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Prevalence of sports-related injuries in Paralympic judo: an exploratory study

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ABSTRACT

Objectives: The aim was to assess the 1-year retrospective prevalence of athletes reporting a sports-related injury among Paralympic judokas with visual impairment (VI), and to identify any associations between injury, vision class, gender and weight category.

Design: Cross-sectional retrospective study.

Methods: The data were collected through an adapted questionnaire given to athletes with VI during an international training camp. Forty-five Paralympic judokas answered the questionnaire. Descriptive statistics and chi-square statistics ($p<0.05$) were used to analyse the data. Spearman's correlation was used to analyse multiple injuries.

Results: Thirty-eight of the athletes reported an injury, giving a 1-year prevalence of 84% (95% CI 71-93). Male athletes reported significantly more injuries compared to female athletes ($p=0.023$). Over two thirds of the injuries (71%; 95% CI 55-83) had a traumatic onset. The majority of injuries (74%; 95% CI 58-85) occurred during judo training, and in the standing technique tachi waza (82%; 95% CI 66-91). The shoulder was the most single affected body location (29%). Forty-five percent of the injuries led to a time loss from sport for more than three weeks, and 40% of judokas reported multiple injuries.

Conclusions: The results from this study demonstrate a high prevalence of mainly traumatic and severe sports-related injuries amongst athletes with VI participating in Paralympic judo. A first step towards prevention could be to minimize the time in tachi waza. However, to improve sports safety and to develop effective strategies for injury prevention, more comprehensive epidemiological studies, and also technical studies assessing injury mechanisms are warranted.

Keywords: Sports for persons with disabilities; Judo; Paralympic Judo; Sports injuries; Epidemiology; Visual impairment

INTRODUCTION

Whilst mainstream judo is an established combat sport, Paralympic judo is a much younger sporting discipline. It made its Paralympic debut during the 1988 Paralympic Games for men and 2004 for women, and is exclusively for athletes with visual impairment (VI). Similarly to Olympic judo, athletes in Paralympic judo ("Paralympic judokas") are divided into gender and weight categories. In addition, Paralympic judokas are classified into three vision classes (B1, B2, B3) depending upon their visual impairment. Interest in the sport is steadily growing, with increasing numbers of partially sighted and blind athletes participating each year.[1]

At the time of writing it is estimated that around 253 million people worldwide are visually impaired, of whom 36 million are blind.[2] Individuals with a disability have been shown to be less active in sporting pursuits, and to have lower fitness levels compared to able-bodied individuals.[3] Individuals with VI also have a higher risk of mortalities through accidents and falls.[4] In conjunction with other medical issues sometimes associated with VI (including deafness, obesity, joint problems, development delay and diabetes)[5], the loss of vision may have a deleterious impact on aspects of daily life. Factors such as; mobility, employment, studying, socializing, and leisure pursuits are all likely to be compromised.[6]

To enhance the health of persons with VI, sporting participation is recommended due to the potential physical, psychological, and social benefits this confers.[3] Participation in sports is, however, not without risk. Injuries are a concern in all sports, often leading to a decrease in performance, and sometimes also morbidity and mortality.[7] Data from judo in able-bodied athletes has shown that these athletes are prone to a range of injuries,[8] however to date there has been little focus given towards injuries in Paralympic judo. Recent studies have shown that Paralympic athletes suffer from more injuries compared to their Olympic counterparts,[9] [10] and this is especially pertinent in VI sport.[9] Yet, few studies have assessed the specific injury burden in Paralympic judo, which is a barrier to injury prevention, as epidemiological research and periodic health

evaluation on the aetiology of sports injuries is required to target vulnerable athlete groups and to better understand the risks associated with each sport.[7]

Given the absence of existing studies examining sports injuries in Paralympic judo, an exploration is warranted in order to move towards safe sports participation for athletes already having an impairment. The aim of this study was to assess the 1-year retrospective prevalence of athletes reporting a sports-related injury among Paralympic judokas with VI, to describe the mechanism, type and severity of injury, and to identify any associations between injury, vision class, gender and weight category.

METHOD

This study used a cross-sectional descriptive design to examine the retrospective 1-year prevalence of self-reported sports-related injuries among elite Paralympic judokas with VI. The use of prevalence allows for the examination of the frequency of a specific outcome in a certain population at one specific time, with data providing an indication of the overall burden of injury and future research directions.[11 12] The study design further provides an estimate in the need for athlete and medical resources, athlete availability prior for example a competition and future research directions.[11 13] Primary outcome measures for this study were; proportion of athletes with an injury, total number of injuries and mechanism, type and severity of injury. Data were collected during an international training camp in Birmingham, United Kingdom in June 2016

following the “Great Britain VI Grand Prix”. The Grand Prix organisation committee and judo coaches were informed about the study prior to the training camp, and athletes were recruited during the first day of the training camp. The data collection was completed and ethically approved within the framework of a bachelor thesis written by a blind student (xx) at Xxxxxxx University. The study follows the World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects, and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

70 athletes from fifteen countries attended the international training camp. All athletes were invited to participate in the study during an oral information session given to athletes, coaches and guides by XX and XX prior to the start of the training camp. The inclusion criteria were as follows:

1. being a judoka with an international visual classification B1, B2 or B3 granted by the International Blind Sport Federation (B1: a very low or no vision, visual acuity lower than LogMAR 2.6; B2: visual acuity ranging from LogMAR 1.5 to 2.6 (inclusive) and/or visual field constricted to a diameter of less than 10 degrees; B3: the least severe visual impairment eligible for Paralympic sport. Visual acuity ranging from LogMAR 1.4 to 1.0 (inclusive) and/or visual field constricted to a diameter of less than 40 degrees.)[1]

2. being able to communicate in English;
3. present at the international training camp.

Participation in the study was voluntary and informed consent was collected from all participants. 45 athletes agreed to participate in the study. Ten athletes were excluded because they could not communicate in English, and 15 athletes did not respond to the invitation. The questionnaire was delivered during the training camp, and because of the different severity of athletes´ VI, athletes were given the opportunity to choose how to enter their data via three different platforms. The options were:

i) enlarged text on paper;
ii) iPad entry with speech synthesizer;
iii) Computer with Braille and speech synthesizer.

The questionnaire used in this study is developed and adapted to Paralympic athletes in accordance with the Web Content Associability Guidelines, and it has been evaluated in a feasibility and usability study [14 15]. The athletes were first asked demographic questions (age, gender, weight category, visual classification, hours of training/week and involvement in other sports). The athletes were then asked about any previous sports-related injuries (self-

reported) in the previous year. To include types of both traumatic and overuse injuries, a sports injury was defined and questioned to the athletes as:

"Have you had any new musculoskeletal pain, feeling or injury during the past year that caused changes in normal training or competition to the mode, duration, intensity, or frequency, regardless of whether or not time is lost from training or competition".[15]

If the participant reported an injury, they were asked additional questions including: time loss from training; type of injury; injury mechanism (standing technique "tachi waza", ground technique "newaza" or other situation); body location; diagnosis; and contribution of VI to the injury.[15] [11] Severity of injury was measured by the number of days of absence from training, reported as: "minor" (0–3 days), "mild" (4–7 days), "moderately serious" (8–21 days), "serious" (>21 days-3 months), and "long-term severe" (>3 months) and "catastrophic".[11] Each self-diagnosed injury was categorised by the authors using a matrix for classification of musculoskeletal diagnoses into body location, injury type and diagnosis (as per the 10th revision of the International Statistical Classification of Disease and Related Health Problems (ICD-10)).[16] Each athlete could report multiple injuries from different time periods and in different body regions, but only one (the most severe injury with longest time loss) was used in the main prevalence analyses, as prevalence is a measure of

disease status measuring the proportion of athletes that had an injury during the last year. [13]

The data were assessed for normality, and quantitative descriptive statistics (median, interquartile range (IQR), min-max, frequency and proportion) were used. A 95% confidence interval (CI) was used in the prevalence analyses. Differences in prevalence proportions and homogeneity between different subgroups (age-group, gender, vision class (B1, B2, B3 and B1 compared to B2 and B3), weight category (low or heavy), hours of training and involvement in other sport) was analysed using the non-parametric Pearson chi-square test ($p<.05$), with Cramer's V as a measure of effect size. Fisher´s exact test was used to interpreted contingency tables with numbers <5[17] As many athletes reported multiple injuries, and therefore also multiple absence from sport, these injuries were further analysed. Total days of absence due to injury was established for those who reported more than one injury. An estimated score of total days of absence from sport participation due to injury was estimated at the predetermined time intervals, and the median in each time interval was used as the number of each absence period. Relationships between total days of absence from sport due to injury, and weight category and vision class were calculated with Spearman's correlation coefficient. The data were analysed using IBM SPSS Statistics 24.

RESULTS

A total of 45 athletes responded to the questionnaire, and the demographic data from this are presented in Table 1. The median duration of weekly judo practise was 12 hours (interquartile range (IQR) 10-20, min-max 6 hours-40 hours). Athletes with the most severe impairment (B1) practised judo for 12 hours (IQR 9-17), the middle group B2 for 10 hours (IQR 8-22), and athletes with most vision (B3) for 16 hours (IQR 10-22). Almost one third of the athletes (29%) were also involved in sports other than judo.

Overall, 38-athletes reported a sports injury, giving a 1-year prevalence of 84% (95% CI 71-93). Significantly more males reported an injury compared to female athletes (p=0.023) (Table 1). No other significant differences in prevalence proportion were detected between vision class, blind versus partially sighted athletes, weight category, light versus heavy weight, age-group, involvement in other sports, contribution of the impairment and hours of judo training/week.

Of these injuries, over two thirds (71%; 95% CI 55-83) had a traumatic onset, with the remaining 11 injuries (29%; 95% CI 17-45) being of a non-traumatic overuse-related origin. The majority of injuries (74%; 95% CI 58-85) occurred during judo practise. Regarding onset of injury, 21% occurred (95% CI 11-37) during judo competition, and 5% (95% CI 0-19) during other training. Most of the injuries (82%; 95% CI 66-91) occurred in tachi waza, with far fewer occurring in either newaza (13%; 95% CI 21-50) or in other situations (5%; 95% CI 0-19). For six of the injuries (16%; 95% CI 7-31), the athletes reported a

direct link in the injury mechanism to their vision impairment. Of all injuries, 39% occurred to the upper extremity, with the shoulder girdle being the most single affected body location (29%), followed by elbow/upper arm (5%) and hand/fingers (5%). Overall, 42% of the injuries occurred in the lower extremity, and were spread almost evenly between the hip/groin (13%), knee/lower leg (18%), and foot/toe (11%). The remaining (18%) of the injuries were to the spine and were located at the cervical/thoracic spine (11%), head/face (5%), and lumbar spine (3%). The most common diagnoses of injury were related to traumatic sprains/strains/ruptures in the lower extremity (26%), followed by contusions in the vertebral column and head (11%) and inflammation and pain (11%) and joint derangement (11%) in the shoulder (Table 2). Several serious injuries with a diagnosis such as concussion, retinal detachment, hip joint dislocation, ankle fractures and anterior-cruciate ligament injuries were also disclosed. The time-loss from sport and severity of injury were as follows; >3 months severity long-term (24%), >21 days severity serious (21%), 8-21 days severity moderately serious (24%), 4-7 days severity mild (11%), 0-3 days severity minor (n=20%).

Concerning multiple injuries, 18 athletes (40%) reported multiple injuries (Table 3). In total, 70 injuries were reported giving an overall estimation of 1.6 injuries/athlete during one year. Of these 70 injuries, 43 injuries (61%) were traumatic and 27 injuries (39%) were related to non-traumatic overuse. The

most common body locations for these injuries were to the shoulder and knee/lower leg.

A weak significant relationship (r = 0.399) was seen between total absence from sport due to multiple injuries and vision class, where the lowest vision class (B1) contained judokas with the lowest total time loss absence due to injury (p=0.007). No significant relationships could be seen between total absence due to multiple injuries and weight category or age-group.

DISCUSSION

The results from this study revealed a high 1-year prevalence (84%) of mostly traumatic and severe sports injuries amongst athletes participating in Paralympic judo. Similar cross-sectional studies amongst able-bodied athletes participating in judo have reported lower injury prevalences, ranging from 13-29%.[18] Paralympic judo has also been highlighted following the recent Paralympic Games in 2016 and 2012 as one of the sports with a higher injury proportion (16.5%) and (21.7%) compared to other Paralympic sports.[9,10] When compared to judo at the Olympic Games 2012 and 2008, Paralympic judo had higher injury proportions.[18]

Of particular concern is that the majority of the injured athletes reported that they had a traumatic injury, with almost half of the injuries leading to a time loss of greater than 21 days, indicating that many athletes suffered

from severe injuries. Common consequences of this are loss of training time, strength, cardiovascular capacity, performance and a decrease in psychological well-being.[7,19] Similarly to studies of able-bodied judokas, sprains, strains and ruptures were the most common injury diagnoses.[18] Previous studies within Paralympic sport have shown that the number of overuse injuries are as common as traumatic injuries.[9,10,20] Further studies are thus needed to examine if Paralympic judokas are more exposed to traumatic injuries compared to other Paralympic athletes.

Regarding body locations, the shoulder girdle was the most injured body location in this study, followed by the knee/lower leg. Among able-bodied athletes similar results have been reported. [8,18,21] To prevent traumatic injuries in these joints, which commonly lead to long-term consequences such as osteoarthritis,[22] it has been recommended to improve falling skills and athletes´ levels of strength and flexibility.[18] Of concern is also that 16% of the athletes in this study reported a traumatic injury to the spine/head. Such injuries may lead to devastating consequences, including paralysis and neuropathological changes.[23] Severe head and spine injuries are a problem also in able-bodied judo, and it has been recommended to conduct neuromusculoskeletal examinations, neck muscle training along with injury surveillance and video analysis for preventing these injuries [24]. Such strategies as well as guidelines for the acute handling, rehabilitation and return to sport is recommended to also be implemented in Paralympic judo. In this study it was also seen that significantly

more men reported injuries. Studies among able-bodied judokas have reported inconsistent findings regarding sex differences[18] , and the studies from the Paralympic Games are not gender and sport specific. Thus, further studied assessing sex differences is needed[9].

Most injuries in this study occurred during training. Also, when studying able-boded judokas, higher injury risks during training were seen compared to competition.[21,25] A concern is that not all athletes have medical support during training, and the risk for catastrophic events may therefore be even greater. It is noteworthy that most injuries occurred in tachi waza, indicating that future studies should further assess techniques, throws and falls. Based on the results it could be recommended to minimize time in tachi waza, and to ensure appropriate safety and medical support when practicing in tachi waza. An implementable prevention strategy could be to allow matches continue into newasa more easily, to avoid excessive time spent in tachi waza. In some sports, for example handball,[26] video analysis has been used to better understand injury mechanisms. Injury situations identified on video footage together with injury surveillance and referee decisions would allow us to better understand injury mechanisms in Paralympic judo, and is therefore recommended. In this study, athletes with the most severe impairment (B1), had the lowest total time loss absence due to multiple injuries, indicating that this group had more minor injuries compared to the more sighted athletes. One explanation could be that partially sighted athletes are exposed to more matches compared to B1 athletes [1].

However, further studies based on athlete exposure including training hours and match time is desirable to establish whether there is any association between absence due to injury, vision class and exposure. Additional research is also needed to assess specific risk factors related to the impairment, training behaviors, and the possible implementation and effectiveness of any injury prevention strategies adapted to Paralympic judo.

Noteworthy is that the elite judokas in this study trained for 12 hours per week on average, which is lower compared to able-bodied judokas.[8] A study from Brazil also revealed that Paralympic judokas had lower levels of muscle power performance when compared to Olympic judokas[27]. In addition, athletes with VI have been shown to have impaired postural balance,[28] with especially blind judokas suffering from performance disadvantages when competing with sighted or partially sighted athletes.[29] All of these attributes may increase the injury risk in this population, and it is recommended that training recommendations, medical support and future injury prevention strategies are specifically adapted to Paralympic judokas in order to create a safer sport.

Limitations of this study are the retrospective research method with self-reports, which may lead to recall bias, selection bias and unconfirmed diagnoses. Another limitation is the absence of data of whether the Paralympic athletes trained with able-bodied athletes. As this is a cross-sectional study not based on actual exposure to sports, it is not possible to establish any causality of injury

because of the lack of epidemiological temporality.[13] The low number of athletes and absence of statistical power are also limitations. However, a total population design was used to obtain an approximation of the injury burden and further research direction in this understudied population. It is advised that further global prospective studies following athletes over time and based on sport exposure are undertaken. Another limitation is that only English speaking individuals were included in the study, and thus injuries are likely to be under reported from major, non-English speaking judo nations. It is therefore recommended that future studies offer questionnaires in different languages. A strength of the study is the adaptation of questionnaire modalities to persons with VI and to Paralympic athletes. Previous studies have shown that there are challenges to collect data from persons with VI.[14,30]

CONCLUSION

The results from this exploratory study revealed a high prevalence of mainly traumatic and severe sports-related injuries amongst athletes with VI participating in Paralympic judo. Male athletes reported significantly more injuries. The majority of the injuries occurred during the standing technique tachi waza, with the shoulder being the most injured body location. A first step towards prevention could be to minimize the time in tachi waza. However, to develop effective strategies for injury prevention, more comprehensive

epidemiological studies and technical studies assessing injury mechanisms are needed. This will allow this subset of athletes who already have a significant impairment to participate in judo more safely.

PRACTICAL IMPLICATIONS

- 84% of a population of athletes with visual impairment participating in Paralympic judo suffered from an injury during one year. Males reported significantly more injuries compared to females.
- Most athletes reported a traumatic injury that caused a considerable time loss from sport. A majority of the injuries occurred in the standing technique tachi waza.
- A first step in prevention of injuries in Paralympic judo could be to minimize the time in tachi waza. However, further prospective studies are needed to identify onset of injury and underlying risk factors

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Table 1. Participant demographics, 1-year prevalence of sports-related injuries and proportion of injured athletes.

	Total number of athletes (n) and (%) of all	**Injury prevalence, n (%; 95% CI)**	**Injured athletes (% of all athletes in the study)**
All	45 (100%)	38, (84%; 71-93)	84%
Female	14 (31%)	9 (64%; 39-84)	20%
Male	31 (69%)	29 (93%; 77-100)*	64%
Age group			
18-23	15 (33%)	12 (80%; 53-94)	27%
24-29	10 (22%)	10 (100%; 65-100)	22%
30-35	15 (33%)	12 (80%; 53-94)	27%
36-41	6 (9%)	3 (50%; 19-81)	7%
42+	1 (2%)	1 (100%; 16-100)	2%
Vision class			
B1	14 (31%)	9 (64%; 39-84)	20%
B2	19 (42%)	18 (95%; 72-100)	40%
B3	12 (27%)	11 (92%; 61-100)	24%
Weight category			
Low weight**	23 (51%)	19 (42%; 29-57)	42%
-48 kg (w)	2 (4%)	1 (50%; 10-91)	2%
-52 kg (w)	6 (13%)	4 (67%; 29-91)	9%

-57 kg (w)	1 (2%)	1 (100%; 16-100)	2%
-60 kg (m)	8 (18%)	8 (100%; 60-100)	18%
-63 kg (w)	1 (2%)	1 (100%; 16-100)	2%
-66 kg (m)	4 (9%)	3 (75%; 28-97)	7%
Heavy weight***	22 (49%)	19 (42%; 29-57)	42%
-70 kg (w)	2 (4%)	1 (50%; 10-91)	2%
+70 kg (w)	2 (4%)	0 (0%; 0-73)	0%
-73 kg (m)	3 (7%)	3 (100%; 36-100)	7%
-81 kg (m)	2 (4%)	2 (100%; 27-100)	4%
-90 kg (m)	7 (16%)	6 (86%; 45-100)	13%
-100 kg (m)	6 (13%)	6 (100%; 53-100)	13%
+100 kg (m)	1 (2%)	1 (100%; 16-100)	2%
*Significant difference ($p<0.05$). **Low weight=-48kg, -52 kg, -57 kg, -60 kg, -63 kg, -66 kg. ***Heavy weight=-70 kg, +70 kg, -73 kg, -81kg, -90kg, -100 kg, +100kg.			

Table 2. Diagnoses by body region and onset of the most severe injury reported by 38 visually impaired judokas*.

Non-traumatic Injury (n=11)					**Traumatic Injury (n=27)**			
Body region	Inflammation and Pain (n=6)	Stress Fracture (n=0)	Joint derangement (n=5)		Sprain, Strain or Rupture (n=14)	Fracture (n=3)	Dislocation (n=2)	Contusion (n=8)
Vertebral column	1	-	-		1	1	-	4
Head, face	1				1			1
Cervical, thoracic						1		2
Lumbar, pelvis, sacrum								1
Upper extremities	4	-	4		3	-	1	3
Shoulder girdle	4		4				1	2
Upper arm, elbow					1			1
Forearm, wrist, hand					2			
Lower extremities	1	-	1		10	2	1	1
Hip, groin, thigh	1		1		2		1	1
Knee, lower leg					6			
Ankle, foot/toe					2	2		

*Modified in a matrix from Jacobsson et al. 2010 and adapted for Paralympic sport by Fagher et al 2016.

Table 3. Frequency of multiple injuries (n=70) during the previous year per participant (n=45).

Number of injuries during the past year	Number of participants
0	7 (16%)
1	20 (44%)
2	10 (22%)
3	5 (11%)
4	2 (4%)
5	1 (2%)