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Four week lumbopelvic-hip complex intervention program and its effects on tuck jump assessment in active youth

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Abstract: Injury in youth physical activity has become a major concern with the rising rate of participation. Lumbopelvic-hip complex (LPHC) stability, also known as core stability, has been found to contribute to proper force dissipation and ultimately more effective mechanics. Therefore, the purpose of this study was to examine the effects of a LPHC neuromuscular strengthening program on at-risk youth using the Tuck Jump Assessment. Forty-five youth grades 6, 7, and 8 participated in the Tuck Jump Assessment. Then those participants who scores were indicative of 'at risk' were enrolled in a four-week LPHC intervention program. Those participants whose scores did not fall into the 'at risk' category were the control group. After four-weeks groups were retested with the Tuck Jump Assessment. A paired T-test revealed that the intervention group had significant improvement on their Tuck Jump Assessment ($p \leq 0.01$), while the control group's scores did not change. It was thus concluded that strengthening the LPHC provides more control and stability in functional activity. Implementation of an intervention program in youth may decrease the susceptibility to injury in physical activity as well as contribute to more sound mechanics.

Key Words: core training; kids; injury prevention; neuromuscular training

Introduction: The rise in childhood obesity has become a focal point in modern society. Obesity leads to both physical and emotional stress, which has become a major health care concern in youth. As a result of this obesity epidemic, there has been an increase in youth physical activity participation. Youth are participating in a multitude of activities that require different skills and mechanics. During this time, youth must develop mechanically sound movement patterns to safely perform essential skills. Therefore, it is critical to address the mechanics of youth and intervene with those at risk, prior to the age in which sport specification occurs. A solid neuromuscular foundation may decrease the risk of injury and provide not only improved performance benefits but increase physical well-being [10].

Physical activity requires stability and balance in the lumbopelvic-hip complex (LPHC) [4]. The hip, pelvis, and trunk segments and surrounding musculature, attaching or originating on those segments, form the LPHC [9]. Without proper support from the LPHC, there will be a decrease in neuromuscular control in the distal segments [9]. Control imbalances resulting from the LPHC musculature leads to improper movement down the kinetic chain [9]. Deficits in LPHC neuromuscular control are represented in movements such as landing, deceleration, and cutting, which present as common mechanisms of injury [8, 9]. Common structures often affected by the functionality of the LPHC are the hip and knee. When LPHC stability and strength are inefficient often one presents in high-risk positions such as increased hip varus, hip flexion and knee valgus during functional activities [9]. Underdevelopment and de-emphasis on the stability of the LPHC in youth could predispose this population to injury during physical activity. In addition it should be noted that gender plays a role in neuromuscular control. Females tend to have decreased levels of neuromuscular control compared to their male counterparts, making them more susceptible to injury [7]. Dynamic neuromuscular control increases body awareness and proprioception in addition to bone, ligament, and tendon strength in both genders [7].

Often, strengthening programs for the LPHC focus specifically on hip abductor and external rotator musculature. However, the LPHC is comprised of many more muscle groups that work to stabilize the pelvis and provide proper alignment and stability of both the lower and upper extremity (5). Of major support for the LPHC is the gluteus medius (4,11]. The gluteus medius plays a critical role in preventing excessive hip adduction and internal rotation; common causative mechanism of injury (5).

Myer and co-workers [7] support the implementation of neuromuscular training programs in efforts to decrease the risk of injury and increase performance factors. The Tuck Jump Assessment[8] regarded as an accurate clinical measurement tool, has been utilized to screen individuals at risk for injury prior to an intervention program [9). Appropriate and reliable assessments during youth may ensure proper biomechanical development and overall health as well as decrease the likelihood of injury [1O]. Therefore, the purpose of this study was to examine the effects of a LPHC neuromuscular strengthening program on at-risk youth (grades 6, 7, and 8) using the Tuck Jump Assessment (6].

Methods--Study Design: The Tuck Jump Assessment[6] was used to examine the effects of a LPHC intervention program on a convenient sample of active youth (n = 45). Those participants whose performance score matched 'at risk' [a score of 5 or above on the 10-point scale] were enrolled in a LPHC intervention program (n = 23). The participants who were not ' at risk' (those who scored 4 or less) were considered the control group. The LPHC intervention program was conducted for 4-weeks. During' the 4-weeks of the intervention program the control group were instructed not to perform any LPHC exercises. At the completion of the 4-week LPHC intervention program, all participants (n = 45) were retested on the Tuck Jump Assessment. All tuck jump assessments prior to and following the LPHC intervention were assessed by the primary investigator and recorded by an athletic training student.

Participants: Forty-five youth (12.0 ± 0.58 years; 159.8 ± 13.2 cm; 54.3 ± 9.7 kg) volunteered to participate. All participants were actively involved in physical education class. Before participation, all participants were informed of all possible risks. All consent forms were completed and signed by both the participants and their parent/guardian, all of which was approved by the Institutional Review Board of the University.

Procedure: The Tuck Jump assessment was performed in the elementary school's gymnasium and recorded by two digital cameras (Flip Video, Cisco, 2011) positioned orthogonal to each other for frontal and sagittal views. Prior to the performance of the Tuck Jump Assessment, participants were instructed to start in an athletic position with feet shoulder width apart. Participants were then instructed to jump and swing arms forward and pull knees up as high as possible allowing thighs to be parallel to the ground. Once they landed, they were instructed to immediately begin their next jump. Participants were to perform as many tuck jumps in 10 seconds. Participants were evaluated as per previously criterion for the Tuck Jump Assessment [6]. Participants who scored a 5 or above on the 10-point scale were enrolled as 'at risk'. Those participants whose score matched 'at risk' were enrolled in the LPHC intervention program (n =23). Those participants, who scored a 4 or below, served as the control group. The control group did not participate in the LPHC intervention program and were instructed not to perform any LPHC exercises during the 4 weeks. After four-weeks, the Tuck Jump Assessment was conducted again on all 45 participants.

Lumbopelvic-hip Complex Intervention Program: The LPHC intervention program was performed

five days a week for four weeks under the supervision of a physical education instructor who had been trained on the program. The program consisted of two hip exercises (I] straight leg abduction, and (2] straight leg diagonal abduction (Figures 1-2) utilizing a Theraband® [yellow, red, blue or black]. Each exercise consisted of three sets of 10 repetitions and was performed bilaterally. The participants were given a demonstration by the primary investigator and instructed to move their leg in a position of abduction for 2 seconds and a position of adduction for 2 seconds [1]. Each participant was instructed on the utilization of choosing different colors of Theraband®. Participants were explained the overload principle and were encouraged to increase their resistance if their exercises felt easy. They were only allowed to change to greater resistance if they were able to complete the entire intervention regimen with no trouble or discomfort.

Results: A paired samples T-test was used to evaluate the differences in Tuck Jump Assessment scores prior to the LPHC intervention and immediately following. Alpha was set a priori < 0.0 I. Descriptive statistics are presented in Figure 3 for the intervention group. Statistical analyses were performed using SPSS 19.0 (Chicago, IL, USA). The paired sample T-test revealed there was a significant improvement in the Tuck Jump Assessment scores following the LPHC intervention program *(p* = 0.000). There were no differences reported in control group Tuck Jump Assessment Scores (Figure 4).

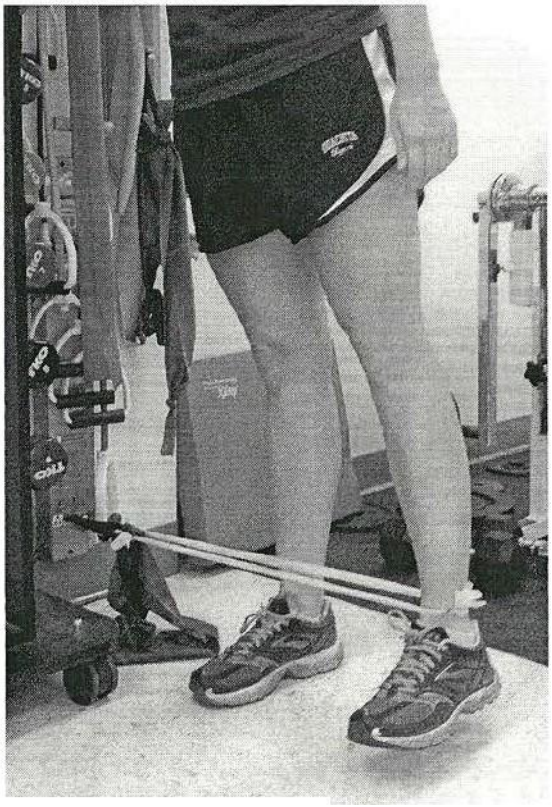

Figure 1: Straight led abduction

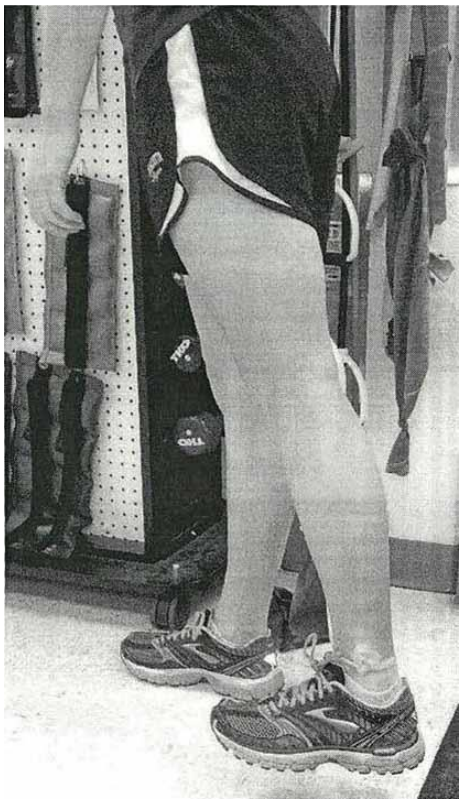

Figure 2 Straight leg diagonal abduction

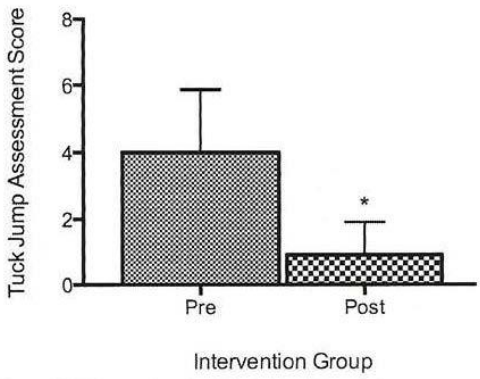

Figure 3. Means and standard deviation of intervention group pre and post Tuck Jump Assessment.

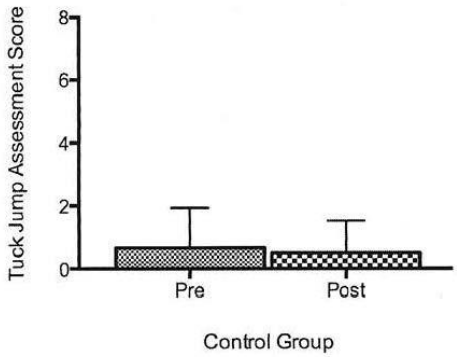

Figure 4. Means and standard deviation of the control group pre and post Tuck Jump Assessment.

Discussion: The increased participation in youth sports has led to a greater frequency and risk for injury. However, addressing and strengthening the LPHC may improve body mechanics and decrease the likelihood of injury. Strengthening the gluteus medius and minimus has been proven to support biomechanical stability in physical activity [11]. The present data support improvement in functional movement after completion of a LPHC intervention program as evident by the Tuck Jump Assessment. The significant improvement seen in the Tuck Jump Assessment suggests participants had an increase in LPHC strength and function.

A LPHC development program for youth is optimal in attempt to address muscle imbalances and postural control. Lumbopelvic-hip complex stability allows the kinetic chain to function efficiently and ensures sound movement kinematics [3]. Adequate strength of the LPHC muscles contributes to the force produced by the quadriceps and hamstring muscles during activity [11]. Lumbopelvic-hip complex strength and stability are often disregarded in youth while emphasis is placed on the upper and lower extremities. When the focus centers on strengthening of the arms and legs, muscle imbalances develop and produce inefficient forces. The implementation of a LPHC strengthening program during adolescents is time and cost effective as well as simplistic in nature. Proper instruction must be stressed to address the LPHC in an effort to not only establish a stable base of support and increase optimal body mechanics but also reduce the prevalence of injury.

Oliver and colleagues presented data suggesting increased LPHC initiation allowed for greater landing mechanics with the notion that proximal stability will enhance kinematics distally [9]. In addition, Hewett and colleagues specifically examined female athletes participating in a neuromuscular training program [2]. Results illustrated greater stability in the lower extremities. The present data supports the current literature, and it suggests that a LPHC strengthening intervention programs coupled with neuromuscular training will enhance dynamic movement patterns and ultimately reduce the prevalence of injury in youth.

Although this study aimed at predicting the effects of a LPHC intervention program youth, we were limited to our convenient sample of active youth (n = 45). All participants were in grades 6, 7, or 8 and were enrolled in a public school Health and Physical Education class. Further study could be done using interscholastic youth rather than Health and Physical Education students. This population might be more predictable for predicting positive outcomes.

Clinical Implications: Performance enhancement is often perceived as the result of muscle strength, power and endurance. While these entities are imperative to performance and functional activity, it is essential to develop a stable base of support for efficient force transfer prior to sport specialization and focus on extremity strength. In order to maximize and effectively execute functional activity, emphasis should be placed on strengthening and stabilizing the muscles of the LPHC. Implementation of LPHC protocols is simple as well as cost efficient, and it should be incorporated into physical education classes beginning early in youth development. As individuals build strength and control of the LPHC, functional movement will become safer and more mechanically sound. Sound mechanics not only extend to the lower extremity as exemplified in the current study, but movement about the kinetic chain will improve and decrease the likelihood of unfavorable actions and stress about all extremities [3]. Forces will dissipate in a more appropriate fashion and injury will be less likely to ensue. With maturation the strength and stability of the LPHC will begin to develop and allow for controlled force dissipation within the extremities. The proper progression of development will contribute to performance enhancement and safety. The combination of a LPHC strengthening program may be coupled with a neuromuscular training program that will also benefit performance and decrease the risk of injury.

Conclusion: Results of this study show an evidence-based outcome for establishing an intervention program for those LPHC instability. The authors of this study were able to demonstrate that strengthening the gluteus medius and minimus muscles improves biomechanical stability as it pertains to the Tuck Jump Assessment.

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