3 Knee propulsion 3 Hip absorption 1 Hip propulsion 1 Hip absorption 3 Hip propulsion 3	**Joint Moment** Ankle dorsiflexion 1 Ankle dorsiflexion 3 Ankle plantarflexion 3 Knee flexion 1 Knee extension 1 Knee flexion 3 Knee extension 3 Hip flexion 1 Hip extension 1 Hip flexion 3 Ankle inversion 1 Ankle eversion 1 Ankle inversion 3 Knee adduction 1 Knee abduction 1 Hip adduction 1 Hip abduction 1 Hip adduction 3 Ankle internal rotation 1 Ankle external rotation 1 Ankle internal rotation 3 Ankle external rotation 3 Knee internal rotation 1 Knee internal rotation 3 Hip internal rotation 1 Hip external rotation 1 Hip internal rotation 3 Hip external rotation 3	**EMG** Tibialis Anterior 1 Tibialis Anterior 3 Medial Gastrocnemius 1 Medial Gastrocnemius 3 Vastus Lateralis 1 Vastus Lateralis 3 Biceps Femoris 1 Biceps Femoris 3 Gluteus Medius 1 Gluteus Medius 3

Joint Angle
Ankle plantarflexion 1
Ankle dorsiflexion 1
Ankle plantarflexion 3
Knee extension 1
Knee flexion 1
Knee flexion 3
Ankle eversion 1
Ankle inversion 1
Ankle eversion 3
Ankle inversion 3
Hip abduction 1
Hip adduction 1
Hip abduction 3
Hip adduction 3
Knee internal rotation 1
Hip external rotation 3

Appendix D: Pilot Study

A pilot study was conducted to test the protocol and recruitment capacity. We recruited and screened 34 participants between August 2019 and March 2020. Initially, the study began with the focus on individuals with experience in any rhythm dance (Swing, Rumba, Salsa, Cha Cha). However, after recruiting the first set of participants with experience in swing dancing only, it came to our attention that those individuals fit the amateur category for the swing dance related elements but fit the inexperienced category for the remaining three dance elements, and thus were excluded. So, the research was refocused to individuals with experience in all five rhythm dance elements. Because swing dance and rhythm ballroom dance are similar in some movements, we used the data collected from the swing dancers to estimate the sample size for this project. The data from this pilot study was not included in the dissertation.

The triple-step movement was collected and analyzed by following the protocol outlined in Chapter 3. The triple step is one of the most common elements in both swing dancing and the Cha-Cha – although not performed identically in both dances – and translates the syncopated rhythm of the music into body movement (Appendix D, Figure 1). It requires taking a small step to the side with one foot, bringing the second foot together to meet the first foot, and then taking a larger step to the side again with the first foot. In swing dance, this step is performed in an up-beat manner with an element of bounce to it where after the first step to the side, dancers often hop to replace the first foot with the second foot before moving into the third step, which can lead to a brief flight phase between the first and second steps. However, this hop does not tend to occur in the Cha-Cha. Given the representative features of the triple step element in swing dance, it is significant to systematically analyze the mechanical loading associated with each of the three steps in the triple step movement.

We addressed two hypotheses with this pilot study, one of which corresponds with the second hypothesis of the main dissertation.

1) Men and women will demonstrate different movement patterns that may alter their respective risks for injury (Hypothesis 2 in the main dissertation project).
2) Dancing individually versus with a partner will exhibit few differences in mechanics and muscle activity.

Methods

Participants

Eight recreational swing dancers – 4 male (age: 33.5 ± 4.8 years; height: 1.78 ± 0.05m; mass: 75.8 ± 6.6kg; dance experience: 2.8 ± 1.5 years) and 4 female (age: 28.2 ± 3.1 years; height: 1.67 ± 0.06m; mass: 71.4 ± 18.5kg; dance experience: 5.4 ± 3.9 years), without any known cardiovascular, neurological, or musculoskeletal conditions, participated in the present study. Participants were considered recreational dancers if they had completed 50 lessons/sessions/exposures of swing dancing within the previous year but had not competed professionally. All participants signed a written informed consent document before their participation in the study, approved by the Institutional Review Board at Georgia State University.

Protocol

After changing into tightly fitted clothing and standardized socks (Under Armour, Baltimore, MD), participants' anthropometric measurements were taken. Following a five-minute warm-up, 16 retroreflective markers were applied to anatomical landmarks on the participants' body based on a modified Vicon Plug-in-Gait marker set.

Participants performed a triple step to either the right or left with and without a partner three times each in a random order. The triple step was performed such that the first and the second steps landed on the first force plate, and the third step landed on the second force plate (Appendix B, Steps 4.1 and 4.2). To closely mimic the momentum that is typical of swing dancing, participants first performed a rock step first and then immediately went into the triple step.

Three-dimensional lower extremity kinematics were collected via the markers by an 8-camera motion capture system (Vicon, UK) at 100Hz. The GRF was gathered by two force plates at 1000Hz, synchronized with the motion capture system.

The motion capture procedure was arranged to gather dancers' kinetic and kinematic data individually and partnered. Specifically, dancers came to the data collection in pairs. They performed the triple steps in the following order: the first individual completed the triple steps with all markers, followed by the two individuals together but only the first participant with markers attached. The markers were then switched to the second participant whereby data was collected paired again, followed by the second participant individually.

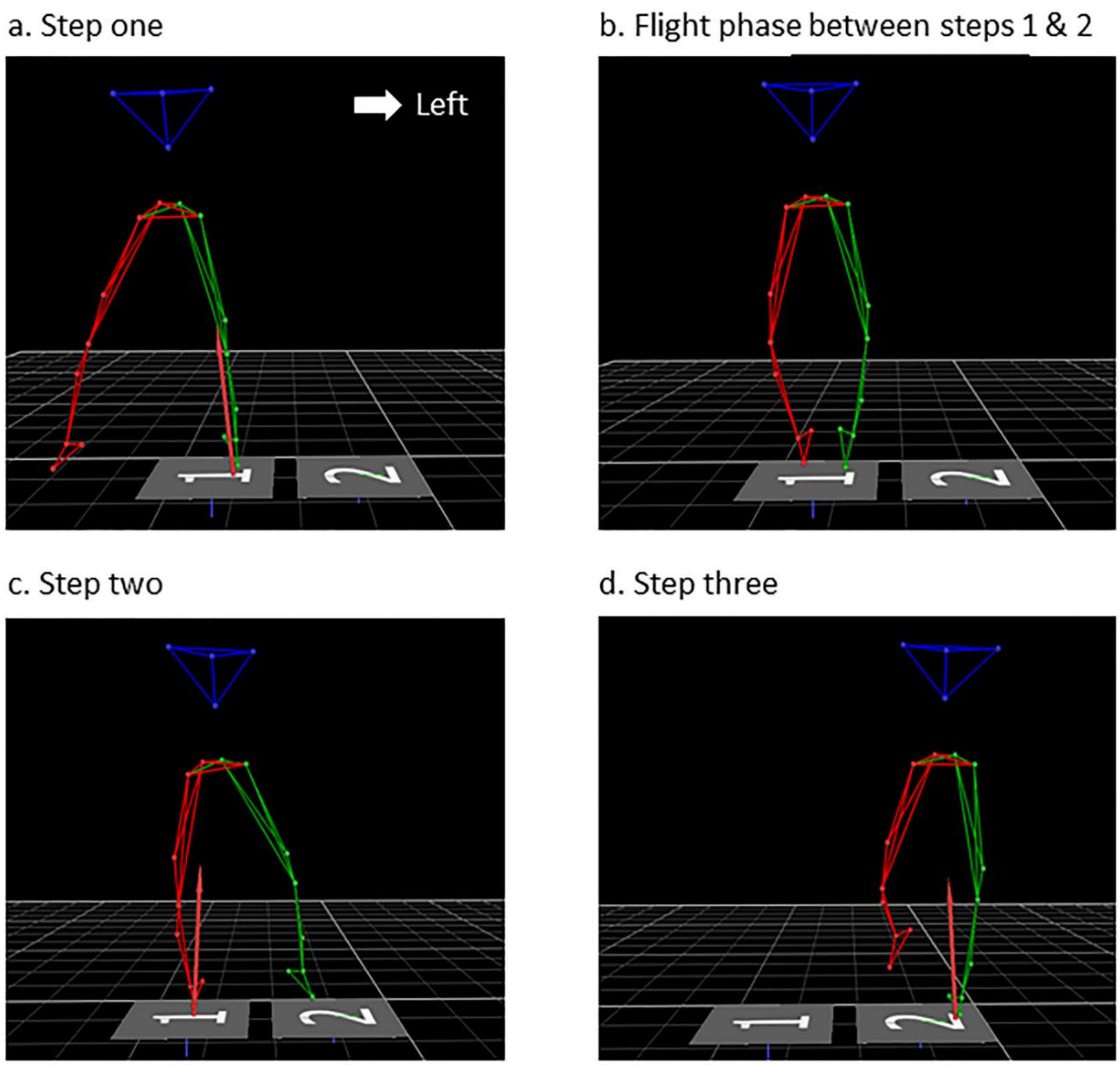
Data Reduction and Statistical Analysis

The data collected were processed and analyzed using the approach established in Chapter 3. Variables of interest that were calculated for this pilot study were the vertical GRF, loading rate, lower extremity joint power absorption and propulsion, and lower extremity joint moments during the landing phase.

Marker paths and GRF were all low-pass filtered using fourth-order, zero-lag Butterworth filters with a cutoff frequency of 7 and 30Hz respectively (Pai et. al., 2006). The centers of pressure of both feet were determined from the GRF. Joint centers were calculated from the filtered marker paths and measured anthropometric parameters. Angle and angular velocity in three planes were determined for bilateral lower limb joints based on the joint center data using inverse kinematics. Resultant joint moments of bilateral ankle, knee, and hip joints in three planes were calculated based on the filtered GRF, center of pressure, and joint angular parameters using inverse dynamics in conjunction with gender dependent segmental inertial parameters. The power was calculated as the dot product of the three-dimensional moment and angular velocities for each joint.

The timing of touchdown (TD) and liftoff (LO) of each of the three steps were determined manually based on the kinematics of the foot. The duration of the stance phase for each step was the time elapsed from TD to LO of the respective step. The following kinetic measurements were determined for the stance phase of each step. The peak vertical GRF was the maximum value of the vertical component of the GRF and normalized to body weight (BW). The loading rate was the slope of the vertical GRF from each TD to the peak vertical GRF and expressed in BW/s (Figure 2a). Peak power absorption and propulsion were determined as the maximum and minimum values of the joint power and normalized to body mass (W/kg). The peak moment for each joint in all three planes was identified in both directions (extension/flexion, abduction/adduction, internal/external rotation) and normalized to body mass (Nm/kg). Average values of each outcome variable over three trials were calculated for each of the three steps. A custom MATLAB (Mathworks, MA) program was developed to conduct all calculations.

Outcome measurements were reported in mean ± standard deviation (SD). To test the first hypothesis, independent *t*-tests were run to compare measurements between genders. Such comparisons were made for each of the three steps in both directions (to the right and left). To test the second hypothesis, paired *t*-tests were used to compare the outcome measurements between dancing conditions: with vs. without a partner. Comparisons were again made for each of the three steps in both directions (to the right and left). SPSS 25 (IBM, NY) was used with a significance level of α=0.05.



Appendix D Figure 1. Representative body movement sequences of a triple step to the left by a participant and the illustration of the force plate set-up. When triple stepping to the left, as illustrated here, participants stepped the left foot (in green) onto the first force plate **(a)**, then brought the right foot (in red) to meet the second foot with a slight hop and a flight phase **(b)**, the right foot replaced the left foot on the first force plate **(c)**, and then the left foot was stepped onto the second force plate where the participants were asked to end the movement and hold **(d)**. When triple stepping to the right, the sequence of the force plates was flipped. The numbered squares on the floor show the respective force plates.

Results

All eight participants completed the entire protocol and no adverse effects or discomfort were reported. Laboratory set-up was found to be sufficient for collecting the desired variables. Additionally, the tested protocol was determined to be adequate to achieve the desired results. Results from this pilot study verified that it would be possible to meet the required recruitment capacity. Through conducting the pilot study, we also established strong relationships with local dance studios, groups, and organizations, which was beneficial during the recruitment process for the main dissertation project.

Comparison between male and female recreational dancers

Ground Reaction Force & Loading Rate. Independent *t*-tests showed a significant difference in the peak GRF during the third step of the triple step to the left with a partner (p = 0.019), and in the peak GRF during the first step of the triple step to the right with a partner (p = 0.014). In both cases, males demonstrated a significantly greater GRF compared to the females. There were no differences seen with the loading rate between males and females for any of the three steps ($p > 0.05$) (Appendix D Table 1).

Joint Moments. Independent t-tests revealed significant differences in the joint moments at all three lower extremity joints between males and females in all three planes of motion. However, the sagittal plane is the only plane of motion in which differences at the hip were observed (Appendix D Tables 2-4).

In the sagittal plane, independent *t*-tests illustrated significant differences in the peak ankle plantarflexion moment during the first (p = 0.037) and second (p = 0.046) step of the triple step to the left, and the third step of the triple step to the right with a partner (p = 0.009); the peak hip flexion moment during the first step of the triple step to the right individually (p = 0.019) and with a partner ($p = 0.031$); and the peak hip extension moment during the second step of the triple step to the right with a partner ($p = 0.026$).

In the frontal plane, the independent *t*-tests revealed significant differences in the peak ankle eversion moment during the second step of the triple step to the right with a partner ($p = 0.019$). At the knee, differences were seen in the peak knee adduction moment during the first ($p = 0.014$) and second ($p = 0.013$) steps of the triple step to the left individually, during the second step of the triple step to the left with a partner ($p = 0.010$), and the first ($p = 0.007$) and second ($p = 0.040$) steps of the triple step to the right individually. Additionally, differences were observed in the peak knee abduction moment during the first ($p < 0.001$) and third ($p = 0.048$) steps of the triple step to the left individually, during the first step of the triple step to the left with a partner ($p = 0.009$), during the second ($p = 0.001$) and third ($p = 0.015$) steps of the triple step to the right individually, and during the second step of the triple step to the right with a partner ($p = 0.005$).

In the transverse plane at the ankle, independent *t*-tests demonstrated significant differences in the peak ankle internal rotation moment during the first ($p = 0.018$) and third ($p = 0.041$) steps of the triple step to the left individually, the second step of the triple step to the right ($p = 0.002$), and the second step of the triple step to the right with a partner ($p = 0.003$). Differences were also illustrated in the peak ankle external rotation during the first ($p = 0.022$) and third ($p = 0.032$) steps of the triple step to the left individually, the first step of the triple step to the left with a partner ($p = 0.028$), and the second step of the triple step to the right individually ($p < 0.001$), and with a partner ($p = 0.003$). At the knee, differences were seen in the peak knee internal rotation moment during the first step of the triple step to the left ($p = 0.009$), and during the first step of the triple step to the left with a partner ($p = 0.017$). Further, differences were observed in the peak knee external rotation moment during the first ($p = 0.008$) and third ($p = 0.006$) steps of the triple step to the left individually, the first step of the triple step to the left with a partner ($p = 0.003$), and the second step of the triple step to the right with a partner ($p = 0.012$).

Joint Power. Independent *t*-tests revealed only one significant difference in lower extremity joint power between males and females (Appendix D Tables 5 and 6). Females exhibited significantly greater power absorption at the left hip during the third step of the triple step to the left with a partner ($p = 0.024$).

Comparison between dancing with and without a partner in recreational dancers

Ground Reaction Force & Loading Rate. Paired *t*-tests showed no significant differences in the peak vertical GRF between dancing with and without a partner for any of the three steps ($p > 0.05$, Appendix D Table 1). No differences were found with the loading rate between partnered and individual dance conditions ($p > 0.05$, Table 4.1).

Joint Moments. Few joint moment measurements exhibited significant between-condition differences ($p > 0.05$, Appendix D Tables 2-4). The observed significant between-condition differences during the triple step to the left included: knee flexion moment during the first step ($p = 0.037$), hip flexion moment during the first step ($p = 0.018$), knee extension moment during the first step ($p = 0.009$) and the third step ($p = 0.011$), and ankle eversion moment during the first step ($p = 0.049$). When participants performed the triple step to the right, the following peak joint moments were different between conditions: the knee extension moment in the first step ($p < 0.003$), hip abduction moment in the third step ($p = 0.012$), ankle internal rotation moment in the second step ($p = 0.041$), ankle external rotation moment during the third step ($p = 0.012$), and knee external rotation moment during the second ($p = 0.035$) and third step ($p = 0.014$).

Joint Power. Similarly, few significant differences were observed in lower extremity joint power between partnered and non-partnered conditions ($p > 0.05$, Appendix D Tables 5 and 6). Variables which demonstrated significant condition-related differences encompassed: left ankle power absorption in the first step of the triple step to the left ($p = 0.012$), left knee power propulsion in the third step of the triple step to the left ($p = 0.019$), right knee power propulsion in the first step of the triple step to the right ($p = 0.002$), and right hip power propulsion in the second step of the triple step to the left ($p = 0.007$).

Appendix D Table 1. Comparisons of peak ground reaction force and peak loading rate (in mean ± standard deviation and body weight (BW) and BW/s) between dancing conditions (partnered vs. individual) and genders. The former comparisons were conducted by paired *t*-tests and the latter ones were conducted by independent *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	**Condition**	**Step 1**			**Step 2**			**Step 3**		
		Female	**Male**	*p*-value*	**Female**	**Male**	*p*-value*	**Female**	**Male**	*p*-value*
Ground Reaction Force	TSL	1.37 ± 0.13	1.45 ± 0.14	0.44	1.35 ± 0.10	1.43 ± 0.15	0.43	1.14 ± 0.16	1.09 ± 0.06	0.55
	TSLP	1.24 ± 0.07	1.36 ± 0.12	0.17	1.33 ± 0.13	1.4 ± 0.14	0.55	1 ± 0.02	1.12 ± 0.06	**0.02**
	p-value@	0.20			0.62			0.39		
	TSR	1.37 ± 0.15	1.37 ± 0.15	0.99	1.37 ± 0.09	1.38 ± 0.08	0.82	1.08 ± 0.14	1.12 ± 0.05	0.62
	TSRP	1.23 ± 0.06	1.39 ± 0.05	**0.01**	1.35 ± 0.11	1.38 ± 0.18	0.81	1.02 ± 0.07	1.07 ± 0.02	0.39
	p-value@	0.10			0.33			0.06		
Loading Rate	TSL	6.72 ± 1.90	7.29 ± 0.71	0.60	8.36 ± 0.34	9.94 ± 1.15	**0.07**	6.61 ± 2.69	4.83 ± 2.26	0.35
	TSLP	6.51 ± 1.50	7.54 ± 2.76	0.59	8.33 ± 1.69	9.98 ± 1.51	0.23	5.74 ± 1.92	4.74 ± 2.41	0.59
	p-value@	0.54			0.96			0.74		
	TSR	8.58 ± 1.35	7.39 ± 0.96	0.20	9.9 ± 2.55	8.91 ± 0.85	0.51	4.04 ± 3.28	6.23 ± 2.13	0.31
	TSRP	6.9 ± 1.16	8.95 ± 3.23	0.39	8.95 ± 1.70	9.11 ± 1.94	0.91	4.26 ± 3.57	4.32 ± 1.65	0.98
	p-value@	0.71			0.24			0.58		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.
*: comparison between females and males;
@: comparison between all dancers dancing individually and with a partner.

Appendix D Table 2. Comparisons of sagittal plane peak joint moments (in mean ± standard deviation and Nm/kg) between genders and dancing conditions (partnered vs. individual). The former comparisons were conducted by independent *t*-tests and the latter ones were conducted by paired *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Condition	Step 1			Step 2			Step 3		
		Female	Male	*p*-value*	Female	Male	*p*-value*	Female	Male	*p*-value*
Peak Ankle Dorsiflexion	TSL	-0.03 ± 0.01	-0.02 ± 0.01	0.666	-0.02 ± 0.04	-0.04 ± 0.06	0.498	-0.05 ± 0.03	-0.01 ± 0.01	0.074
	TSLP	-0.02 ± 0.01	-0.03 ± 0.02	0.331	-0.03 ± 0.02	0.04 ± 0.04	0.570	-0.02 ± 0.00	-0.02 ± 0.01	0.501
	p-value@	0.762			0.486			0.682		
	TSR	-0.02 ± 0.02	-0.00 ± 0.02	0.248	-0.01 ± 0.03	0.01 ± 0.03	0.357	-0.04 ± 0.04	-0.03 ± 0.01	0.367
	TSRP	-0.01 ± 0.01	0.01 ± 0.05	0.408	-0.02 ± 0.03	0.00 ± 0.02	0.441	-0.03 ± 0.02	-0.02 ± 0.01	0.654
	p-value@	0.406			0.101			0.158		
Peak Ankle Plantarflexion	TSL	1.47 ± 0.22	1.88 ± 0.22	0.037	1.39 ± 0.20	1.89 ± 0.34	0.046	0.89 ± 0.25	1.20 ± 0.21	0.105
	TSLP	1.42 ± 0.12	1.67 ± 0.48	0.420	1.48 ± 0.18	1.94 ± 0.28	0.057	0.85 ± 0.17	1.02 ± 0.51	0.611
	p-value@	0.266			0.327			0.373		
	TSR	1.49 ± 0.22	1.80 ± 0.34	0.174	1.42 ± 0.25	1.75 ± 0.13	0.061	0.93 ± 0.30	1.22 ± 0.13	0.118
	TSRP	1.28 ± 0.27	1.69 ± 0.29	0.106	1.40 ± 0.36	1.81 ± 0.12	0.121	0.82 ± 0.23	1.44 ± 0.15	0.009
	p-value@	0.124			0.991			0.948		
Peak Knee Flexion	TSL	-0.17 ± 0.13	-0.12 ± 0.07	0.535	0.30 ± 1.04	-0.12 ± 0.05	0.481	-0.21 ± 0.04	-0.22 ± 0.15	0.817
	TSLP	-0.19 ± 0.08	-0.20 ± 0.10	0.873	0.44 ± 1.02	-0.16 ± 0.14	0.416	-0.19 ± 0.06	-0.26 ± 0.07	0.209
	p-value@	0.037			0.504			0.618		
	TSR	0.20 ± 0.82	-0.19 ± 0.10	0.418	-0.16 ± 0.15	-0.13 ± 0.05	0.722	0.00 ± 0.55	-0.28 ± 0.12	0.359
	TSRP	0.24 ± 0.73	-0.17 ± 0.08	0.384	-0.13 ± 0.10	-0.15 ± 0.08	0.740	0.06 ± 0.52	-0.36 ± 0.32	0.276
	p-value@	0.188			0.514			0.770		
P ea k	TSL	1.06 ± 0.56	0.79 ± 0.30	0.437	0.40 ± 0.47	0.74 ± 0.39	0.316	0.73 ± 0.30	0.37 ± 0.24	0.112

	TSLP	0.77 ± 0.54	0.55 ± 0.33	0.522	0.31 ± 0.47	0.68 ± 0.52	0.369	0.40 ± 0.37	0.23 ± 0.28	0.520
	p-value@	0.009			0.565			0.011		
	TSR	0.63 ± 0.60	0.88 ± 0.43	0.513	0.98 ± 0.64	0.78 ± 0.42	0.629	0.34 ± 0.46	0.49 ± 0.35	0.644
	TSRP	0.42 ± 0.49	0.66 ± 0.52	0.567	0.84 ± 0.60	0.70 ± 0.66	0.784	0.28 ± 0.48	0.19 ± 0.21	0.764
	p-value@	0.003			0.333			0.056		
Peak Hip Flexion	TSL	-0.36 ± 0.20	-0.21 ± 0.09	0.221	-0.41 ± 0.30	-0.22 ± 0.11	0.284	-0.32 ± 0.34	-0.16 ± 0.20	0.439
	TSLP	-0.25 ± 0.18	0.12 ± 0.04	0.341	-0.37 ± 0.18	0.19 ± 0.11	0.159	-0.35 ± 0.30	-0.11 ± 0.11	0.203
	p-value@	0.018			0.325			0.417		
	TSR	-0.33 ± 0.18	-0.04 ± 0.06	0.019	-0.31 ± 0.41	-0.28 ± 0.09	0.867	-0.29 ± 0.30	-0.09 ± 0.09	0.255
	TSRP	-0.32 ± 0.18	0.03 ± 0.12	0.031	-0.33 ± 0.28	-0.19 ± 0.13	0.471	-0.29 ± 0.22	-0.03 ± 0.03	0.109
	p-value@	0.255			0.668			0.633		
Peak Hip Extension	TSL	0.44 ± 0.33	0.35 ± 0.18	0.647	0.26 ± 0.11	0.40 ± 0.07	0.075	0.27 ± 0.12	0.30 ± 0.27	0.853
	TSLP	0.39 ± 0.38	0.43 ± 0.11	0.885	0.20 ± 0.09	0.35 ± 0.23	0.342	0.18 ± 0.14	0.29 ± 0.05	0.289
	p-value@	0.607			0.370			0.673		
	TSR	0.51 ± 0.32	0.34 ± 0.16	0.387	0.31 ± 0.23	0.40 ± 0.14	0.552	0.40 ± 0.30	0.32 ± 0.17	0.654
	TSRP	0.23 ± 0.14	0.34 ± 0.21	0.453	0.17 ± 0.07	0.43 ± 0.14	0.026	0.42 ± 0.33	0.46 ± 0.17	0.888
	p-value@	0.127			0.339			0.067		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.
*: comparison between females and males;
@: comparison between all dancers dancing individually and with a partner.

Appendix D Table 3. Comparisons of frontal plane peak joint moments (in mean ± standard deviation and Nm/kg) between genders and dancing conditions (partnered vs. individual). The former comparisons were conducted by independent *t*-tests and the latter ones were conducted by paired *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Condition	Step 1			Step 2			Step 3		
		Female	Male	*p*-value*	Female	Male	*p*-value*	Female	Male	*p*-value*
Peak Ankle Inversion	TSL	0.00 ± 0.01	0.00 ± 0.00	0.707	-0.05 ± 0.02	-0.09 ± 0.05	0.225	-0.02 ± 0.01	-0.06 ± 0.04	0.707
	TSLP	0.00 ± 0.00	-0.01 ± 0.01	0.110	-0.06 ± 0.02	-0.08 ± 0.03	0.486	0.00 ± 0.00	-0.06 ± 0.04	0.056
	p-value@	0.228			0.906			0.124		
	TSR	-0.03 ± 0.02	-0.03 ± 0.05	0.870	-0.03 ± 0.03	-0.06 ± 0.04	0.316	-0.08 ± 0.05	-0.09 ± 0.03	0.603
	TSRP	-0.03 ± 0.02	0.00 ± 0.00	0.077	-0.02 ± 0.01	-0.03 ± 0.02	0.510	-0.06 ± 0.07	-0.05 ± 0.04	0.775
	p-value@	0.460			0.173			0.162		
Peak Ankle Eversion	TSL	0.15 ± 0.06	0.16 ± 0.07	0.762	0.10 ± 0.07	0.10 ± 0.06	0.953	0.14 ± 0.05	0.13 ± 0.05	0.973
	TSLP	0.21 ± 0.06	0.18 ± 0.07	0.586	0.09 ± 0.02	0.08 ± 0.07	0.880	0.15 ± 0.04	0.11 ± 0.08	0.492
	p-value@	0.049			0.243			0.822		
	TSR	0.08 ± 0.05	0.13 ± 0.07	0.339	0.14 ± 0.14	0.12 ± 0.08	0.858	0.08 ± 0.08	0.11 ± 0.06	0.462
	TSRP	0.09 ± 0.05	0.17 ± 0.05	0.090	0.11 ± 0.04	0.21 ± 0.04	0.019	0.08 ± 0.07	0.16 ± 0.03	0.143
	p-value@	0.746			0.714			0.329		
Peak Knee Adduction	TSL	-0.59 ± 0.26	-0.14 ± 0.01	0.014	-0.46 ± 0.16	-0.17 ± 0.06	0.013	-0.45 ± 0.23	-0.18 ± 0.07	0.067
	TSLP	-0.41 ± 0.25	-0.14 ± 0.03	0.197	-0.36 ± 0.07	0.13 ± 0.08	0.010	-0.24 ± 0.20	-0.22 ± 0.11	0.841
	p-value@	0.306			0.162			0.299		
	TSR	-0.42 ± 0.11	-0.17 ± 0.06	0.007	-0.58 ± 0.30	-0.19 ± 0.06	0.040	-0.36 ± 0.13	-0.20 ± 0.12	0.120
	TSRP	-0.35 ± 0.18	-0.15 ± 0.08	0.130	-0.45 ± 0.20	-0.18 ± 0.04	0.069	-0.24 ± 0.11	-0.19 ± 0.08	0.527
	p-value@	0.221			0.115			0.117		
Peak Knee Abduction	TSL	0.20 ± 0.10	0.58 ± 0.06	<0.001	0.28 ± 0.04	0.50 ± 0.26	0.143	0.22 ± 0.22	0.56 ± 0.06	0.048
	TSLP	0.23 ± 0.07	0.56 ± 0.12	0.009	0.27 ± 0.08	0.42 ± 0.19	0.288	0.36 ± 0.25	0.50 ± 0.33	0.550
	p-value@	0.943			0.182			0.964		
	TSR	0.25 ± 0.14	0.51 ± 0.17	0.060	0.26 ± 0.05	0.51 ± 0.06	0.001	0.23 ± 0.18	0.57 ± 0.08	0.015

	TSRP	0.25 ± 0.11	0.45 ± 0.11	0.062	0.24 ± 0.07	0.65 ± 0.15	0.005	0.29 ± 0.19	0.55 ± 0.20	0.136
	p-value@	0.515			0.308			0.521		
Peak Hip Adduction	TSL	-0.48 ± 0.28	-0.48 ± 0.23	1.000	-0.54 ± 0.23	-0.38 ± 0.17	0.289	-0.37 ± 0.23	-0.40 ± 0.20	0.849
	TSLP	-0.39 ± 0.17	-0.41 ± 0.17	0.888	-0.43 ± 0.07	-0.32 ± 0.14	0.245	-0.18 ± 0.12	-0.41 ± 0.24	0.180
	p-value@	0.283			0.154			0.243		
	TSR	-0.36 ± 0.16	-0.49 ± 0.19	0.346	-0.57 ± 0.36	-0.42 ± 0.10	0.471	-0.34 ± 0.25	-0.43 ± 0.23	0.647
	TSRP	-0.32 ± 0.07	-0.43 ± 0.32	0.603	-0.49 ± 0.29	-0.41 ± 0.06	0.647	-0.24 ± 0.17	-0.38 ± 0.11	0.292
	p-value@	0.460			0.250			0.178		
Peak Hip Abduction	TSL	0.76 ± 0.17	0.66 ± 0.21	0.483	0.84 ± 0.11	0.67 ± 0.08	0.050	0.83 ± 0.29	0.69 ± 0.09	0.385
	TSLP	0.73 ± 0.12	0.70 ± 0.19	0.852	0.79 ± 0.10	0.65 ± 0.222	0.356	0.91 ± 0.24	0.63 ± 0.39	0.329
	p-value@	0.608			0.598			0.954		
	TSR	0.77 ± 0.14	0.77 ± 0.12	0.990	0.75 ± 0.08	0.73 ± 0.10	0.734	0.73 ± 0.06	0.73 ± 0.18	0.932
	TSRP	0.71 ± 0.12	0.60 ± 0.27	0.501	0.77 ± 0.21	0.77 ± 0.11	0.966	0.84 ± 0.05	0.81 ± 0.28	0.880
	p-value@	0.183			0.796			0.012		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.
*: comparison between females and males;
@: comparison between all dancers dancing individually and with a partner.

Appendix D Table 4. Comparisons of transverse plane peak joint moments (in mean ± standard deviation and Nm/kg) between genders and dancing conditions (partnered vs. individual). The former comparisons were conducted by independent *t*-tests and the latter ones were conducted by paired *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Condition	Step 1			Step 2			Step 3		
		Female	Male	*p*-value*	Female	Male	*p*-value*	Female	Male	*p*-value*
Peak Ankle Internal Rotation	TSL	-0.17 ± 0.07	-0.03 ± 0.02	0.018	-0.14 ± 0.04	-0.06 ± 0.06	0.060	-0.09 ± 0.03	-0.03 ± 0.03	0.041
	TSLP	-0.14 ± 0.11	-0.02 ± 0.01	0.206	-0.11 ± 0.02	-0.04 ± 0.04	0.051	-0.04 ± 0.03	-0.02 ± 0.01	0.373
	p-value	0.592			0.140			0.127		
	TSR	-0.10 ± 0.03	-0.08 ± 0.07	0.733	-0.19 ± 0.06	-0.04 ± 0.02	0.002	-0.06 ± 0.04	-0.04 ± 0.04	0.421
	TSRP	-0.07 ± 0.04	-0.06 ± 0.09	0.779	-0.14 ± 0.03	-0.03 ± 0.02	0.003	-0.03 ± 0.01	-0.03 ± 0.02	0.784
	p-value	0.152			0.041			0.176		
Peak Ankle External Rotation	TSL	0.10 ± 0.05	0.20 ± 0.05	0.022	0.06 ± 0.02	0.24 ± 0.24	0.224	0.07 ± 0.03	0.17 ± 0.06	0.032
	TSLP	0.09 ± 0.04	0.16 ± 0.03	0.028	0.09 ± 0.04	0.22 ± 0.18	0.281	0.16 ± 0.13	0.15 ± 0.11	0.944
	p-value	0.352			0.974			0.670		
	TSR	0.08 ± 0.03	0.19 ± 0.17	0.260	0.05 ± 0.01	0.22 ± 0.03	<0.001	0.07 ± 0.07	0.15 ± 0.06	0.184
	TSRP	0.08 ± 0.02	0.19 ± 0.12	0.054	0.07 ± 0.03	0.24 ± 0.05	0.003	0.12 ± 0.13	0.22 ± 0.06	0.262
	p-value	0.642			0.165			0.012		
Peak Knee Internal Rotation	TSL	-0.09 ± 0.03	-0.02 ± 0.02	0.009	-0.10 ± 0.03	-0.06 ± 0.06	0.290	-0.04 ± 0.02	-0.03 ± 0.03	0.524
	TSLP	-0.06 ± 0.02	-0.02 ± 0.01	0.017	-0.08 ± 0.03	-0.04 ± 0.04	0.186	-0.01 ± 0.01	-0.02 ± 0.01	0.402
	p-value	0.331			0.295			0.166		
	TSR	-0.08 ± 0.02	-0.08 ± 0.06	0.937	-0.08 ± 0.07	-0.03 ± 0.02	0.303	-0.05 ± 0.02	-0.04 ± 0.04	0.772
	TSRP	-0.06 ± 0.03	-0.05 ± 0.07	0.725	-0.06 ± 0.05	-0.03 ± 0.02	0.323	-0.03 ± 0.01	-0.03 ± 0.02	0.759
	p-value	0.095			0.202			0.145		
Peak Knee External Rotation	TSL	0.07 ± 0.01	0.15 ± 0.04	0.008	0.06 ± 0.02	0.12 ± 0.10	0.237	0.09 ± 0.03	0.16 ± 0.02	0.006
	TSLP	0.07 ± 0.00	0.16 ± 0.02	0.003	0.08 ± 0.05	0.14 ± 0.11	0.439	0.14 ± 0.02	0.16 ± 0.11	0.775
	p-value	0.484			0.209			0.700		
	TSR	0.05 ± 0.02	0.12 ± 0.06	0.105	0.07 ± 0.04	0.12 ± 0.02	0.073	0.07 ± 0.06	0.14 ± 0.06	0.137

	TSRP	0.07 ± 0.01	0.17 ± 0.09	0.175	0.09 ± 0.05	0.23 ± 0.05	0.012	0.10 ± 0.07	0.24 ± 0.08	0.066
	p-value	0.128			0.035			0.014		
Peak Hip Internal Rotation	TSL	-0.13 ± 0.06	-0.12 ± 0.06	0.911	-0.12 ± 0.07	-0.10 ± 0.04	0.586	-0.12 ± 0.04	-0.05 ± 0.04	0.052
	TSLP	-0.09 ± 0.03	-0.11 ± 0.04	0.613	-0.11 ± 0.06	-0.07 ± 0.04	0.291	-0.04 ± 0.03	-0.03 ± 0.03	0.623
	p-value	0.158			0.162			0.078		
	TSR	-0.14 ± 0.07	-0.13 ± 0.03	0.907	-0.11 ± 0.06	-0.11 ± 0.05	0.974	-0.09 ± 0.05	-0.07 ± 0.02	0.391
	TSRP	-0.12 ± 0.07	-0.10 ± 0.06	0.837	-0.10 ± 0.06	-0.14 ± 0.05	0.421	-0.10 ± 0.05	-0.05 ± 0.04	0.250
	p-value	0.151			0.803			0.593		
Peak Hip External Rotation	TSL	0.16 ± 0.12	0.08 ± 0.03	0.308	0.13 ± 0.13	0.08 ± 0.06	0.544	0.11 ± 0.07	0.10 ± 0.04	0.673
	TSLP	0.12 ± 0.09	0.07 ± 0.05	0.354	0.07 ± 0.06	0.07 ± 0.04	0.963	0.10 ± 0.02	0.12 ± 0.01	0.330
	p-value	0.348			0.253			0.823		
	TSR	0.13 ± 0.07	0.10 ± 0.07	0.566	0.18 ± 0.12	0.07 ± 0.03	0.161	0.12 ± 0.08	0.07 ± 0.05	0.321
	TSRP	0.11 ± 0.06	0.09 ± 0.10	0.788	0.14 ± 0.05	0.07 ± 0.03	0.103	0.10 ± 0.04	0.10 ± 0.03	0.873
	p-value	0.302			0.432			0.905		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.

*: comparison between females and males;

@: comparison between all dancers dancing individually and with a partner.

Appendix D Table 5. Comparisons of peak joint power absorption (in mean ± standard deviation and W/kg) between dancing conditions (partnered vs. individual) and genders. The former comparisons were conducted by paired *t*-tests and the latter ones were conducted by independent *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Condition	Step 1			Step 2			Step 3		
		Female	**Male**	*p*-value*	**Female**	**Male**	*p*-value*	**Female**	**Male**	*p*-value*
Ankle Power Absorption	TSL	-1.89 ± 0.36	-1.34 ± 0.64	0.190	-3.27 ± 0.84	-3.73 ± 1.14	0.538	-1.30 ± 0.82	-1.00 ± 0.49	0.550
	TSLP	-1.44 ± 0.33	-1.12 ± 0.68	0.490	-3.31 ± 1.25	-3.64 ± 1.58	0.780	-0.59 ± 0.39	-0.79 ± 0.38	0.527
	p-value@	**0.012**			0.872			0.123		
	TSR	-1.30 ± 0.45	-1.25 ± 0.66	0.900	-3.47 ± 1.52	-3.42 ± 0.43	0.946	-1.20 ± 0.92	-1.10 ± 0.30	0.842
	TSRP	-0.95 ± 0.40	-1.54 ± 0.74	0.227	-2.68 ± 0.97	-3.39 ± 0.60	0.319	-0.80 ± 0.62	-1.16 ± 0.22	0.391
	p-value@	0.297			0.129			0.069		
Knee Power Absorption	TSL	-0.50 ± 0.33	-0.24 ± 0.09	0.177	-1.19 ± 1.52	-0.82 ± 0.48	0.663	-0.39 ± 0.33	-0.35 ± 0.29	0.854
	TSLP	-0.35 ± 0.30	-0.48 ± 0.29	0.584	-1.22 ± 1.30	-1.04 ± 1.13	0.851	-0.24 ± 0.03	-0.43 ± 0.43	0.493
	p-value@	0.535			0.976			0.689		
	TSR	-0.55 ± 0.37	-0.40 ± 0.09	0.478	-1.74 ± 1.20	-0.92 ± 0.63	0.277	-0.41 ± 0.07	-0.38 ± 0.28	0.820
	TSRP	-0.60 ± 0.45	-0.32 ± 0.14	0.357	-1.00 ± 0.64	-0.84 ± 1.02	0.802	-0.37 ± 0.32	-0.50 ± 0.30	0.603
	p-value@	0.926			0.200			0.752		
Hip Power Absorption	TSL	-0.60 ± 0.20	-0.32 0.14±	0.069	-0.54 ± 0.25	-0.28 ± 0.07	0.091	-0.56 ± 0.20	-0.35 ± 0.13	0.128
	TSLP	-0.55 ± 0.26	-0.27 ± 0.06	0.080	-0.61 ± 0.25	-0.29 ± 0.07	0.059	-0.60 ± 0.09	-0.29 ± 0.15	0.024
	p-value@	0.196			0.383			0.295		
	TSR	-0.39 ± 0.54	-0.38 ± 0.06	0.956	-0.44 ± 0.24	-0.35 ± 0.05	0.547	-0.37 ± 0.19	-0.34 ± 0.09	0.814
	TSRP	-0.50 ± 0.42	-0.29 ± 0.05	0.389	-0.52 ± 0.26	-0.33 ± 0.09	0.274	-0.52 ± 0.18	-0.32 ± 0.23	0.258
	p-value@	0.872			0.549			0.159		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.
*: comparison between females and males;
@: comparison between all dancers dancing individually and with a partner.

Appendix D Table 6. Comparisons of peak joint power propulsion (in mean ± standard deviation and W/kg) between dancing conditions (partnered vs. individual) and genders. The former comparisons were conducted by paired *t*-tests and the latter ones were conducted by independent *t*-tests. The *p*-values for comparisons showing significant difference are bolded.

Variable	Condition	Step 1			Step 2			Step 3		
		Female	**Male**	*p*-value*	**Female**	**Male**	*p*-value*	**Female**	**Male**	*p*-value*
Ankle Power Propulsion	TSL	4.19 ± 1.32	4.58 ± 1.30	0.685	1.26 ± 0.49	2.25 ± 1.45	0.240	0.32 ± 0.16	0.49 ± 0.26	0.321
	TSLP	3.32 ± 0.78	4.12 ± 2.25	0.588	1.48 ± 0.61	1.49 ± 0.46	0.971	0.46 ± 0.52	0.41 ± 0.38	0.885
	p-value@	0.396			0.417			0.980		
	TSR	4.20 ± 2.06	3.87 ± 0.81	0.779	1.67 ± 0.91	1.51 ± 0.85	0.805	0.52 ± 0.51	0.52 ± 0.20	0.994
	TSRP	3.18 ± 1.29	3.52 ± 0.94	0.718	1.74 ± 1.22	1.58 ± 1.16	0.868	0.31 ± 0.43	0.54 ± 0.22	0.431
	p-value@	0.075			0.914			0.407		
Knee Power Propulsion	TSL	1.84 ± 1.20	1.28 ± 0.36	0.401	0.69 ± 0.69	0.49 ± 0.17	0.597	0.58 ± 0.25	0.40 ± 0.18	0.271
	TSLP	1.29 ± 1.15	1.20 ± 0.99	0.915	1.09 ± 1.23	0.45 ± 0.43	0.364	0.27 ± 0.23	0.30 ± 0.24	0.879
	p-value@	0.441			0.545			**0.019**		
	TSR	2.08 ± 1.24	1.46 ± 0.49	0.388	0.60 ± 0.61	0.57 ± 0.49	0.939	0.61 ± 0.47	0.49 ± 0.46	0.722
	TSRP	1.42 ± 1.14	1.01 ± 0.49	0.593	0.52 ± 0.48	0.75 ± 0.72	0.625	0.42 ± 0.30	0.18 ± 0.05	0.209
	p-value@	**0.002**			0.661			0.112		
Hip Power Propulsion	TSL	0.97 ± 0.66	0.50 ± 0.38	0.269	0.55 ± 0.42	0.34 ± 0.19	0.416	0.54 ± 0.09	0.43 ± 0.30	0.493
	TSLP	0.92 ± 0.36	0.67 ± 0.55	0.531	0.50 ± 0.26	0.25 ± 0.16	0.176	0.42 ± 0.26	0.49 ± 0.35	0.799
	p-value@	0.898			**0.007**			0.681		
	TSR	1.01 ± 0.72	0.52 ± 0.36	0.271	0.63 ± 0.53	0.27 ± 0.14	0.240	0.56 ± 0.40	0.44 ± 0.27	0.637
	TSRP	0.77 ± 0.21	0.63 ± 0.75	0.790	0.48 ± 0.32	0.31 ± 0.20	0.464	0.63 ± 0.66	0.42 ± 0.29	0.630
	p-value@	0.739			0.434			0.668		

Note: TSL = triple step to the left; TSLP = triple step to the left with a partner; TSR = triple step to the right; and TSLP = triple step to the right with a partner.
*: comparison between females and males;
@: comparison between all dancers dancing individually and with a partner.

Power Analysis

The sample size was determined based on the preliminary results from the pilot study. The ankle absorption power was used as the primary outcome measure to calculate the sample size. Considering that the triple-step in swing dancing is similar to the triple step movement done in ballroom dance, it was selected as the movement to conduct the power analysis. The design strategy was to conduct a sample size calculation to address the hypothesis regarding the gender-related difference, followed by a power analysis to address the hypothesis about the dancing condition-difference (partnered vs. individual).

The estimated effect size d of the ankle absorption power between genders calculated from the independent *t*-test in our pilot study was 1.047. With an α level of 0.05 and a statistical power of 0.80, the software of G*Power (Faul et al. 2007) indicates that 16 subjects per group are needed. For the comparison between conditions, using the indicated sample size of 16 per group or 32 participants in total, the effect size d of 1.047, and $\alpha = 0.05$, the software G* Power indicates that the predicted power based on the independent *t*-test will be 0.999. Thus, 16 subjects per group would provide a minimum power of 0.80 for detecting a significant between-gender and -condition difference in the ankle absorption power. By considering a possible data loss rate of 20% due to technical failure, we would plan to recruit 20 subjects with an even gender distribution per group (inexperienced, recreational, and professional). When examined the hypotheses related to gender, steps, and dancing conditions, three groups will be pooled together to ensure enough power.

It is acknowledged that this sample size estimate is not ideal for the dissertation project due to the lack of information about the dancing experience level. However, as mentioned earlier, there was no prior existing study which directly examined the biomechanical characters of ballroom dance. Thus, it was challenging to conduct a more accurate sample estimation.