DISABILITY-RELATED INJURIES IN ATHLETES WITH DISABILITIES

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ABSTRACT

Objectives: Athletes with disabilities are highly skilled. Sports-related injuries and disorders interfere with their efforts. Several aspects of these injuries have been studied in previous studies. The aim of this study was to correlate the types of injuries with the disability group in athletes with physical disabilities.

Methods: One hundred and thirty nine elite athletes with physical disabilities completed a questionnaire about sports-related injuries that resulted in at least one day off from training or competition.

Results: All disability groups show soft tissue injuries in high percentages. Cerebral palsy (CP) athletes reported soft tissue injuries (P < 0.01) and lacerations (P < 0.001) in higher percentage than Other Disabled Athletes (ODA) and Spinal Cord Injured (SCI) athletes. Spinal cord injured athletes sustained fractures (P < 0.05) and blisters (P < 0.05) in higher percentages than the other groups. No differences were found between the studied groups for contusions, low back pain, ruptures, thermoregulation disorders, urinary tract infections, pressure sores and pneumonias.

Conclusion: CP athletes sustained soft tissue injuries and lacerations more than other disability groups did because moving and walking patterns of this population add risk factors for such injuries. Fractures and blisters occur more frequently to SCI athletes because they participate in higher percentage in wheelchair basketball which is high risky sport.

Key words: sports for the disabled, athletic injuries, illnesses, disabled athletes

INTRODUCTION

Previous studies have investigated the frequency and types of injuries in athletes with disabilities. Some of them have focused on risk factors that influence the frequency and types of injuries. Curtis and Dillon measured and described the prevalence and incidence of injuries that occurred in wheelchair athletes. They reported that 33% of the injuries sustained by disabled athletes were soft tissue injuries and most of the responding athletes (72%) reported at least one injury during their participation in sports. The majority of injuries were associated with wheelchair track (26%), basketball (24%) and road racing (22%). Burnham et al. reported that 51% of the injuries sustained by the 151-member 1988 Canadian Paralympic team were musculoskeletal, 49% were acute, and the shoulder, low back and knee were the most common injured regions. Ferrara & Davis reported that almost half (48%) of the total injuries sustained by elite wheelchair athletes were strains and muscle injuries, and 22% were abrasions. Ferrara et al. in a cross-disability retrospective injury survey of 426 National Wheelchair Athletic Association (NWAA), United States Association for Blind Athletes (USABA) and United States Cerebral Palsy Athletic Association (USCPAA) athletes reported that 32% of the respondents had at least one sport-related injury. Shoulder and arm/elbow region injuries accounted for 57% and 53% of total injuries of NWAA and USABA groups, respectively. Ferrara and Buckley reported that 63 of the 128 reported injuries in 319 athletes from different disability organizations were sprains and strains. They also reported that the majority of the moderate time-loss injuries (24.3%) were illnesses, the majority (25%) of major time-loss injuries involved the shoulder and 40.3% of the injuries sustained by Wheelchair Sports – USA (WSUSA)
athletes were minor. Davis and Ferrara\textsuperscript{6} reported that wheelchair-dependent athletes sustained primarily upper extremity injuries (65\%), visual impaired athletes sustained primarily lower extremity injuries (53\%), and athletes with cerebral palsy sustained a more equal distribution of injuries across the upper (43\%) and lower (44\%) extremities. Nyland et al.\textsuperscript{7} reported that the most common injury region for Disabled Sports – USA (DSUSA) athletes was shoulder (26\%), for USABA – the hip and thigh (21\%), for USCPAA athletes it was lumbar region, and for WSUSA athletes - shoulder (18\%). Taylor & Williams\textsuperscript{8} investigating the incidence of injuries in wheelchair racers reported that training variables such as distance pushed per week, the amount of speed training, the number of weight training sessions and the length of time the athlete had been involved in wheelchair racing were not associated with the occurrence of an injury. Wilson & Washington\textsuperscript{9} surveying 83 junior wheelchair athletes reported that 97\% of participants in track, 22\% of participants in field and 91\% of participants in swimming had at least one injury. Establishing the aetiology and injury mechanisms and identifying preventive measures are two of a 4-step approach to sport epidemiology suggested by Van Mechelen et al.\textsuperscript{10}

Our study investigates the relationship between the different disability groups, as a risk factor, and the type of injuries in Greek athletes with locomotor disabilities participating in paralympic sports. The study was conducted during the 2000 Panhellenic Championship for Athletes with Disabilities that was held in Athens as the final qualification test for the 2000 Paralympic Games in Sydney.

METHODS

This study is a retrospective survey. A questionnaire was distributed to 180 athletes with locomotor disabilities. One hundred and thirty nine athletes responded. In the first part of the questionnaire there were questions concerning demographic variables such as age, sex, years since the onset of the disability, type and cause of disability, sports participation history and finally training status. The second part dealt with only sports-related injuries and illnesses experienced in athlete’s sports life. Athletic injury was defined as «any injury that caused an athlete to stop, limit or modify participation for 1 day or more» and was based on the definition used by Ferrara et al.\textsuperscript{4} In this part of the questionnaire the subjects were asked to report the site of injury, history, signs and symptoms of the pain in any body part, shown in a body figure, the mechanisms of injury sustained, the period (training or competition) when the injury occurred. Athletic injuries were defined as soft tissue injuries, fractures, contusions, lacerations, blisters, ruptures, low back pain, and sports-related illnesses were defined as pressure sores, thermoregulation disorders, urinary tract infections and pneumonia. Soft tissue injuries were defined as muscle-pulls, sprains, strains, bursitis and tendinitis.\textsuperscript{1} Athletes were divided in three major groups according to International Paralympic Committee (IPC). Athletes with spinal cord injury and with poliomyelitis compete under the rules of the International Stoke Mandeville Wheelchair Sports Federation (ISMWSF) and we consider them as Spinal Cord Injured (SCI). Athletes with cerebral palsy and with acquired brain injury (CP) belong to the Cerebral Palsy - International Sports and Recreation Association (CP-ISRA). Finally, athletes with amputations and with other disabilities like arthrogryposis, dysmelias, dwarfism, etc, belong to the International Sports Organization for the Disabled (ISOD). In this study athletes belonging to ISOD are considered as Other Disabled Athletes (ODA). Chi-square test was used to correlate the three major disability groups with the type of injury and/or illness.

One hundred and fifteen men (82.7\%) and 24 women (17.3\%) took part in the study. The mean age of the athletes was 32.8 ± 8.6 years with a range of 16 to 56 years. Athletes averaged 24.5 ± 12.5 years since onset of disability ranged from 3 to 56 years. There were 75 SCI (14 tetraplegics, 32 paraplegics, 29 polio survivors) all wheelchair-bound, 33 CP athletes (18 ambulatory, 15 wheelchair-bound), and 31 ODA (10 upper limb amputees, 11 lower limb amputees and 10 «Les Autres»). «Les Autres» athletes included 1 with congenital dislocation of the hip, 1 with ankylosing spondylitis, 2 with brachial plexus paralysis, 1 with myopathy, 2 with polyneuropathy, 1 with Charcot Marie Tooth, 1 with arthrogryposis, 1 with clubfoot (Table 1).

RESULTS

The athletes competed in 6 paralympic sports. Eighty-six (61.9\%) athletes participated in one sport and 53 (38.1\%) in two and more different sports. Sports participation history and sports related injuries are shown in Table 1.

There were 178 injuries reported by 69 athletes of all the disability groups. 27 athletes reported one injury; the rest 42 athletes reported from 2
up to 10 injuries. Seventy five SCI reported 110 injuries (1.47 per athlete), 31 ODA athletes reported 36 injuries (1.16 per athlete), and 33 CP athletes reported 32 injuries (0.97 per athlete). A total of 30.9% of injuries were associated with Wheelchair Basketball, 23% with Standing track and field events, 19.1% with swimming and 18% with wheelchair field events.

Soft tissue injuries accounted for 58.9% of all injuries. The frequency of injuries in each disability group in descending order shows that the most common injuries for SCI were soft tissue injuries (STI) (51.8%) and fractures (10.9%). For ODA were STI (61.1%) and thermoregulation disorders (11.1%). For CP athletes were STI (81.3%) and lacerations (9.4%) (Table 3).

CP athletes had soft tissue injuries in 81.3% that is higher than ODA and SCI (p < 0.01) and lacerations in higher percentage (9.4%) than DA (2.8%) (p < 0.001).

SCI group sustained fractures in higher percentage (10.9%) than ODA (2.8%) and CP athletes (p < 0.05). They had a higher percentage of blisters (10%) than CP group (3%) and ODA group who had no blisters. SCI sustained also urinary tract infections in 6.4%, pressure sores in 0.9% and pneumonia in 0.9% whereas other disability groups sustained none of these injuries/illnesses but without statistical significance.

The competitive season accounted for 78 (43.8%) injuries and training period accounted for 100 (56.2%) injuries with no differences among the disability groups (p > 0.05) (Table 4).

**DISCUSSION**

CP patients are not a homogenous population; they range from severe spastic quadriplegia to moderate hemiplegia and to minimal athetosis. Similarly, wheelchair users range from complete tetraplegics to ambulatory polio survivors who compete in wheelchair. ODA include upper limp amputees and lower limb amputees. In each disability group, the disability categories show different athletic performances and different movement patterns. Ferrara and Peterson¹¹ believe that this is the main problem in defining the population of the study and interpreting the results. They suggest that each category should be studied separately. But the limited number of

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**Table 1.** Demographic data for each disability group of athletes

<table>
<thead>
<tr>
<th>Disability group</th>
<th>Number of athletes</th>
<th>Age mean ± SD</th>
<th>Male mean ± SD</th>
<th>Female mean ± SD</th>
<th>Years disabled mean ± SD</th>
<th>Years participating in sports for the disabled mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal cord injured</td>
<td>75</td>
<td>34.56 ± 8.3</td>
<td>61</td>
<td>14</td>
<td>24.10 ± 13.6</td>
<td>7.86 ± 5.7</td>
</tr>
<tr>
<td>Cerebral Palsy</td>
<td>33</td>
<td>29.69 ± 7.4</td>
<td>27</td>
<td>6</td>
<td>27.66 ± 8.6</td>
<td>6.15 ± 4.5</td>
</tr>
<tr>
<td>Other disabled athletes</td>
<td>31</td>
<td>31.90 ± 9.1</td>
<td>27</td>
<td>4</td>
<td>22.29 ± 12.8</td>
<td>6.90 ± 3.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>139</strong></td>
<td><strong>32.8 ± 8.6</strong></td>
<td><strong>115</strong></td>
<td><strong>24</strong></td>
<td><strong>24.54 ± 12.5</strong></td>
<td><strong>7.24 ± 5.0</strong></td>
</tr>
</tbody>
</table>

**Table 2.** Sports participation history and related injuries

<table>
<thead>
<tr>
<th>Sport</th>
<th>Number of athletes participating</th>
<th>Number of injuries</th>
<th>Percentage of injuries (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheelchair basketball</td>
<td>34</td>
<td>55</td>
<td>30.9</td>
</tr>
<tr>
<td>Standing track &amp; field</td>
<td>35</td>
<td>41</td>
<td>23</td>
</tr>
<tr>
<td>Swimming</td>
<td>51</td>
<td>34</td>
<td>19.1</td>
</tr>
<tr>
<td>Wheelchair field</td>
<td>57</td>
<td>32</td>
<td>18</td>
</tr>
<tr>
<td>Gym</td>
<td>27</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Wheelchair track</td>
<td>7</td>
<td>7</td>
<td>3.9</td>
</tr>
<tr>
<td>Power lifting</td>
<td>6</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Wheelchair dancing</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shooting</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>178</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Participants and the limited number of injuries in this study made it difficult to analyse statistically each disability category such as high paraplegics, tetraplegics, hemiplegics and lower extremity amputees. Therefore, we classified the athletes in three major groups.

Many physically and cognitively challenged athletes participate in organized and recreational sports. Health benefits of sport participation by athletes with disabilities have been well recognized. Some conditions in these athletes, such as problems with thermoregulation, autonomic control, neurogenic bladder and bowel, latex allergy, and many associated and secondary complications deserve special consideration.12 Investigating the incidence of each type of injury among the disability groups we found that soft tissue injuries were the most common injuries of all groups and among each disability group which is in accord with the findings of previous reports.1,3,5 CP athletes had soft tissue injuries in higher percentage than ODA and SCI and this result is statistically significant. Wheelchair users suffer from overuse syndromes of the upper extremities especially in the shoulder due to vigorous training, competing efforts and improper or continuous propulsion technique. CP athletes who are wheelchair-bound, despite the usual causes for STI present limited range of motion, spasticity and discoordination which add stresses to muscles, joints and tendons even in the lower extremities. Even ambulatory CP athletes have the same risk factors for developing STI. These factors enhance the possibility for STI and explain why CP athletes, wheelchair–bound and ambulatory, suffer from STI more than the other disability groups. Prevention methods for STI are routine stretching, warm-up, cool-down which are critical for CP athletes.1

SCI athletes sustained fractures in higher percentage than the ODA athletes. Nine of 12 fractures...
sustained by SCI occurred in basketball, two in swimming and one in power-lifting. Wheelchair basketball is the sport with the highest risk for fractures as reported by another study. In our study, SCI accounted for 79.4% of all the basketball players injuries. This suggest that SCI athletes are more susceptible to fractures in basketball due to severe osteoporosis. Scaphoid fracture occurred in a paraplegic patient during power-lifting due to overextension of the wrist joint during a vigorous lift suggesting that improper lifting technique is the cause of this fracture.

Almost half of the blisters of the SCI athletes occurred in wheelchair track events and half occurred in wheelchair basketball that are sports with the highest risk for blisters. SCI sustained blisters in 10% of all injuries that is almost half of the 18% reported by Curtis and Dillon, triple than the 6% reported by Ferrara and Davis. In our study blisters seems relevant only to wheelchair sports due to friction, shearing forces and irritation from repeated contact with other objects, like the handrim of a wheelchair. This is in accordance with previous studies which have reported that the use of wheelchair is the main cause of blister formation.

CP athletes reported ruptures in higher percentage than ODA. Ruptures occurred in lower limbs of ambulatory CP swimmers and in wheelchair-bound CP swimmers who are able to walk with a little help to reach the swimming pool. They also occurred during standing track events. This suggests that the cause is the typical spastic walking and running pattern of the CP athletes. Analysing the frequency distribution of contusions, low back pain and ruptures, with statistically insignificance (p > 0.1), we found no significant difference between the studied groups.

Urinary tract infections, pressure sores and pneumonia, illnesses occurring mainly to SCI individuals, were studied here as sports-related injuries. Only SCI group sustained these illnesses in our study although these results cannot be statistically interpretable due to missing observations. In our study, 85.7% of urinary tract infections were associated with field events and were reported by one complete tetraplegic who had limited fluid intake during competitions. Only one pressure sore was reported in a tetraplegic athlete in a wheelchair marathon race. Only one case of pneumonia occurred in a T12 paraplegic who was training in field events during the winter. A study on the types and risk factors of injuries sustained by athletes with disabilities reported a total of 39 injuries (9% of the Paralympic athletes) in athletes competing in adapted winter sports at elite level. Most of these injuries were of acute, traumatic onset and involved the disciplines of alpine skiing and sledge hockey. Sprains (32%), fractures (21%), and strains and lacerations (14% each) were the most common; eight (21%) resulted in time lost from training or competition. Although the injury patterns observed among winter Paralympians are not appreciably different from able-bodied athletes competing in similar disciplines, in many instances the risk factors for sport-specific injury appear to be unique to disabled or adapted competition, and several of the more severe injuries are potentially preventable.

Hyperthermia and hypothermia are thermoregulation disorders that mainly occur in SCI patients due to lack of normal control of body temperature. But in our study, SCI athletes did not contribute more to overall thermoregulation disorders. We found that hyperthermia (all cases in field events) was reported in one athlete with poliomyelitis, two lower extremity amputees and one hemiplegic. Hypothermia (all cases in swimming) was reported in three athletes with poliomyelitis, one upper extremity amputee and one swimmer with Charcot-Marie-Tooth disease. Decrease in sensory awareness, sympathetic nervous system dysfunction and deficiency of body mechanisms to regulate heating and cooling are other factors causing these disorders. These factors may be common in all disability groups and this is the explanation for our findings suggesting that all groups are susceptible to these disorders.

Resting energy expenditure of persons with a spinal cord injury (SCI) is generally lower than that seen in able-bodied individuals due to the reduced amounts of muscle mass and sympathetic nervous system available. In order to predict the energy expenditure of persons with SCI, the generation and validation of prediction equations in relation to specific levels of SCI and training status are required. Specific prediction equations for the SCI would enable a quick and accurate estimate of energy requirements. When compared with equivalent able-bodied individuals, sports energy expenditure is generally reduced in SCI with values representing 30-75% of able-bodied values. The lowest energy expenditure values are observed for sports involving athletes with tetraplegia and
where the sport is a static version of that undertaken by the able-bodied, such as fencing. As with able-bodied sports there is a lack of SCI data for true competition situations due to methodological constraints. However, where energy expenditure during field tests is predicted from laboratory-based protocols, wheelchair ergometry is likely to be the most appropriate exercise mode. The physiological and metabolic responses of persons with SCI are similar to those for AB athletes, but at lower absolute levels. However, the underlying mechanisms pertaining to substrate utilization appear to differ between the able-bodied and SCI. Carbohydrate feeding has been shown to improve endurance performance in athletes with generally low levels of SCI, but no data have been reported for mid to high levels of SCI or for sport-specific tests of an intermittent nature.18

Little research exists on sports injuries to young athletes with disabilities.19 In a study in high school athletes with disabilities, 38 injuries were reported (2 per 1000 athletes); soccer (3.7 per 1000) had the highest rate of injury, including mostly abrasions and contusions. At highest risk for injury were athletes with autism, history of seizures, and starters. This information may provide the physicians and trainers the rationale to stratify a protocol for preparticipation medical examination of these athletes, to create special guidelines, particularly for athletes with autism and seizure history.19 Moreover, little is known about sport nutritional problems and requirements of athletes with physical disabilities. Since proper nutrition is important for both performance and injury healing, learning about the nutritional areas in which athletes with disabilities are deficient may assist professionals in educating them.20

In conclusion, in this study we present disability-related sports injuries in athletes with disabilities. CP athletes sustained soft tissue injuries and lacerations to a greater degree than other disability groups did because moving and walking patterns of this population add risk factors for such injuries for them. Fractures and blisters more frequently occur to SCI athletes. No differences exist between the three disability groups for thermoregulation disorders, contusions, low back pain and ruptures. A careful preparticipation evaluation and proper classification of athletes ensures safe sports participation by athletes with disabilities. Urinary tract infections, pressure sores and lacerations although disability-related, need more studies.

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REFERENCES
ÍНВАЛИДНОСТЬ И СВЯЗАННЫЕ С НЕЙ РАНЕНИЯ У СПОРТСМЕНОВ С ПОВРЕЖДЕНИЯМИ

Д. Пататукас, А. Фармакидис, В. Агели, С. Фотаки, Х. Цибидакис, А. Маврогенис, Я. Папатанасиу, П. Папагелопулос

РЕЗЮМЕ

Цель: Травмы при спорте и болезни ограничивают усилия спортсменов. В прежних исследованиях изучены различные аспекты этих ранений. Настоящая работа ставит себе целью сопоставить виды ранений с отдельными группами повреждений у спортсменов с поражениями.

Методы: 139 элитных спортсменов с повреждениями заполняют вопросник (вопросы касаются спортивных травм, что отнимает у спортсменов хотя бы один тренировочный или состязательный день).

Результаты: Среди всех групп повреждений особо большой процент мягких повреждений. У спортсменов с церебральным параличом (CP) зарегистрированы мягкие повреждения (P < 0.01), как и разрывы (P < 0.001) в более высоком проценте по сравнению с остальными спортсменами с повреждениями и спортсменами с спинномозговыми травмами (SCI). Спортсмены с спинномозговыми травмами получают фрактуры (P < 0.05) и ушибы (P < 0.05) в большем проценте по сравнению с другими группами спортсменов. Не существуют разницы между обследованными группами относительно контузий, болей в пояснице, разрывов, терморегуляционных нарушений, инфекций мочевой системы, компрессионных ран и пневмоний.

Заключение: Ранения и разрывы мягких тканей наблюдались чаще у спортсменов с церебральным параличом, чем у спортсменов других групп инвалидности, так как двигательные модели у этой группы добавляют факторы риска для этих ранений. Фрактуры и ушибы чаще получают спортсмены с спинномозговыми травмами из-за того, что эти спортсмены в большем проценте играют в баскетбол в инвалидных креслах, что является спортом высокого риска.