African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)
Supplement (March), 2012, pp. 107-119.

Self-reported incidence of injuries among ballroom dancers

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Abstract

Ballroom dancing is an increasingly popular sport around the world. However, unlike other forms of dancing such as ballet and modern, very little is known about the incidence, nature and severity of injuries sustained by dancers. The aims of this study were: 1) to quantify the incidence of injuries 2) to identify the nature of injuries; and 3) to identify potential aetiological risk factors of injury retrospectively, by means of a questionnaire, at the 2004 South African national championships. The overall incidence of injury was 0.99 per 1 000 dancer-hours. There was a statistically significant difference ($p<0.001$) between males (0.49) and females (1.45) with regard to incidence of injury per 1 000 hours of dance. Acute injuries occurred more frequently in males (80%) and chronic injuries occurred more frequently in females (54.5%). Overall, the most frequently injured anatomical sites were ankle, foot and toe (39.5%), followed by back and neck (23.3%). Males showed a relatively even distribution of injuries ($p>0.05$), whereas a statistically significant difference ($p<0.05$) was observed among females, where muscle spasms (24%) and blisters (21%) were the most frequently occurring injuries. In conclusion, dancers need to be educated about the necessity to seek medical advice when injured, and should supplement their dance training with core stability strengthening exercises and fitness training that reduce the risk of injuries and improve performance.

Keywords: Ballroom dancing, injuries, retrospective study.

How to cite this article:
Kuisis, S.M., Camacho, T., Krüger, E. & Camacho A.L. (2012). Self-reported incidence of injuries among ballroom dancers. *African Journal for Physical, Health Education, Recreation and Dance,* March (Supplement), 107-119.

Introduction

The popularity of ballroom dancing has spread beyond the borders of America and Europe, and has become a popular sport all over the world. Ballroom dancing is one of the fastest growing sports in South Africa, with approximately 920 participants registered with the Federation of Dance Sport South Africa (FEDANSA) in 2003. International standards prescribe the specific dance styles used for the differing competitive classifications in ballroom dancing. These classifications can be further divided into two distinct divisions, namely Latin and Modern. Latin dance styles include the samba, cha cha, rumba, paso doble and the jive. Modern dance styles include the waltz, tango, Viennesse waltz, slow foxtrot and the quick step (Tremayne & Ballinger, 2008).

Parkkari, Kujala and Kannus (2001) stated that sports injuries are amongst the most common injuries in modern western societies. Dance is considered to be one of the

most physically demanding activities to perform, as it combines both athletic performance and aesthetic values (Steinberg, Siev-Ner, Peleg, Dar, Masharawi, Zeev & Hershkovitz, 2011). As in other dance forms - i.e. ballet and modern dancing - injuries are also a common occurrence in ballroom dancing. Due to the very athletic and artistic nature of ballroom dancing, speed of movement, co-ordination, muscular strength and flexibility is required. There are a number of factors that may predispose dancers to injury, including: dancing experience, preparatory training (cross-training), technique training, warm-up, collisions with own partner or other couples, and open-toe shoes. The nature and the severity of injuries sustained by ballerinas and modern dancers have been well researched (Lawson, Hajducka & McQueen, 1995; DeMann, 1997; McMeeken, Tully, Stillman, Nattrass, Bygott & Story, 2001; Nilson, Leanderson, Wykman & Strender, 2001; Stein, Polatsch, Gidumal & Rose, 2002; Askling, Hund, Saartok & Thorstensson, 2002; Coplan, 2002; Bronner, Ojofeitimi & Rose, 2003; and Steinberg *et al*. 2011). However, injuries sustained by ballroom dancers have not been well documented.

The purpose of this study was to undertake a retrospective analysis of the epidemiology of acute and overuse injuries by means of a questionnaire completed by National ballroom dancers at the 2004 South African National Latin American and Ballroom Dancing Championships. The aims of the study were to quantify the incidence (number) of injuries, identify the nature (type and site) of injuries, and identify potential aetiological risk factors (causes) of injury.

Methods and Material

Subjects

One hundred and sixteen dancers voluntarily participated in the study, all of whom gave informed consent, or parental consent in the case of minors. All participants were interviewed by a biokineticist, who recorded all the information on specially prepared data sheets. The mean age of the sample was 19.7±8.3 years. A single retrospective interview was conducted, with a one-year limitation to the retrospection. The questions focused on previous as well as current injuries. Other information gathered was demographic data, other athletic activities (number of hours per week), number of years of participation (experience), number of hours spent dancing per week, anatomical site of injury, injury classification, factors related to injury - such as onset, how the injury occurred, surface on which the injury occurred, and warm-up and stretching routine. Based on the results of the questionnaire, two groups were defined: an injured group (with a self-reported history of injury) and a non-injured group (with no self-reported history of injury).

Definition of Injury

For the purpose of this study, an injury was defined as any condition sustained during practice or competition that: i) necessitated the complete cessation of participation in practice or competition; and/or ii) required treatment from a doctor, physiotherapist or biokineticist; and/or iii) absence from dancing for two or more days. All injuries were recorded on the questionnaire designed specifically for the study.

Injury Incidence

The incidence of injury was calculated in relation to exposure-time and thus expressed as injuries per dancer hours (d-hrs), i.e. the number of d-hrs as numerator and number of injuries incurred as denominator; where d-hrs was calculated as the product of the total number of dancing hours per season (practice and competition) and the number of injuries during that time. To compare the results of this study with other results in the literature, the number of injuries per 1 000 dancer-hours was also calculated, with the number of injuries as the numerator and the exposure time (per season) as the denominator, multiplied by 1 000.

Delimitation

This study did not involve a clinical examination; consequently, there was no formal diagnosis of the injury. The researcher relied solely on the memory and judgement of the subjects to self-report their injury history.

Statistical Analysis

Data of an ordinal nature was analyzed using standard descriptive statistics (mean and standard deviation) while data of a nominal nature was categorized into frequency counts and relative frequencies (percentages). Categorical inferential analyses for differences among sets of data were computed using the Chi-square statistic with alpha set at a minimum of $p \leq 0.05$.

Results and Discussion

Incidence of Injury

A total of 116 dancers were interviewed, of which 32.8% reported a current or previous injury, while 67.2% reported no injury over the previous year and had no current injury. Among the male dancers who participated in the study, 16.7% reported a current or previous injury, while 83.3% were injury free. Among the female dancers, 46.8% reported a current or previous injury, while 53.2% were injury free. Among the 38 dancers who reported an injury, 43 injuries were reported, thus indicating multiple injuries per dancer. Interestingly, multiple injuries per dancer was also reported in studies conducted on both ballet and modern dancers (Byhring & Bo, 2002; Sides & Ambegaonkar, 2009).

The mean number of hours spent dancing per week was 7.2 and 8.4 for the male and female dancers respectively (see Table 1). These results were similar to the reported 8.6 hours spent on dance per week by dance aerobics instructors (Malliou, Rokka, Beneka, Mavridis & Godolias, 2007) and considerably lower than the 30-40 hours spent on practicing and performing by national ballet dancers (Byhring & Bo, 2002). The overall incidence of injury reported was 0.99 per 1 000 hours of dance training and, more specifically, 0.49 for the male dancers and 1.45 for the female dancers. This was lower than 1.4 to 4.6 injuries per 1 000 hours exposure in ballet, figure skating, endurance sports (running and rowing), contact sports (soccer), non-contact sports (tennis, gymnastics, basketball), and explosive sports (sprinting and long jumping) (Kajer & Larsson 1992; Byhring & Bo, 2002; Bonner *et al.* 2003).

Table 1: Mean exposure hours (dance training) per week among male and female dancers

	Males	Females
Overall	7.2	8.4
Injured	7.5	10.3
Uninjured	7.9	9.2

Table 2: Incidence of injury (injury/d-hrs and injuries/ 1 000 hours)

	Injuries per dancer-hours	Injuries per 1 000 dancer-hours
Overall	1:1005	0.99
Males	1:2050	0.49
Females	1:688	1.45
Significance	$p<0.001$	

*Indicates a highly significant difference in the incidence of injuries among male & female dancers

In terms of the anatomical site of injury, a significantly high difference ($p<0.0001$) was observed for the overall group, with the ankle, foot and toe being the most frequently injured site (39.5%), followed by the back and neck (23.3%). Mouth, teeth, jaw, upper extremity and chest injuries occurred least frequently (4.7%).

Among the male dancers, however, no significant differences ($p>0.05$) were observed with regard to anatomical sites of injury. In contrast, a significant difference ($p<0.001$) was observed amongst the female dancers, with ankles, feet and toes being the most frequently injured sites (39.4%) and mouth, teeth, and jaw injuries occurring least frequently (3%) (Figure 1).

Table 3: Incidence of injury (/dancer-hours and /1 000 hours) by gender and competitive division

	Males			Females			Overall		
lvertalc	Injury/ d-hrs	Injury/ 1 000 hrs	% injured	Injury/ d-hrs	Injury/ 1 000 hrs	% injured	Injury/ d-hrs	Injury/ 1 000 hrs	% injured
Juvenile 1 (<9 yrs)	0:320	0	0				0:320	0	0
Juvenile 2 (10-11 yrs)	1:2006	0,5	11	1:1266	0,79	48	1:1513	0,66	55
Junior 1 (12-13 yrs)	1:1228	0,81	11	1:628	1,59	21	1:714	1,4	18
Junior 2 (14-15 yrs)	1:1179	0,85	22	1:1046	0,96	14	1:1091	0,92	16
Youth (16-18 yrs)	1:4186	0,24	11	1:578	1,73	10	1:1299	0,77	11
Adult (19-35 yrs)	1:1841	0,54	44	1:588	1,70	38	1:917	1,09	39
Senior (35-49 yrs)	0:1525	0	0	1:563	1,78	10	1:1072	0,93	8
Masters (50+ yrs)									
Significance	p>0,05			p<0,001			p<0,0001		

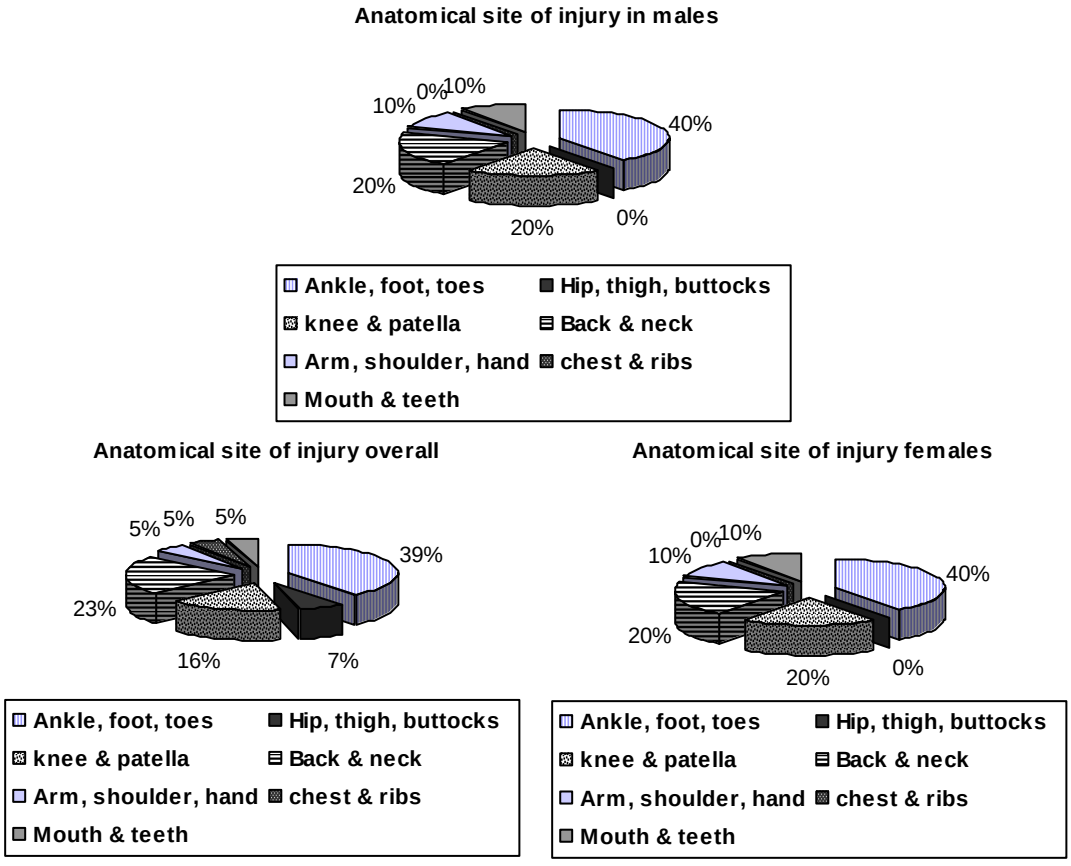
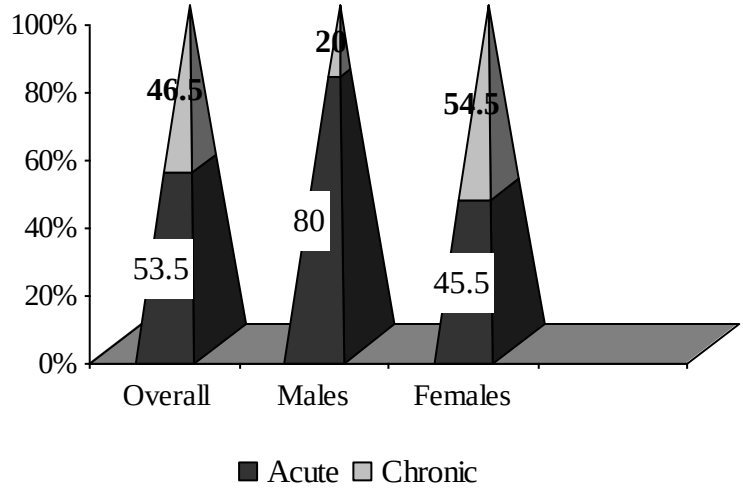


Figure 1: Anatomical site of injuries among male and female dancers

Similarly, studies conducted on both ballet and modern dancers reported that the majority of injuries reported by dancers were located in the lower extremity, specifically the ankle and foot (Byhring & Bo, 2002; Sides & Ambegaonkar, 2009). As the base of the kinetic chain, the foot and ankle undergo tremendous stress during dance, thus possibly accounting for the higher incidence of injuries in the foot and ankle in most dance forms (Peer & Dubois, 2004).

The majority of injuries reported in this study were acute in nature. Despite this, no significant difference ($p>0.05$) was found between the acute and chronic injuries reported for the overall group and among the female dancers. However, among the male dancers a significant difference ($p<0.05$) between acute and chronic injuries was observed, with acute injuries occurring more frequently. Similarly, in a self-reported study on hamstring injuries in student ballet dancers, 66% of the injuries reported were acute in nature and only 34% were chronic in nature (Askling *et al.,* 2002). When comparing the nature of injuries among the male and female dancers, female dancers had significantly ($p<0.001$) more chronic injuries than the male dancers (Figure 2.).



*p>0,05 indicating a non-significant difference between males and females with regard to acute injuries; *p<0,001 indicating a highly significant difference between males and females with regard to chronic injuries

Figure 2: Nature of injuries among male and female dancers

Table 4 indicates the type of injuries sustained by the overall group as well as by the male and female dancers. No significant difference was noted among the male dancers with regard to the types of injuries sustained. However, a significant difference ($p<0.05$) was noted among the female dancers, with muscle spasms (24%)

and blisters (21%) being the most frequently occurring injuries, and dislocations, fractures, contact and patella injuries occurring least frequently (3%). Furthermore, there were significant differences between the male and female dancers with regard to blisters ($p<0.01$) and contusions ($p<0.05$). In both cases the incidence was higher among the female dancers.

Risk Factors

Potential factors resulting in injury may be: previous dancing experience (Table 5), extracurricular (cross-) training, age, warm-up (Table 6), and stretching (Table 7). Another contributing factor to the aetiology of injury is the dancing surface (Figure 3).

Table 4: Type of injuries overall, among male and female dancers

Type	Overall (%)	Males (%)	Females (%)
Dislocation	5	10	3
Muscle pull	7	10	6
Blisters	17	0	21
Bruise	14	10	15
Fracture	5	10	3
Contact	6	10	3
Ligament injury	12	10	12
Muscle spasm			24
Patella			3
Crepitus		10	
Other	36	30	9
Significance		p>0,05	p<0,05*

* Indicates a statistically significant difference among female dancers with regard to type of injury

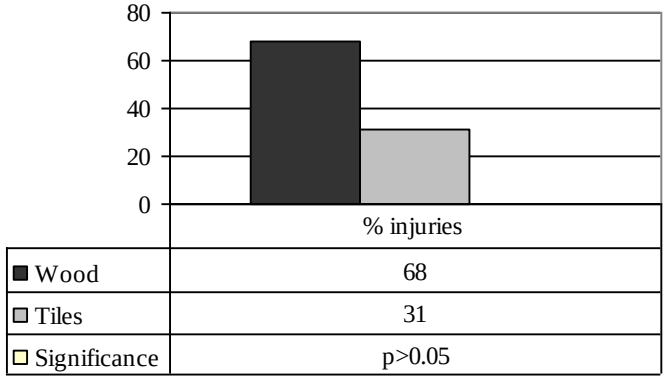


Figure 3: Percentage of injuries occurring on different dancing surfaces

Dancing Experience

Among the injured dancers, there was a significantly greater number ($p<0.0001$) of injured females than injured males. There were, however, no significant differences ($p>0.05$) between uninjured male dancers and uninjured female dancers, with regard to years of dancing experience. Among females, there were highly significant differences ($p<0.001$) between the injured and uninjured dancers with regard to years of dancing experience: injured female dancers had more years of dancing experience than the injured male dancers, and the uninjured dancers (Table 5.).

Askling *et al*. (2002) reported that injuries among ballet and modern dancers are partly due to inadequate training and that, in spite of daily practice, dancers are not properly prepared for the demands of dance performance. Bronner *et al*. (2003) stated that injuries in amateur ballet dancers are often attributed to the dancers attempting skills that they are poorly prepared for; and that injuries to professional ballet dancers are usually related to their background and training, and the choreography of their dances. This may also be true for experienced ballroom dancers, as their choreography consists of a higher degree of difficulty in terms of freedom of dance elements and skills than the choreography of less-experienced dancers who typically have more compulsory elements. Therefore, experienced dancers have to train much harder, for much longer, and more frequently than less experienced dancers, which, in turn, will increase their risk of injuries, especially overuse injuries.

Table 5: Mean years of dancing experience among male and female dancers

Variable	Males	Females	Significance
Injured	3,3	11,1	P<0,0001
Uninjured	4,9	5,1	p>0,05
Significance	p>0,05	p<0,001	

Training hours (exposure to dancing) and cross-training

Among male dancers, the average time spent on training was 7.9 hours per week, while the average time spent on cross-training was 1.9 hours per week. Among female dancers, the corresponding weekly training periods were 9.2 and 2.0, respectfully. In comparison to elite ballet dancers (both male and female), it seems that ballroom dancers tend to dedicate less hours to dancing and other forms of physical activity.

In a study conducted by McMeeken *et al*. (2001), young, elite, Australian female dancers dedicated approximately 6–40 hours per week to dancing only, and engaged in physical activity for 8–43 hours per week. Male dancers dedicated approximately 8–56 hours per week to dancing only, and engaged in physical activity for 8–57 hours.

Age

Adult male dancers had the highest percentage of injuries (44%). This could probably be attributed to the fact that adult dancers spend more hours training than younger dancers (Table 3). Adult dancers are also more competitive and serious about their dancing than juvenile and junior dancers. Among female dancers, however, juveniles (10-11 years) had the highest percentage of injuries (48%), followed by adult female dancers (38%). According to Steinberg *et al*. (2011), the pubertal growth spurt experienced by young females between the ages of 11-13 years can contribute to injuries. During this period, bones grow faster than ligaments and tendons, thus exposing the soft tissue to a higher risk of injury. Senior dancers appear to be less frequently injured, probably owing to the fewer training hours and a decline in competitiveness, as well as a tendency toward dancing for social reasons. Ross (2005) stated that the deconditioning of the musculoskeletal system results from joint injury, obesity and ageing.

According to Steinberg, Siev-Ner and Hershkovitz (2005), the type, pattern and incidence of injury in young dancers increases significantly as the dancers become older. However, Chen, Mears and Hawkins (2005) reported that athletic capacity may be sustained well into advanced age, and many physiological consequences of aging may be mitigated or reversed by regular exercise. Chen *et al*. (2005) added that tailoring athletic activity to the athlete's general health and functional requirements may be a mandate for the athlete's age-related medical and musculoskeletal problems.

Warm-up Time

Among male dancers, there were no significant differences ($p<0.05$) between the injured and uninjured dancers concerning the time spent warming up. This was also true for the female dancers (Table 6).

Table 6: Mean time (minutes) spent warming up among male and female dancers

Variable	Males	Females
Injured	14.5	18.0
Uninjured	15.8	19.2
Significance	$p>0.05$	$p>0.05$

The warm-up is generally designed to prepare the cardio-respiratory and musculoskeletal system to meet the demands of exercises (Thomas, 2000). It is believed that warming up prior to a performance or practice session prepares the muscles for higher intensity exercise by increasing local blood flow to the muscles and loosening the connective tissues to prevent injuries, e.g. muscle strains. A study conducted on aerobic dance instructors reported that the rate of injury decreased when a warm-up and cool down, as part of a class, lasted approximately 15 minutes (Malliou *et al*., 2007). Contrary to the finding of this study, Hagerman (2001) claimed that warm-up does little to prepare the muscle for higher intensity work and actually decreases the body's ability to produce maximal torque and power. He explains that while the body is able to replenish its stores of ATP (that are used during warm-up) with stored phosphocreatine, it takes approximately 8 minutes to restore 97% of the depleted phosphocreatine. Thus, if higher intensity exercise is begun within this time period, a decrease in power production and lower torque will be experienced. Hagerman (2001) also claimed that if an athlete waits until all substrates have been replenished, he or she would then again have lost any increase in local blood flow and oxygen delivery.

Stretching

Among male dancers, there were no significant differences ($p>0.05$) among injured and uninjured dancers with regard to time spent stretching. This was also true for the female dancers. However, among injured male and female dancers, there were significant differences ($p<0.01$), indicating that the injured female dancers spent longer periods of time stretching than their male peers. This trend was similar ($p<0.0001$) for the uninjured dancers (Table 7).

Table 7: Mean time (minutes) spent stretching among male and female dancers

	Males	Females
Injured	9.8	17.2
Uninjured	8.2	17.7
Significance	$p>0.05$	$p>0.05$

It has been widely accepted and promoted in sports that increasing the flexibility of a muscle tendon unit promotes better performance, reduces muscle soreness and decreases the frequency of injuries (Witvrou, Mahieu, Danneels & McNair, 2004; Ingraham, 2005). However, little or no scientific evidence supports the practice, and recent research suggests that stretching, which increases flexibility beyond what is needed for sport-specific movements, may cause injury (Ingraham, 2005; Steinberg *et al*., 2011). Askling *et al*. (2002) stated that when extensive stretching is part of a warm-up, the incidence of injury is higher. Pope, Herbert, Kirwan and Graham (2000) reported that a typical muscle stretching protocol performed during pre-exercise warm-ups does not produce clinically meaningful reductions in the risk of

exercise-related injury in army recruits. More recent research shows that general fitness, rather than stretching, is a more important and modifiable risk factor in injury prevention (Pope *et al.*, 2000; Ingraham, 2005).

Dancing Surface

This study found a significant difference ($p<0.05$) between the surfaces on which injuries occurred. More injuries (61.5%) were reported on wooden surfaces than on tiles or concrete (38.5%). Wooden surfaces are preferred to tiled and concrete surfaces because of its shock absorbing properties and are thus commonly used in the majority of dance studios. Therefore, most dancers are exposed to dancing on wooden surfaces. Despite the shock absorbing properties of wooden surfaces, when poorly maintained, it may become slippery, dusty and uneven. Thus a poorly maintained surface and higher use and exposure to wooden surfaces by dancers may contribute to the higher incidence of injuries reported on wooden surfaces. Olsen, Myklebust, Engebretsen, Holme and Bahr (2003) stated that for injury prevention, a cleaning and maintenance routine should be developed to maintain floor conditions, such as shoe – surface traction, as regularly as possible. This may possibly explain the greater incidence of injury on wooden surfaces (Figure 3).

Conclusion

Bronner *et al*. (2003) reported that the injury risk may be less in modern dancing than in ballet. In ballroom dancing ten different dance styles with different techniques are performed. As with modern dancing, they may vary in terms of the stresses imparted on the body and perhaps cause fewer muscular imbalances than when only one dance technique is used, such as turnout in ballet. This could be a possible explanation for the low incidence of injury in ballroom dancing. The intensity in ballroom dancing is high and intermittent in nature and is, therefore, less likely to place as much strain on the body as events of longer duration or higher impact, for example long holds and frequent jumps in ballet.

Another possible explanation for the low incidence of injury in this form of dancing is the number of hours that the dancers dedicate to dance training and other forms of physical activity. As mentioned previously, ballroom dancers tend to dedicate fewer hours to dance training than ballet dancers. McMeeken *et al.* (2001) reported that young ballet dancers appear to increase their risk of lower back pain when their weekly activity exceeds 30 hours.

In conclusion, dancers need to be educated about the necessity to seek medical advice when injured, and should supplement their dance training with core stability strengthening exercises and fitness training that may improve fitness parameters, reduce the incidence of injuries (Koutedakis & Jamurtas, 2004) and improve performance without interfering with key artistic and aesthetic requirements.

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