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Injury Risk Analysis among Judo Athletes with Intellectual Disabilities

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ABSTRACT

The main aim of this study was to evaluate injury prevalence, incidence rate, and burden in judo athletes with intellectual disabilities (ID) who participate in international competitions. This retrospective cross-sectional study analyzed data from the past year for 182 judo athletes with ID. Data was collected using a self-reported questionnaire, adapted from previous research, that included questions about injuries impacting training or competition, injury type, mechanism, severity, diagnosis, and location on the body. The injury prevalence among judo athletes with ID occurred most often during training (68.2%) and primarily affected the lower extremities (35%). Age group and injury prevalence were significantly related ($\chi^2 = 7.91$; $P = 0.04$), while gender, weight, and ability level were not. Results were closer to those previously reported for conventional judo, which is likely due to the lower practice intensity among judo athletes with ID. Injury prevalence was lower than in prior studies, but the incidence rates aligned when considering training time in judo athletes with ID. Injury burden analysis revealed that females had a lower burden than males, while older athletes experienced a higher burden than younger athletes. Most injuries occur during training, which is likely attributable to safety-focused competition rules.

Introduction

Judo is an intermittent, grappling-based combat sport in which athletes perform multiple high-intensity efforts to gain a competitive advantage by throwing an opponent to the ground or demonstrating control in groundwork through holds or submissions [1]. Most

judo-related activities involve physical contact, and the perceived risk of injury is high during training and competition [2]. While the epidemiology of injuries in judo has been previously explored, changes in training paradigms and competitive rules, as well as ex-

panded access to unique participant groups, warrant periodic reevaluation.

In a systematic review, Pocco et al. [3] found that the most common cause of injury was sprains, followed by muscle strains and concussions, with the knees, shoulders, and fingers being the most frequently affected body parts. Further investigations suggest other injury-prone parts of the body, including the upper and lower limbs [4], lower back, shoulder, and knees [5]. A recent study on judo injuries in a competitive setting identified the head as the most commonly injured body part, with sprains being the most common type of injury [6]. These authors also reported that the incidence of tournament injuries requiring medical attention ranged from 2.5% to 72.5%, and from 1.1% to 4.1% for injuries leading to missed training/competition time. A study of 4,659 judo athletes showed a severe injury prevalence of 79% [4], while another study on Paralympic judo athletes showed an injury prevalence of 84% within the previous year [7]. An examination of the mechanism of injuries showed that the majority of incidents occurred in the standing position while executing a throw (25.85%), getting into a throwing position (22.30%), grip fighting (15.07%), falling to the ground (14.77%), and during groundwork (18.30%) [8].

Consensus on the definition of the term “sports injury” remains elusive. A prominent definition states that an injury involves tissue damage or any other impairment in normal bodily function resulting from participation in sports [9]. The Clarsen and Bahr [10] classification system of injuries further distinguishes between medically attended injuries, time-loss injuries, and other or unspecified injury categories. The broad definition of Fagher et al. [7] has been adopted for the current investigation, which defines injury as any new musculoskeletal pain or injury that has caused changes in normal training or competition in terms of mode, duration, intensity or frequency, whether or not training or competition time has been missed. The former definition is also consistent with the criteria established in Paralympic Sports for recording and reporting injury data [11].

Previous research on sports injuries has primarily concentrated on conventional sports with less emphasis on parasports. Moreover, there is a dearth of research on individuals with intellectual disabilities (ID) who participate in parasports, including judo.

According to data from the Special Olympics, in 2019, there were approximately 20,000 judo athletes with intellectual disabilities (ID) spread across 45 countries [12]. Adapted judo competitions are increasingly common, with support from organizations such as the European Judo Union (EJU), the Special Needs Judo Union (SNJU), and the Special Olympics, which have hosted worldwide adapted judo championships every four years since 2003. The 2023 Adapted Judo training camp in Poreč, Croatia, which was a part of the 8th Judo Festival [13], shows an increasing diversity of training opportunities for adapted judo athletes. The rules of adapted judo disallow certain techniques and practices that could cause injuries if not carried out correctly [14]. Some of these techniques are restricted not only because of the physical demands required but also because athletes may lack the understanding and reaction time needed to respond to them [15]. For example, armlocks and strangulation techniques are not permitted because the players involved may not possess the necessary cognitive ability to realize their own strength or submit within a safe timeframe. The need for

additional attention to safety is underscored by the high pain threshold and joint hypermobility or hypomobility of some athletes with ID [15].

To ensure the safety of the adapted judo participants, an ability level classification system (► **Table 1**) was developed by comparing the skills of athletes with disabilities with those of a conventional competitive judoka (for level 1) or a conventional recreational judoka (levels 2–5). This classification system has been shown to be reliable [16] and has been used for many years in competitions organized by the SNJU and Special Olympics and was adopted by the EJU in June 2023.

Several systematic reviews and meta-analyses have found that exercise can lead to psychosocial improvements [17] as well as improved mental and physical health [18] for members of this population. Participation in judo has been shown to have several benefits for people with ID, ranging from improved social and motor skills [19] to improved cardiovascular health [20]. However, safety issues and the potential for injury are often barriers to participation in sports programs for people with ID [21], as injury rates among members of this population are higher than those among the population as a whole [22]. In this context, the main aim of this study was to evaluate the injury prevalence and incidence rate, as well as the burden of injury, of athletes with ID who participated in international judo competitions. It was hypothesized that injuries occur more frequently during training and that there would be age-related differences in judo athletes with ID.

Materials and Methods

Experimental design

This study used a descriptive and retrospective cross-sectional design to analyze the prevalence, incidence rate, and burden of injuries affecting judo athletes with ID over the previous year of competition and training.

Participants

The sample consisted of 182 athletes (118 males and 64 females) with a mean age of 20.79 (± 3.44) years. Data were collected via a self-reported questionnaire over two months (February to March 2023). The inclusion criteria were as follows: 1) having participated in an internationally adapted judo competition organized by Special Olympics within the last year, 2) being able to communicate in English, 3) having more than three years of experience in judo, and 4) having completed the questionnaire in full.

Participants and their guardians were informed of the research aims and voluntary nature of the study. All the participants and their guardians signed an informed consent form. This study was approved by the institutional review board. All aspects of this study were conducted in accordance with the standards of the latest version of the Declaration of Helsinki to safeguard the rights of participants and those of the Taipei Declaration on the use and retention of research data. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, in particular the STROBE-SIIS extension, which includes specific elements for reporting injuries and illnesses in sports.

► **Table 1** Classification system used for people with ID in judo competitions.

Level 1 is a judoka who can perform in a shiai with a mainstream recreational / competitive judoka. This judoka is fast and powerful and has excellent reflexes, in addition to a strong feeling for Judo and an excellent strategic approach. This type of judoka has a minimal disability and therefore usually attends regular education. In general, these are judoka with a slight social physical disability, VI and deaf judokas and judoka with an intellectual disability that has grown beyond level 2.
Level 2 is a judoka who can perform randori with a mainstream recreational judoka. This judoka is fast and powerful and has moderate reactivity, but is usually late responding to judo situations. He has a good judo feeling, but usually no effective strategy.
Level 3 is a judoka who can perform a playful randori with a mainstream recreational judoka. This judoka is reasonably fast and powerful and has reasonably developed reactivity, but is almost always late responding to situational judo. The strategy for this type of judoka often consists of repeating the same technique over and over.
Level 4 is a judoka who can play with another judoka of the same or comparable level. Reactivity is suboptimal. Usually, the only judo technique consists of takedown and osae-komi.
Level 5 is a judoka who can play with other judoka of the same level. These judokas are very passive, or respond very slowly. Constant coaching to take action is necessary. When they end up in osae-komi, the action to escape can take a very long time.

Instruments

This study used an adapted version of the questionnaire created by Fagher et al. [7]. The original questionnaire focused on judo-related injuries experienced by judo athletes with visual impairment and other paralympic sports. Participants were asked to provide the same demographic information as in the original: age, gender, weight class, hours of training a week, and participation in other sports. However, while the original instrument asked about participants' degree of visual impairment, in this case, they were asked to indicate their ability level classification in accordance with the levels established by the Special Olympics for judo competitions for people with ID [14] (see ► **Table 1**). An additional question was added to indicate whether the questionnaire had been completed solely by the athlete or whether assistance had been provided by guardians, coaches, or other caregivers.

In addition to demographic information, participants were asked whether they had experienced injuries that had affected their normal training or competition regimen over the past year, regardless of whether the injury had led to missed training time or competition. If participants answered affirmatively, they were asked questions about how much training time they had lost, the type of injury they had experienced, the mechanism of injury (standing technique or *tachi waza*, ground technique or *ne waza*, or other), the body part affected, and the diagnosis. To categorize the severity of the injuries in terms of time missed, this study followed the system recommended by the International Olympic Committee [9], which establishes the following values: 0 days, 1–7 days, 8–28 days, or > 28 days missed. The reported injuries were categorized using a matrix for classifying musculoskeletal diagnoses into body location, type of injury, and diagnosis according to the 11th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-11) [23].

On some occasions, the questionnaire was administered in person via interviews conducted at competitions held during the data collection period, while other participants completed the instrument via an online form. Data were entered into a spreadsheet for statistical analysis.

Statistical analysis

Descriptive statistics were used to analyze various types of injuries. Given the specific characteristics of judo for people with ID, an injury risk analysis was carried out for the one-year evaluation period using the following equation:

- The prevalence, expressed as a percentage, was calculated by dividing the total number of injuries reported by the number of participants in the sample.
- The incidence rate, expressed as a rate over a period of time, was calculated by dividing the number of total injuries by the total number of hours of judo-related physical activity (training and competition) reported by the participants and multiplying by 1,000.
- The burden of injury, expressed as a rate over a period of time, was calculated by dividing the total number of days missed due to injury by the total number of hours of judo-related activity (training and competition) reported by the participants and multiplying by 1,000.

When an athlete had experienced multiple injuries resulting in different lengths of time missed and affecting different parts of the body, only one injury was considered to calculate the prevalence (regardless of the number of stoppages due to injury). The incidence rate was analyzed by considering the total number of stoppages over the year, while the analysis of injury burden considered the total number of missed training or competition days.

The nominal variables (gender, age, ability level classification, body weight, seriousness of injury, and time of injury) were used to group the results and to assess associations between categories using the Chi-square (χ^2) test. To facilitate comparison, the participants were divided into two weight groups according to their body weight: the light group included the first three weight categories (up to 57 kg for women and up to 73 kg for men) and the heavy group included the categories above these weights. Finally, confidence intervals (CI) were set at 95 %, and the level of statistical significance was established at $p < 0.05$. Statistical analysis was carried out using the software package SPSS 25.0 (SPSS, Inc., Chicago, Illinois, USA). (Data available at <https://figshare.com/s/ee1db2e88fb7fb894619>).

Results

Most of the questionnaires (95.1 %) were completed with the assistance of the parents/guardians and caregivers of people with ID, while only 4.9 % were completed by the athletes themselves. The number of injuries, number of days missed due to injury, and total number of hours of activity were used to calculate the prevalence, incidence rate, and injury burden. Demographic data for the primary independent variables are shown in ► **Table 2**.

The participants performed judo for an average of 2.76 hours a week (± 1.04), with a median time spent on the sport of 3 hours a week (min-max, 1–10 h). The participants reported that 31.8 % of

► **Table 2** Demographic information and prevalence of injuries considering the total sample, gender, age, weight and ability level classification.

		Total number n (%)	Injury PREVALENCE n (%; 95% CI)
TOTAL		182 (100%)	20 (10.9%; 9.46–12.52)
Gender	Male	118 (64.8%)	14 (11.9%; 9.46–14.3)
	Female	64 (35.2%)	6 (9.4%; 8.11–10.68)
Age group*	<17 y	89 (48.9%)	8 (8.9%; 7.15–10.64)
	18–23 y	51 (28.0%)	5 (9.8%; 7.25–12.24)
	24–30 y	21 (11.5%)	1 (4.8%; 6.61–2.98)
	>30 y	21 (11.5%)	6 (28.6%; 16.59–40.60)
Weight category	Light	110 (60.4%)	12 (10.9%; 8.95–12.84)
	Heavy	72 (39.6%)	8 (11.1%; 8.65–13.54)
Ability level classification	Level 1	11 (6.0%)	1 (9.1%; 4.02–14.17)
	Level 2	38 (20.9%)	4 (10.5%; 7.33–13.66)
	Level 3	50 (27.5%)	9 (18.0%; 13.15–22.84)
	Level 4	58 (31.9%)	6 (10.3%; 7.78–12.81)
	Level 5	25 (13.7%)	0 (0%; 0–0)
*Significant association ($P < 0.05$).			

judo injuries occurred during competitions and 68.2% during training sessions. Meanwhile, 78.6% took place during the use of standing techniques (*Tachi waza*), 7.1% occurred in the context of ground techniques (*Ne waza*), and 14.3% in other situations. In terms of body parts, the most common injuries were in the lower limbs (35% feet and toes, 15% knees, 10% lower legs), while upper-body injuries were less frequent (15% shoulders, 10% head/face, 5% elbow/arm, 5% back, and 5% hand).

► **Table 2** also shows the prevalence of injuries considering the total sample, gender, age, weight and ability level classification. From the chi-squared tests, a significant association was found between the prevalence of injuries and the age group of judo athletes ($\chi^2 = 7.91$; $P = 0.04$). No significant association was found between prevalence of injuries and gender ($\chi^2 = 2.63$; $P = 0.608$), weight ($\chi^2 = 0.51$; $P = 0.77$), and ability level classification ($\chi^2 = 5.67$; $P = 0.225$).

► **Fig. 1** shows the incidence rate by gender (A), age group (B), weight category (C) and ability level classification (D), and ► **Fig. 2** shows the injury burden for the same independent variables.

Discussion

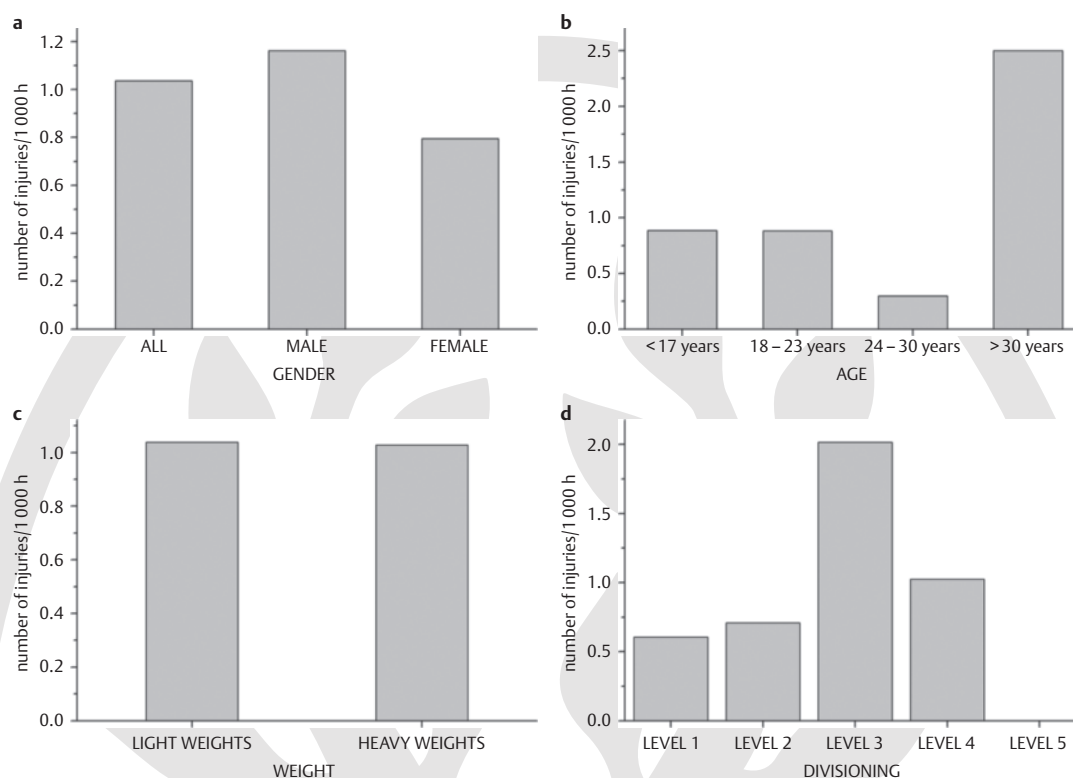
This study was a retrospective investigation of the prevalence, incidence rate, and burden of injuries affecting judo athletes with ID. While studies have been conducted on the typology of injuries related to sports practice, including judo, for individuals classified under the broad category of general disability (e. g. para-sports), there is a dearth of research focused on the injury prevalence or incidence within a specific population of individuals with ID. Therefore, this research represents a pioneering effort to perform injury risk analyses within this group.

The majority of injuries among judo athletes with ID in our study occurred during training periods, accounting for 68.2%, compared to 31.8% during competition. This aligns with the findings of the

only study reporting this data in adapted judo, which includes athletes with ID as well as other types of physical disabilities [24] and found that 76.4% of injuries occurred during training and 23.5% during competition. Gutiérrez-Santiago et al. [25] reported an incidence rate of 18.9% for athletes with visual impairment during world judo championships, which is markedly higher than the values demonstrated in the current study for judo athletes with ID. A review article by Mooren et al. [6] found that the incidence proportion during conventional judo competitions ranged from 2.5% to 72.5% for injuries requiring medical evaluation, and from 1.1% to 4.1% for injuries that cause time loss. Other findings contrast greatly from those reporting a low incidence [26] to those with a high incidence [27]. Perhaps the lower occurrence of injuries during judo competition among athletes with ID can be attributed to adaptations to competition regulations, as they are highly restrictive concerning activities with increased injury risk. Therefore, the current findings imply that competition regulations and ability level classifications serve the purpose of limiting the occurrence of injuries in adapted judo. Additionally, the frequency of adapted judo competitions for individuals with ID is typically lower than that for conventional judo athletes and those with visual impairment.

The most affected body parts found in the sample of judo athletes with ID in this study were similar to those shown for adapted judo participants [24], who reported 49% of injuries localized in the knee and 23% in the shoulder. In contrast, athletes with visual impairment competing with a high frequency in national and international judo competitions [7] exhibit a higher rate of shoulder injuries; however, they align with the current study in that practicing standing judo has the highest number of injuries. The same was also reported for elite athletes during conventional judo competitions, where the highest rates of injuries occurred in the standing position (78%) [8]. Therefore, promoting the practice of ground-based judo or paying more attention to the limitations of standing judo is suggested. Injury evaluation during judo practice in conventional judo athletes also showed similar results, with slight variations. The shoulder and knee are primarily affected [3], and anterior cruciate ligament tears and vertebral disc prolapse appear to be the most severe types of injuries reported [4]. Studies analyzing injuries during conventional judo competitions present similar anatomical locations, but with different orders of incidence. For instance, the knee, shoulder, and elbow were the most common injury sites during high-level judo competitions between 2005 and 2020 [26], whereas a systematic review by Mooren et al. [6] found that the head is the most commonly reported site of injury in judo tournaments, followed by the hands, knees, elbows, and shoulders.

The results of this study showed very low levels of total injury prevalence (10.9%) compared to judo athletes with visual impairment, who showed an injury prevalence of 84% [7]. This could be because the regulations for the Paralympic competition have minimal modifications compared to the regulations for judo competitions for people with ID, which include specific adaptations for each ability level classification. In comparison, a study by Kons et al. [24] showed a relatively lower total prevalence (19.6%) in judo athletes with ID. The injury prevalence between male and female judo athletes with ID in the present study is very similar across gender and is consistent with other judo studies that mention no significant sex-related causes or differences in injury severity [3, 24]. However,



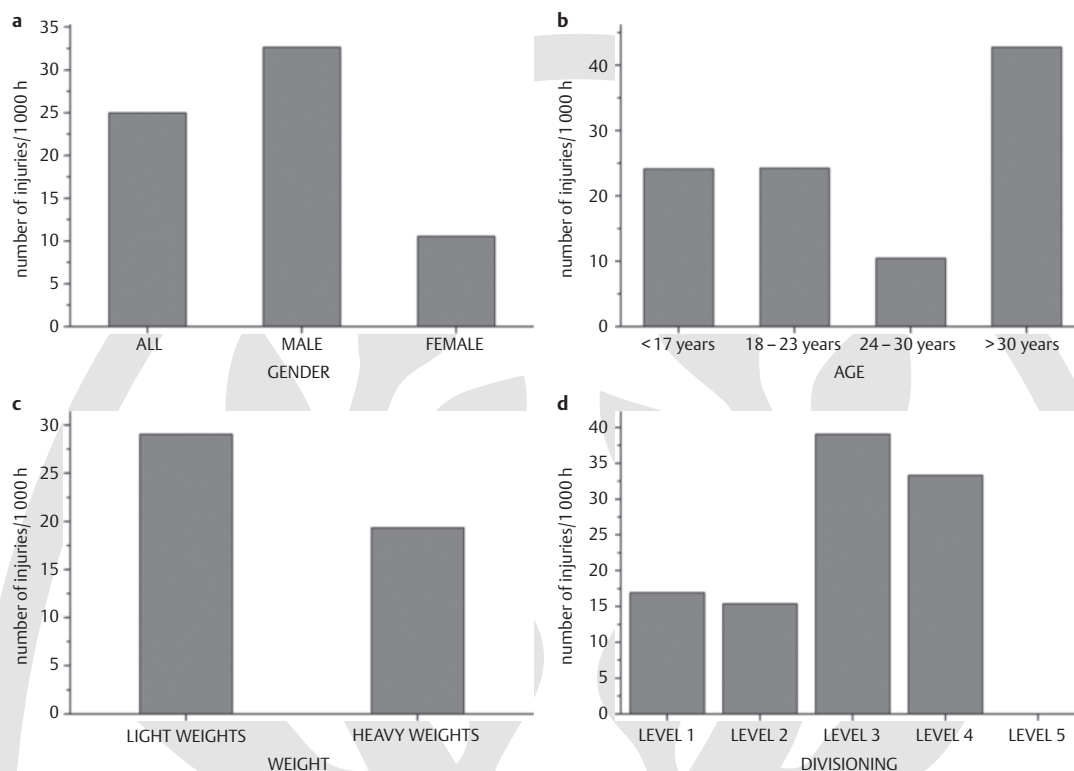
► **Fig. 1** Incidence rate expressed as number of injuries per 1,000 h of judo-related physical activity (training and competition) by gender, age group, weight category and ability level classification.

er, in some other comparisons involving conventional judo athletes, a higher susceptibility to injuries among women was observed, particularly when considering injury situations or categories, while studies also clearly demonstrated differences between men and women [7, 26].

Considering the age group comparison, injury prevalence was similar across all groups, except for those over 30 years old, where the value was three times higher than that of the younger age groups. Notably, the 24–30 years old age group exhibited the lowest prevalence. In line with this, other studies have also found that older age groups tend to experience more injuries during judo practice [6]. Conversely, a study encompassing 21 competition seasons in France yielded the opposite results, indicating that younger age groups were more prone to sprains and fractures [28]. The current division by weight categories demonstrated a similar injury prevalence as Lystad et al. [27], which showed no significant differences in injury incidence among weight categories. This aspect could be related to grouping into only the Light and Heavy weight categories to avoid dispersion; however, other studies with similar groupings found differences in injury patterns based on weight categories [7, 29]. Finally, the ability level classification did not yield significant differences between the groups. Notably, judo athletes with ID categorized as Level 3 exhibited a higher injury incidence, whereas the Level 5 group reported no injuries in the previous year. Studies reporting injuries in judo athletes with visual

disabilities also did not report differences in categories among Paralympic judo competition groups [7].

When observing the incidence rate of injuries, which takes practice time into account, the results of the current study align more closely with those of previous work. This alignment is likely because individuals with ID who practice judo have a lower average practice time than other populations, such as judo athletes with visual impairment [7]. Including injury burden results provides insights into the impact and disruption caused, as it considers both incidence and injury severity [30]. Some interesting aspects emerge that may go unnoticed when only the prevalence data are considered. For instance, women exhibit lower injury burden levels than men. Among the different age categories, the group aged > 30 years continued to display higher values than the others. Heavyweight judo athletes show a lower injury burden rate than lightweight judo athletes, although their incidence rates are nearly equal. Lastly, in the context of ability level classifications, the level 4 group stood out with a value exceeding 30 days lost/1,000 h, despite the incidence rate showing moderate values similar to those of the level 1 and 2 groups. Research on Olympic judo athletes reported that the proportion of injuries resulting in > 7 days of absence was 35.9%, while in other Olympic combat sports, it was 39.6% for wrestling, 32.5% for taekwondo, and 21.0% for boxing. However, looking at the overall incidence and severity of injuries, it was highlighted that the injury burden is greatest in judo compared to other Olympic combat



► **Fig. 2** Injury burden expressed as the number of injuries per 1,000 h of judo-related physical activity (training and competition) by gender, age group, weight category and ability level classification.

sports [27]. Comparisons of injury burden with other sports pose challenges as it is difficult to find studies from other sports reporting this indicator under similar conditions. For example, a study involving professional football players reported values of 14 days lost/1,000 h [31], while another study on field hockey [32] found values of 61.4 days lost/1,000 h. The differences appear substantial, and the specificity of each situation makes comparisons unhelpful for drawing consistent conclusions.

Sports injuries in people with ID have received limited attention in research; however, sports injuries in people with physical disabilities have been evaluated. For instance, one study found that athletes with autism spectrum disorder and a history of seizures had a higher risk of injury during sports activities [33]. Moreover, athletes with ID need to be closely monitored during sports practice as seizures are likely to occur, especially when they are fatigued, stressed, or dehydrated [34]. It is important to note that individuals with ID have poorer postural control than their non-ID counterparts, manifesting as difficulties in balance and gait [35]. These issues related to balance and gait are well-established risk factors for falls [36], resulting in a higher incidence of falls and accidents among individuals with ID. This information contrasts with the low prevalence and incidence rates in judo by individuals with ID. This may be unsurprising, because practicing judo contributes to improved balance, as demonstrated in studies involving the general adult population without ID [37]. In the case of individuals with ID,

practicing judo has proven beneficial in enhancing physical fitness and motor skills [19, 20], thereby indirectly improving postural control [35] and reducing the risk of injuries during sports practice.

The present study has some limitations owing to its retrospective cross-sectional design, which may not provide a comprehensive view of the injury burden. Moreover, as it relies on self-reported injuries, the data may be susceptible to recall bias and may not accurately reflect the true injury burden. Anecdotally, participants had difficulty understanding that any cause of modification in sports practice could be considered an injury cause. Another limitation is the lack of reference studies based on sports-related injuries in the ID population, preventing direct comparison of the results obtained and leaving critical conclusions uncertain. We hope that this study contributes to future research in this field. Finally, the questionnaire did not capture exhaustive information regarding the dates, contexts, and temporal occurrences. In this regard, it offers limited insight into whether the injury occurred during competition or training and the duration of the injury.

Conclusions

The prevalence of injuries in this study of judo athletes with ID was low compared to prior investigations, but the incidence rate was similar when considering the time dedicated to judo practice. The injury burden, which takes into account both the incidence and se-

verity of injuries, provides additional information, as women experience a lower injury burden than men and older athletes experience a greater injury burden than younger athletes.

Most injuries among judo athletes with ID occur during training rather than competition, possibly because of restrictive competition rules that prohibit dangerous actions and promote safe practices. However, the practice of judo focused on ground techniques has been shown to be safer than judo focused on standing techniques. So it would be prudent for coaches to strictly consider the limitations of standing judo during competition as well as during training. For example, avoiding neck holds and sacrifice (*sutemi*) judo techniques, while providing more practice space, and most importantly, teaching athletes who do not have ID to adapt their judo when training with athletes who do. Finally, it is important to note that comparisons of injury burden in other sports are challenging because of the specificity of each situation.

Overall, this study offers valuable insights into injury risk among judo athletes with ID; however, further research is needed to better understand and prevent injuries in this population.

Conflict of Interest

The authors declare that they have no conflict of interest.

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