Gaster, 23(1) 2025, 73-82
https://journal.aiska-university.ac.id/index.php/gaster
e-ISSN: 2549-7006; p-ISSN: 1858-3385
DOI: https://doi.org/10.30787/gaster.v23i1.1699

Systematic Review

Relationship of Impairment Classification to Injury Incidence in Para Sport Athletes: A Systematic Review

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ABSTRACT

Background para sport will be divided into a group determined by the type and level of disability of an athlete; impairment classification in the International Paralympic Committee (IPC) is divided into visual, physical, and intellectual impairment. Athletes with impairments increase the risk of events in para-sports.

Purpose: The aim was to determine if there is a relationship between impairment classification and the incidence of injury in para-sport athletes.

Method: The research is a systematic review following the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines. Data search follows the databases Google Scholar, PubMed, and Scopus using keywords and Boolean search in searching for literature.

Result: 10 studies were obtained with publication years between 2016-2022, of which 1 study included reports of injury incidence in athletes with visual, physical, and intellectual impairment, three studies included reports of injury incidence in athletes with visual impairment and physical impairment, three studies included reports of injury incidence in athletes with visual impairment only, and three studies included reports of injury incidence in athletes with physical impairment only. Injury rates in athletes with visual impairment, where the highest population was 267 of elite judokas participating in the IBSA 2018 world judo, 19.1% were injured.

Conclusion: This study showed variation in injury incidence based on impairment classification in para-sport athletes, with a high prevalence in athletes with a limb deficiency, neurological impairment, and visual impairment.

ARTICLE HISTORY

Received :12 December 2024
Revised :09 January 2025
Accepted :20 January 2025
Avaliable Online :20 February 2025
Published :28 February 2025

KEYWORDS

Impairment; Athlete injuries; Sports injuries; Parasport

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Cite this as: Suci Syafatillah, S., & Saputra Perdana, S. (2025). Relationship of Impairment Classification to Injury Incidence in Para Sport Athletes: A Systematic Review. Gaster, 23(1), 73–82. https://doi.org/10.30787/gaster.v23i1.1699

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INTRODUCTION

Para sport can change the way disability is viewed for the better in terms of social integration and the well-being of people with disabilities. Historically, para-sport was a treatment for paralyzed patients, and it has since been developed to create opportunities for competitive sports for people with disabilities and different types of impairments (Allen et al., 2021). In para-sport competitions, athletes are grouped according to the type and severity of their disabilities, a process known as classification (Krabben et al., 2019). The goal of classification is to reduce the influence of impairments on competition outcomes and ensure a fair and equitable competitive environment. To achieve this, athletes are assessed to determine the extent of their impairments (Allen et al., 2021).

According to the International Paralympic Committee (2016), classification systems must not only be tailored to each sport but also adhere to evidence-based standards across all sports. Athletes eligible to compete in Paralympic sports include those with ten types of disabilities: physical impairment, which is divided into impaired muscle power, range of motion (ROM), hypertonia, ataxia, athetosis, leg length difference, limb deficiency, short stature, visual and intellectual impairment (Hutchinson et al., 2021).

Although sports participation offers numerous benefits for athletes with disabilities, it also carries an increased risk of sports-related injuries and illnesses. While injuries are a concern for all athletes, they can present unique challenges for athletes with disabilities, potentially further limiting their already restricted lifestyles (Weiler et al., 2016). Considering the high injury rates in para-sports, a detailed overview of injuries and illnesses categorized by sport, type of impairment, causes, and prevention strategies can provide valuable insights into the mechanisms behind sport-related health issues. Such an approach will also support research focused on developing effective preventive interventions (Luijten et al., 2023)

Based on the above background, athletes with limitations are owned and fall into the impairment classification grouping that aims to minimize the decline in performance and the impact of the injury on the results of a competition. Thus, this review aims to conduct a comprehensive systematic review and quality assessment of the literature related to the classification of impairment in para-sports and review the incidence rate of injury in para-sports.

METHOD

Search Strategy

This research is a systematic review conducted in accordance with the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines. A systematic review is a structured approach that involves reviewing, evaluating, classifying, and categorizing evidence that has already been collected.

Information Sources

The literature for this study was sourced from the following databases Google Scholar, PubMed, and Scopus using keywords and Boolean search in searching for literature, namely "impairment" AND "athlete injuries" OR "sports injuries" AND "paralympic" OR "para-sport" OR "athletes disability".

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Eligibility Criteria

The study's eligibility was defined using specific inclusion and exclusion criteria. The inclusion criteria are as outlined below: 1) Literature in the form of scientific journals available in full text, 2) Sources from Google Scholar, PubMed, and Scopus, 3) Journals written in English or Indonesian, 4) Journals published between 2014 and 2024, 5) Research studies with observational, descriptive, cross-sectional, or prospective cohort designs, 6) Studies that involve athletes with physical (motor), visual (vision), or intellectual impairments, and 7) Journals that discuss injury incidence in athletes with impairment classifications. Conversely, the exclusion criteria are defined as the opposite of the inclusion criteria. In addition, to limit the scope of the study, the researcher used the *PICO* method (*Population, Intervention, Comparison, Outcome*), such as the following table:

Component	Details
Population	Athletes with physical (motor), visual (vision), or intellectual impairments competing in summer paralympic
Intervention	General observation of injury incidence in Para-athletes
Comparison	n/a
outcomes	Incidence of injuries in athletes with impairment classifications

Table 1. *PICO summary*

Data Collection and Analysis

Literature selection uses the PRISMA method (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*). The PRISMA Flow chart in this study uses a review of the confidence platform.

Quality Assessment

The quality assessment of the scientific journals in this study was carried out using *The Joanna Briggs Institute (JBI) Critical Appraisal Checklist*, which is intended for evaluating qualitative research, cross-sectional studies, and cohort studies. The JBI checklist for qualitative research consists of 10 assessment items, the checklist for cross-sectional studies has 8 items, and the checklist for cohort studies includes 11 items. Each item was rated as "yes," "no," "unclear," or "not applicable," with "yes" earning a score of 1 and the other responses receiving a score of 0. Two independent reviewers, both experts in para-sport research and academia, assessed the selected journals. Any differences in evaluation were resolved through consensus among all reviewers.

Data Synthesis

In this study, data synthesis was conducted by analyzing the literature that fulfilled the quality assessment, as well as the inclusion and exclusion criteria, was considered. The synthesis process focused on the research objectives, aiming to explore the relationship between impairment classifications and injury incidence among para-sport athletes.

Data Extraction

The data extraction results were presented in tables containing details such as the reference study, study design, population, and reported injury rates categorized by impairment classification. The table included information on the impairment classification, total number of athletes, number of injured athletes, injury proportion (per

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100 athletes), incidence rate (per 1,000 athlete-days) with (95% CI), comparisons, and outcomes.

RESULTS

Based on the PRISMA method, from a total of 179 scientific journals identified, 50 of them were excluded due to the identification of duplicate data from convidence, so there were 129 scientific journals screened; from 129 scientific journals 110 other scientific journals did not enter the inclusion and exclusion criteria, and 7 scientific journals entered the exclusion criteria. So that only 10 journal articles can be used in the literature study (figure 1).

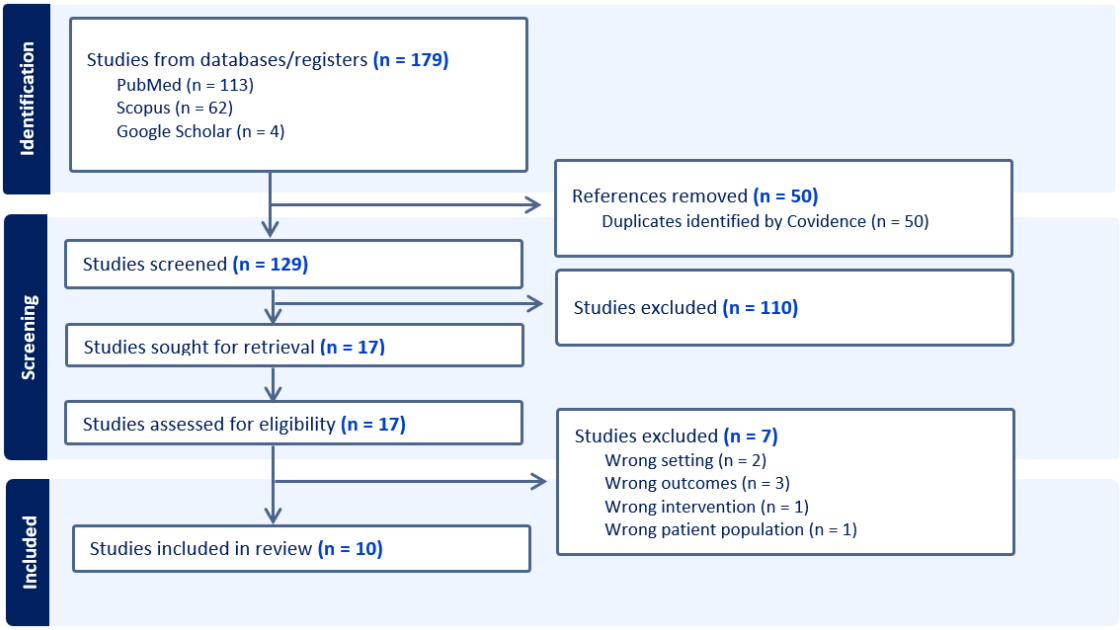

Figure 1 PRISMA Flow Chart

Characteristics Studies

The study characteristics are summarized in **Table 2**. All studies included in this research employed observational or descriptive, cross-sectional, and prospective cohort designs, with participant populations consisting of athletes classified under visual impairment, physical impairment, and intellectual impairment. The search results revealed that one study reported injury incidence in athletes with visual, physical, and intellectual impairments; three studies reported injury incidence in athletes with both visual and physical impairments; three studies focused on injury incidence in athletes with only visual impairment; and three studies reported injury incidence in athletes with only physical impairment. Therefore, the majority of studies that reported injury incidence in athletes with visual impairment numbered seven, while the fewest studies, just one, reported on athletes with intellectual impairment.

Quality Assessment

The quality assessment of the included studies is shown in figure 2. There were total scores of 1 in 3 studies, total scores of 2 in 1 study, total scores of 4 in 3 studies, total

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scores of 5 in 1 study, and total scores of 6 in 2 studies. The studies with the highest total score are journals with authors Lexell with the publication year 2021 and Santos with the publication year 2021. Meanwhile, the studies with the lowest total score are journals with author Blauwet with the publication year of 2016, author Heneghan with the publication year of 2021, and author Fagher with the publication year of 2019.

Injury Rate in Para-athletes by Classification Impairment

The 10 studies that reported the incidence of injury in athletes, 7 reported injury rates in athletes with visual impairment, where the highest population was 267 elite judokas participating in the IBSA 2018 world judo, and 19.1% were injured. 7 studies reported injury rates in athletes with physical impairment, with the highest population of reported injury rates in athletes with limb deficiency being 160 athletes from the Paralympic athletics for a track event, 23.% were injured. There was 1 study that reported injury rates in athletes with intellectual impairment. With 6 athletes from the SRIIPS report, 33% were injured.

References	Design Study	Population	Reported Injury Rates by Classification Impairment					Outcomes
			Classification Impairment	Total Athletes	Number Of Injured Athletes	IP (per 100 athlete)	IR (Per 1000 Athlete-Days) (95% CI)	
(Blauwet et al., 2016)	Prospective cohort study	497 athletes for track event	Visual impairment	121	37	29.8%	29.8 (21.6-37.9)	The study found that athletes with disabilities experienced a higher injury rate, with 18.4 injuries per 100 athletes, compared to non-disabled athletes in athletics, who had injury rates ranging from 97.0 to 135.4 injuries per 100 athletes.
			Amputation	160	36	23.1%		
			Cerebral palsy	98	10	10.2%	23.1 (16.6-29.7)	
							10.2 (4.2-16.2)	
		480 athletes for field events	Visual impairment	49	9	18.4%	18.4 (7.5-29.2)	
			Short stature	20	10	50%		
			Amputation	87	18	20.7%	50.0 (28.1-71.9)	
			Cerebral palsy	84	13	15.5%	20.7 (12.2-29.2)	
							15.5 (7.7-23.2)	
(Fagher et al., 2019)	Cross-sectional	45 Paralympic judokas with visual impairment	Visual impairment	45	38	84%	84 (71-93)	The study found that 84% of the athletes who participated reported having experienced a sports-related injury in the past year. This highlights a significant injury burden among athletes with (VI) participating in judo.

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References	Design Study	Population	Reported Injury Rates by Classification Impairment					Outcomes
			Classification Impairment	Total Athletes	Number Of Injured Athletes	IP (per 100 athlete)	IR (Per 1000 Athlete-Days) (95% CI)	
(Fagher et al., 2020)	Cross-sectional	104 Paralympic athletes with visual, physical, and intellectual impairment	Visual impairment	21	7	33%	33 (15-57)	The period prevalence of SRIIPS among the athletes was 31% (95% CI 23-40) over the past year. This indicates that nearly one-third of the athletes experienced significant injuries that affected their training or competition
			Limb deficiency	10	4	40%	40 (12-74)	
			Spinal cord injury	34	9	26%	26 (13-44)	
			Central neurological injury	19	7	37%	37 (16-62)	
			Les Autres	14	3	21%	21 (5-51)	
			Intellectual impairment	6	2	33%	33 (4-78)	
(Gutiérrez-Santiago et al., 2020)	observative research	267 of elite judokas	Visual impairment	267	51	19.1%	18.9 (14.8-24.2)	The study reveals that Paralympic judokas face a significant injury rate, with an overall injury proportion estimated at 18.9 injuries per 100 athletes. This rate differs across visual classifications, with B1 judokas experiencing 13.8 injuries, B2 judokas 22.3 injuries, and B3 judokas 18.5 injuries per 100 competitors.
(Santos et al., 2021)	descriptive, longitudinal, and epidemiological study	8 athletes with visual impairment	Visual impairment	8	5	62.5%	-	The study found that five out of eight visually impaired athletes sustained a total of seven injuries, resulting in a prevalence rate of 62.5% among the participants.
(Heneghan et al., 2021)	Cohort study	32 athletes with limb deficiency	Limb deficiency	32	22	69%	-	A total of 107 injuries were documented from 32 athletes, indicating a significant occurrence of lumbosacral injuries in this population. The analysis revealed that injuries were primarily myogenic (26.2%) and arthrogenic (32.7%). When examining the

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References	Design Study	Population	Reported Injury Rates by Classification Impairment					Outcomes
			Classification Impairment	Total Athletes	Number Of Injured Athletes	IP (per 100 athlete)	IR (Per 1000 Athlete-Days) (95% CI)	
								onset of injuries, it was found that half of the recorded injuries (40%, n=43) occurred during training sessions.
(Hirschmüller et al., 2021)	Cohort study	58 athletes elite Para athletes	Paraplegic	19	13	68.4%	3.6 (2.1-6.2)	Health concerns were more prevalent among paraplegic athletes (33%) compared to non-paraplegic athletes (26%), highlighting a notable rate of health challenges among elite Para athletes.
(Lexell et al., 2021)	Cohort study	107 Swedish athletes with vision, physical, and intellectual impairment.	Visual impairment Central neurological Les Autres Limb deficiency Spinal cord injury	22 19 14 11 36	6 - - - -	27.3% - - - -	27.3(12.6-48.7) - - - 11.1 (3.3–26.4)	The study identified 13 cases of sport-related concussions (SRC) among participants, resulting in an incidence proportion of 9.3% (95% CI: 4.8–16.7) and an incidence rate of 0.5 SRC per 1000 hours of sports exposure (95% CI: 0.3–0.9). Most of these injuries (69%) took place during sport-specific training sessions.
(Steffen et al., 2022)	Cohort study	94 with neurological and musculoskeletal impairments of Norwegian Para athletes	Neurological impairment Musculoskeletal impairment	51 37	- -	- -	18.1 (16.4-19.4) 22.4 (20.7-24.1)	Approximately 37% of elite Norwegian Para athletes reported experiencing health problems at some point during their preparations for the Games, meaning nearly two out of five athletes faced at least one health issue during the observation period.
(Salerno et al., 2022)	Cross-sectional	21 members of Para swimmers	Hypertonia Muscle Power Passive ROM	2 3 2 9	1 1 1 2	50% 33.3% 50% 22.2%	- - - -	Out of 56 surveys distributed, 21 were returned. Among these, 11 participants

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References	Design Study	Population	Reported Injury Rates by Classification Impairment				Outcomes
			Classification Impairment	Total Athletes	Number Of Injured Athletes	IP (per 100 athlete)	IR (Per 1000 Athlete-Days) (95% CI)	
			Limb Deficiency	5	4	80%	-	(52.4%) reported experiencing an injury that affected their weekly training regimen. all participants (21/21) engaged in strength training, and a high percentage (90.5%) incorporated stretching into their training routines.
			Short Stature	3	3	100%	-	
			Visual Impairment					

Table 2. Summary of documented injury rates, incidence, and prevalence in para sports, organized by impairment classification.

DISCUSSION

The purpose of this study was to assess injury incidence rates across different impairment classifications in para-sport athletes. The findings revealed significant variability in injury prevalence and incidence between classifications, likely influenced by differences in how injuries were defined. Considering the extensive range of impairment clasification in para-sports, it is unlikely that all types and classifications were fully represented in the included studies (Luijten et al., 2023).

The injury incidence rates among athletes with visual impairments, particularly judokas, are difficult to compare due to inconsistencies in how these rates are reported, with many studies calculating injuries per 1,000 athlete-days rather than per bout. In visually impaired judo athletes, the overall injury rate was unaffected by their vision classification, suggesting that the severity of visual impairment did not significantly alter injury patterns. This observation is consistent with findings from other sports involving visually impaired athletes. Additional research is needed to pinpoint specific risk factors associated with impairments, training methods, and the potential effectiveness of customized injury prevention strategies for Paralympic judo (Gutiérrez-Santiago et al., 2020).

Both this study and earlier research found that athletes with limb deficiencies reported a significant number of injuries. Many of these injured athletes regularly used prostheses in their daily lives but competed in wheelchair sports. One possible reason for the high injury rates could be the increased intensity of wheelchair sports for these athletes compared to those with conditions like spinal cord injuries (SCI) (Fagher et al., 2020).

Athletes with neurological disorders exhibit a higher prevalence of medical conditions compared to those with musculoskeletal disorders, with many of these conditions significantly impacting their sports performance and training quality. Both groups, however, experience high rates of musculoskeletal injuries, especially in the upper extremities and the lumbosacral region (Steffen et al., 2022). When comparing different impairment groups, athletes with Cerebral Palsy were found to exhibit increased muscle tone, which may hinder their ability to perform full and powerful eccentric muscle contractions in the lower limbs during sprinting and long-distance running. The physiological differences between athletes with and without Cerebral Palsy might offer

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some protective advantages against lower limb injuries. Nevertheless, additional research is necessary to better understand the biomechanical adaptations in ambulant athletes with increased lower extremity muscle tone.

Studies on injury risks in track and field events at the Paralympic Games revealed that athletes competing in wheelchair or seated throwing events were more susceptible to upper extremity injuries than those participating in wheelchair racing. Additional biomechanical research is required to better understand the underlying injury mechanisms. One hypothesis suggests that the heightened risk for seated throwing athletes is linked to the explosive nature of their throws, which resembles injury patterns seen in other throwing disciplines. Therefore, future shoulder injury prevention programs should focus on seated throwing athletes, emphasizing scapular stabilization to address kinetic chain dysfunctions, such as glenohumeral internal rotation deficits, and incorporating closed kinetic chain exercises to maintain muscle balance (Blauwet et al., 2016).

Understanding the relationship of injury incidence to impairment classification is essential for the prevention and planning of medical services and adaptive devices required to manage injuries to athletes. Heterogeneity in sports and different levels of impairment classifications result in differences in information on the incidence of athletes' injuries. In addition, this study may be limited by the underreporting of injury incidence, which may not indicate the actual number of injuries in the field. The current evidence is limited to the rate of injury incidence versus impairment classification in para-sport athletes.

CONCLUSION

This study revealed differences in injury incidence among para-sport athletes based on impairment classification, with a higher prevalence observed in athletes with limb deficiencies, neurological impairments, and visual impairments. The diversity of impairment classifications and the lack of comprehensive data hinder a complete understanding of injuries, highlighting the need for further research to establish effective prevention strategies and improve medical services.

ACKNOWLEDGEMENT

The authors appreciation to Physiotherapy Department, Universitas Muhammadiyah Surakarta for providing the facilities and support this research.

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