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A Literature Review: Epidemiology of Injuries in Paralympic Athletes

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ABSTRACT

The continued growth of international sporting competition for athletes with disabilities, known as the Paralympics, requires a comprehensive understanding of injury patterns in Winter and Summer Paralympic athletes. Previous studies on Paralympic injury incidence have often been limited to athletes from a specific country, a single Paralympic event, or a specific sport, creating challenges in mapping injury patterns across a diverse Paralympic athlete population. This study aimed to identify injury incidence by sex, age, anatomical region, sport, season of competition, and injury onset, or to map injury patterns in Paralympic athletes. A literature review was conducted using Google Scholar, PubMed, and Scopus. Article quality was assessed using the Newcastle-Ottawa Scale (NOS), with six articles meeting the criteria. Four articles addressed the Winter Paralympics, and two addressed the Summer Paralympics. Results showed the highest injury incidence occurred in men around 35 years of age, primarily in the shoulder, during competition, and generally due to acute trauma. Differences in sport between the Winter and Summer Paralympics contribute to variations in injury incidence. However, 5-a-side football (Summer) and alpine skiing (Winter) consistently showed the highest injury rates. Study limitations include differences in measurement methods, athlete heterogeneity, and sport variation. These findings are important for tailoring injury prevention strategies to specific sports and athlete characteristics.

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INTRODUCTION

In recent years, there has been significant growth in participation in elite sports competitions for athletes with disabilities, now better known as para-athletes (Dehghansai et al., 2017; Fapojuwo et al., 2022; Gajardo et al., 2019). The global sports movement for people with disabilities, namely the Paralympic Movement, provides sporting opportunities for athletes with physical, visual and intellectual impairments, from grassroots level to elite level, with the Paralympics as the main event (A. Gutiérrez-Santiago et al., 2020; Fagher et al., 2016; P. Chandan & Dubon, 2019). Participation in sporting activities has many positive health effects, especially for people with disabilities, as individuals with disabilities tend to have lower physical fitness levels than individuals without disabilities (Fagher et al., 2016; Martin, 2013). Although participation in sports is very beneficial, it also carries the risk of musculoskeletal injuries (Pinheiro, Ocarino, Madaleno, Verhagen, Mello, et al., 2021; Rahman & Budi, 2022; Varkiani et al., 2020).

One cause of musculoskeletal injuries is excessive repetitive activity involving improper movements (Pristianto et al., 2022). Previous research by Fagher & Lexell (2014) showed that injury rates in Paralympic sports are generally high (Derman et al., 2020) with a tendency for more injuries compared to sports for healthy athletes (Soligard et al., 2017). Despite the increasing participation of persons with disabilities in sports, there are still some gaps in understanding injury patterns and risk factors among athletes (Bahr et al., 2017; Clarsen et al., 2020; Steffen et al., 2022; Van De Vliet, 2012). Sports injuries cause problems for all athletes, but for athletes with disabilities they often cause additional problems because there will be further limitations on their already restricted activities of daily living (Fagher et al., 2020; Tuakli-Wosornu et al., 2018; Weiler et al., 2016). Furthermore, injuries can potentially force athletes to take a break from competition, or fatal permanent injuries can prevent athletes from competing forever or cause them to retire early (Clarsen et al., 2014; Hanief & Umar, 2020). In this case, preventing injuries is the first step in understanding the extent of sports injury problems. (Finch et al., 2017; Igolnikov et al., 2018; Pinheiro, Ocarino, Madaleno, Verhagen, De Mello, et al., 2021).

In recent years, the publication of literature on the epidemiology of sports medicine for persons with disabilities has slowed down (Kong & Yam, 2022; Webborn et al., 2012). The epidemiology of injuries in Olympic sports has been studied extensively, whereas Paralympic sports have not been researched in detail (Hollander et al., 2020; Tenforde et al., 2019). To address these shortcomings, the International Paralympic Committee (IPC) Injury Surveillance System (ISS) monitors injuries as part of its efforts to maintain the health of athletes in several ways, including high-quality epidemiological research on injuries and illnesses at the Paralympic Games (Derman et al., 2013; Webborn et al., 2012; Webborn & Emery, 2014). Long-term injury surveillance provides epidemiological data that is essential for identifying and subsequently reducing injuries and illnesses in sport (Engebretsen et al., 2013; Heneghan et al., 2020). Observing the results of injury monitoring at the Paralympics reveals several patterns of injury based on gender, age, anatomical area, and sport, both in the Summer and Winter Paralympics (Kasińska et al., 2022; Rudolph & Willick, 2018; Slocum et al., 2015).

Longitudinal research should continue over several seasons, given the importance of identifying athletes' health issues that require attention, intervention, and further monitoring (Busch et al., 2021; Hirschmüller et al., 2021). Based on several previous studies discussing the incidence of Paralympic injuries, these were limited to athletes from certain countries (Bauerfeind et al., 2015; Jarraya et al., 2021; Park & Sung, 2022), one Paralympic event

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(Derman, Runciman, et al., 2018; Webborn et al., 2012, 2016) or a particular sport (Derman, Blauwet, et al., 2018; Gutiérrez-Santiago et al., 2020; Sá et al., 2022). Thus, the above discussion challenges the author to develop existing research by conducting a systematic review of the diverse Paralympic population, namely the Winter Paralympics and Summer Paralympics. This study aims to identify the overall incidence of injuries based on type, group, and location, or commonly referred to as injury patterns in sports for athletes during the Paralympics, to assist in developing effective injury prevention and management strategies for para-athletes.

METHODS

This study employs a qualitative research design using a Systematic Literature Review (SLR) approach.

Data Sources

Searches were conducted using the Google Scholar, PubMed and Scopus databases. Articles were searched for by entering the keywords 'Sport Injury' OR 'Sport Injuries' AND 'Winter Paralympic' AND 'Summer Paralympic' AND 'Para Athletes'.

Selection Criteria

The inclusion criteria for this study were: (1) full-text articles in English, (2) cohort studies, (3) athletes participating in the Paralympic Games (4) injuries related to Paralympic sports, and (5) no time frame for the articles searched. The exclusion criteria for this study are: (1) e-books and (2) articles in the press.

Articles obtained from the database will be selected using Mendeley software. The selection process involves removing duplicates, studies, titles and abstracts that are irrelevant and do not meet the inclusion criteria.

Data Extraction

Data were extracted independently from the articles to be reviewed based on author, year, study, sample size, population, and research outcomes in the form of injury patterns based on gender, age, anatomical region, sport, competition season, and injury onset (Tables 1 and 3).

Asesment of Study Quality

The study assessment in this research used the Newcastle-Ottawa Scale (NOS) for data collection from all articles with cohort studies to be reviewed (Table 2). NOS is the result of ongoing collaboration between Newcastle University (Australia) and the University of Ottawa (Canada). Of the many methodological quality assessments for cohort studies, NOS is the most commonly used tool and can be modified based on specific subjects (Ma et al., 2020).

The NOS in the cohort study contains eight items and is categorised into three dimensions, namely selection, comparability and outcome. Each item is given a maximum of one star in the selection and outcome categories, while the comparability category is given a maximum of two stars. The quality of the NOS assessment based on AHRQ standards is as follows: (good quality) if there are 3 or 4 stars in the selection domain AND 1 or 2 stars in the comparability domain AND 2 or 3 stars in the outcome domain; (fair quality) if there are 2 stars in the selection domain AND 1 or 2 stars in the comparability domain AND 2 or 3 stars in the outcome domain; (poor quality) if there are 0 or 1 stars in the selection domain OR 0 stars in the comparability domain OR 0 or 1 stars in the outcome domain.

RESULTS

The search for articles through four databases yielded a total of 330 articles, which were then duplicated and removed from the four databases, resulting in 271 articles. The selection

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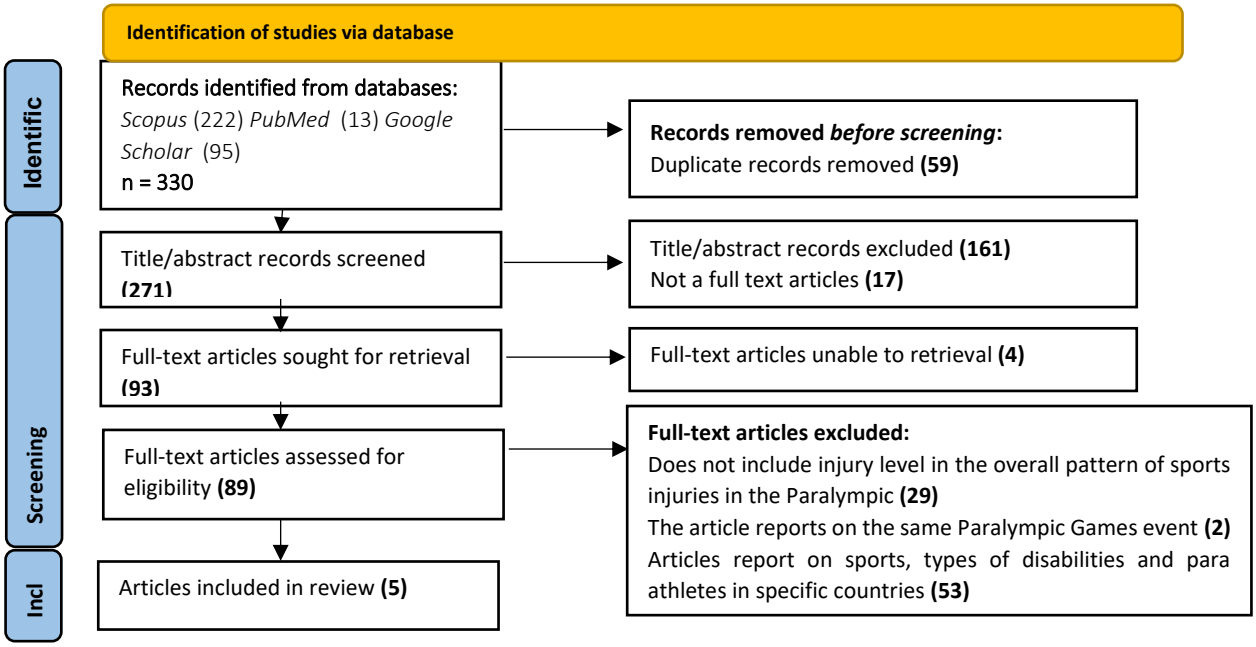
of articles continued by removing articles that did not meet the inclusion criteria. A total of 161 article titles/abstracts and 17 non-full texts in English were excluded, leaving 93 full-text articles. However, 4 of these articles could not be retrieved due to access limitations. Of the remaining 89 full texts, six articles containing the research data sought were selected. Article selection based on the database using PRISMA revealed six articles containing data on the incidence of Paralympic injuries overall, based on gender, age, anatomical area, sport, competition season, and onset of injury at Paralympic competitions in both the Winter and Summer Paralympics (Figure 1).

Figure 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases



Quality Asessment Results

Based on the results of the article quality assessment using the NOS as described above, the six articles collected showed good quality according to the assessment criteria mentioned above.

Articel Search Sampel and Populations

Only a few articles discuss the overall incidence of injuries among athletes at the Paralympics. This is related to the monitoring of injuries at the Paralympics and the 2012 London Summer Paralympic Games (Webborn et al., 2012). The article will be reviewed based on a sample and the overall population of Paralympic athletes. The Stoke Mandeville Games were the first Paralympic Games held in 1960, but only six articles were able to represent the injuries of athletes after injury surveillance was conducted at the Paralympics (Table 1).

Article Search Result by Gender

The incidence rate (IR) of injuries based on gender did not show significant differences in any Paralympic event. However, the total number of injuries at each Paralympic Games is dominated by men. The highest number of injuries among men at the Summer Paralympic Games in London 2012 was 437 injuries with an IR of 13.3, and at the Winter Paralympic Games in Sochi 2014, it was 134 injuries with an IR of 26.7.

Article Search Result by Age

Athletes aged ≤25 years showed the lowest injury rates at each Paralympic Games. There was little difference in injury rates between those aged 26–34 years and those aged ≥35 years. The Winter Paralympics showed higher injury rates than the Summer Paralympics

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across all age groups. The 2014 Sochi Winter Paralympic Games had the highest injury rates among athletes aged ≥35 years.

Table 1. Articel Search Sampel and Populations

No	Author	Year	Sampel	Populasi
1.	Derman et al	2016	547 athletes and 4 sports	Athletes participating at the Sochi 2014 Winter Paralympic Games
2.	Derman et al	2018	3657 athletes and 22 sports	Athletes participating in each sport at the Rio 2016 Summer Paralympic Games
3.	Derman et al	2020	567 athletes and 5 sports	Athletes participating at the Pyeongchang 2018 Paralympic Winter Games
4.	Webborn et al	2012	505 athletes and 4 sports	Athletes participating at the Vancouver 2010 Paralympic Winter Games
5.	Willick et al	2013	4176 athletes and 21 sports	Athletes participating at the London 2012 Summer Paralympic Games

Article Search Result by Anatomical Region

The upper extremities are the anatomical region most frequently affected by injuries in every Paralympic competition, with injuries to the shoulder region being the most common. There is a limited number of articles discussing injuries based on anatomical region. Of the six Paralympics collected, only three articles included injuries based on region. Two of these were Winter Paralympics, while the Summer Paralympics were only included for Rio 2016. When looking at the overall Paralympic injuries by anatomical region based on the articles collected, the Summer Paralympics had a much lower incidence of injury than the Winter Paralympics. Comparing the two Winter Paralympics, the incidence rate of several anatomical regions at PyeongChang 2018 showed a decrease in injuries, but the lower extremities were more dominant.

Article Search Result by Sports

Two of the four articles discussing the Winter Paralympics present research results on injury rates based on the total number of injuries. Four of the six articles collected show injury results based on incidence rates. As athlete participation in the Winter Paralympics increases, the number of sports in the Winter Paralympics also grows each year, so the four articles discussing the Winter Paralympics have data on injuries to athletes in various types of sports. With the addition of sports in each Paralympic competition, the highest and lowest injury incidents also have varying results in each competition. The 2014 Sochi Winter Paralympics showed the highest injury rates in two sports, namely ice sledge hockey and wheelchair curling, based on the incidence rate results. The 2010 Vancouver Winter Paralympics (Webborn et al., 2012) showed a very significant difference in the total number of injuries, which was more than double in each sport. Nordic skiing had the lowest injury incidence based on the total number of injuries and incidence rate, while wheelchair curling was the sport with the fewest injuries during the competition. Alpine skiing and snowboarding were the sports with the highest number of injuries at every Winter Paralympics.

Football 5-a-side was the sport with the highest number of injuries at both Summer Paralympics, namely London 2012 and Rio 2016. Interestingly, judo had the same incidence rate of 15.5 at both Summer Paralympics. Wheelchair tennis, wheelchair basketball, and

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sitting volleyball showed no significant differences. The lowest injury rates at the Summer Paralympics were shooting at London 2012 and boccia at Rio 2016.

Tabel 2. Quality of studies

	Webborn et al.,2012	Derman et al., 2016	Derman et al., 2020	Willick et al, 2013	Derman et al., 2018
1) Representativeness of the exposed cohort a. Truly representative (one star) b. Somewhat representative (one star) c. Selected group d. No description of the derivation of the cohort	a*	a*	a*	a*	a*
2) Selection of the non-exposed cohort a. Drawn from the same community as the exposed cohort (one star) b. Drawn from a different source c. No description of the derivation of the non exposed cohort	a*	a*	a*	a*	a*
3) Ascertainment of exposure a. Secure record (e.g., surgical record) (one star) b. Structured interview (one star) c. Written self report d. No description e. Other	a*	a*	a*	a*	a*
4) Demonstration that outcome of interest was not present at start of study a. Yes (one star) b. No	a*	a*	a*	a*	a*
1) Comparability of cohorts on the basis of the design or analysis controlled for confounders a. The study controls for age, sex and marital status (one star) b. Study controls for other factors (list) (one star) **c.** Cohorts are not comparable on the basis of the design or analysis controlled for confounders	a*	a*	a*	a*	a*
1) Assessment of outcome a. Independent blind assessment (one star) b. Record linkage (one star) c. Self report d. No description e. Other	a*	a*	a*	a*	a*
2) Was follow-up long enough for outcomes to occur a. Yes (one star) b. No c. Indicate the median duration of follow-up and a brief rationale for the assessment above:_____	a*	a*	a*	a*	a*
3) Adequacy of follow-up of cohorts a. Complete follow up- all subject accounted for (one star) b. Subjects lost to follow up unlikely to introduce bias- number lost less than or equal to 20% or description of those lost suggested no different from those followed. (one star) c. Follow up rate less than 80% and no description of those lost d. No statement	a*	a*	a*	b*	b*
QUALITY OF STUDIES	Good	Good	Good	Good	Good

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Article Search Result by Pre-competition and Competition Period

Three Paralympic sports consistently recorded the highest number of injuries during the competition period. The highest number of competition injuries was recorded at the Rio 2016 Summer Paralympics with 369 cases. Meanwhile, the Vancouver 2010 Winter Paralympics recorded the lowest number of pre-competition injuries with 31 cases.

Article Search Result by Onset

Each article presents different results on the level of paralympic injuries based on onset, namely in the form of percentages, incidence rates (IR), or total number of injuries. At London 2012 (Summer), Acute Traumatic Injuries were the highest at 51.5%, followed by Chronic Overuse at 31.8%, and Acute on Chronic at 16.7%. At Vancouver 2010 (Winter), Chronic Overuse (Acute overuse) at 57.5% was the highest, followed by Acute Traumatic Injuries (Acute traumatic) at 40.8% and Acute on Chronic (Acute on chronic) at 0.8%. The 2014 Sochi Winter Paralympics showed the highest acute traumatic and acute on chronic results based on the total number of injuries and incidence rate. The highest chronic overuse injuries were recorded at the 2010 Vancouver Winter Paralympics based on percentage. In general, acute traumatic injuries are the most common type of injury experienced by athletes in Paralympic competitions.

DISCUSSION

Previous studies on the epidemiology of Paralympic injuries have shown significant limitations, which are generally restricted to athletes from certain countries, a single Paralympic event (such as London 2012), or specific sports. These limitations hinder a comprehensive understanding of injury patterns in the diverse population of Paralympic athletes. This systematic review addresses this gap by building on existing research through a systematic review of a more diverse Paralympic population, namely the Winter and Summer Paralympics as a whole. By collating data from six articles covering several Summer and Winter Paralympics, this study aims to present a broader mapping of injury patterns based on gender, age, anatomical region, sport, competition season, and injury onset to aid in the development of more effective prevention and management strategies for para-athletes. The injury patterns obtained in this study show that injuries based on age and gender do not differ significantly in each competition. However, overall, men have a higher injury rate than women in the Paralympics.

Each article categorises age into three groups: ≤25 years, 26–34 years, and ≥35 years. Those aged ≥35 years experience more injuries, while those aged ≤25 years experience fewer injuries. These findings are consistent with the results of a study by Willick et al. (2013) included in this review, whose data showed the highest IR in men (13.3) compared to women (11.5) in London 2012, as well as the highest IR in the 26-34 age group (14.5) and ≥35 years (12.1) compared to <25 years (11.3). The results of this study can be taken into consideration by the International Paralympic Committee (IPC) and various sports federations in setting minimum and maximum age limits for Paralympic competitions (Willick et al., 2013).

The high number of upper limb injuries is not surprising and is supported by other literature (Tenforde et al., 2019), especially in the shoulder, which is the area most frequently injured. This is because para-athletes, especially wheelchair users, require more intensive use of their upper limbs to participate in all para sports. (Tenforde et al., 2019).

The development and differences between sports in the Winter and Summer Paralympics result in different injury rates. Consistently, in the Winter Paralympics, Alpine Skiing and Snowboarding are the sports with the highest injury rates. This is attributed to the

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nature of these two sports as high-speed sports (seated or standing), which directly increase the rate and severity of injuries (Tuakli-Wosornu et al., 2018). Conversely, the lowest injury rates are found in Nordic Skiing and Wheelchair Curling. Meanwhile, at the Summer Paralympics, 5-a-side Football (for visually impaired athletes) showed the highest injury rate, while shooting and Boccia recorded the lowest rates. The injury pattern in 5-a-side Football tends to be dominated by lower extremities and acute trauma, similar to the injury pattern found in football players without disabilities (Bragaru et al., 2011; Webborn et al., 2016). These findings confirm that although para-athletes have disabilities, the mechanisms and patterns of injury in certain sports can resemble those of non-disabled athletes, requiring an injury prevention approach tailored to the physical demands of the sport.

There has been no change in the incidence of injuries in judo at both Summer Paralympics, in line with research indicating that 84% of athletes with quadriplegia participating in judo suffer from multiple injuries (Fagher et al., 2019). Furthermore, data collected through the questionnaire revealed that 45 Paralympic judokas responded that they had experienced traumatic injuries, and half of those injuries resulted in more than 21 days of lost time. Injuries in judo with visual impairment must be further studied in terms of severity and location, as they can have serious consequences for para judo athletes.

The International Paralympic Committee (IPC) defines a sports injury as a musculoskeletal complaint that has just occurred or recurred during competition or training and requires further medical attention, regardless of the potential absence from competition or training (Engebretsen et al., 2013). According to Igolnikov's research (Igolnikov et al., 2018), there are three classifications of sports injuries based on the time of occurrence, namely: (1) acute traumatic injuries, which are single events that cause major trauma to previously healthy tissue; (2) acute injuries in chronic injuries, which are the same type of injury in the same location as a previous injury; and (3) chronic injuries due to overuse, which are manifestations of previous acute traumatic injuries or acute injuries in chronic injuries. This reflects the important role of injury prevention, as each type of injury has different risk factors and mechanisms. Acute traumatic injuries are the most common type. However, data from Vancouver 2010 shows a high percentage of chronic injuries due to overuse, reflecting the importance of tailored injury prevention due to differences in risk factors and mechanisms for each type of injury. Winter sports require further attention, not only in terms of understanding common injuries, but also in terms of a broader understanding of injuries related to disability, rules and regulations in sports, as well as prosthetics and adaptive equipment used (Oh et al., 2019). One preventive measure based on the results of injury observations in one study has shown that mandatory periodic health evaluations prior to the Summer Paralympics can reduce overall injury rates and improve athlete performance (Gawroński et al., 2013).

Understanding injury patterns in sports is important not only for prevention but also for planning medical services, changes in regulations and game rules, and adaptive equipment to address athlete injuries. Heterogeneity in sports, the existence of modalities and also different levels of athlete classification for the same modality, increases the inconsistency of information about musculoskeletal injury events in athletes. The limitations of this study may also be due to the fact that some athletes may not report certain injuries at all and that some injuries may have been treated by the athletes' medical staff. This does not reflect the actual number of injuries that occur on the field. Therefore, the current evidence is still limited to the incidence rates reported in each article, both for the Winter Paralympics and the Summer Paralympics.

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CONCLUSION

The conclusion of this study is that athletes, sports teams, coaches, and medical staff should be aware of the high incidence of musculoskeletal injuries identified among para-athletes. Mapping of overall injury patterns shows that injuries predominantly occur in men, athletes over 35 years of age, localised in the upper extremities (shoulders), most often during competition periods, and generally due to acute trauma. These findings serve as material for evaluation and comparison for future Paralympics. It is hoped that these results will be a starting point for further high-quality research, as well as assist in designing and implementing effective injury prevention strategies specific to sports and athlete characteristics in order to optimise the quality of life and performance of athletes with disabilities.

AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

REFERENCES

Bahr, R., Clarsen, B., & Ekstrand, J. (2018). Why we should focus on the burden of injuries and illnesses, not just their incidence. *British journal of sports medicine*, *52*(16), 1018-1021.

Bauerfeind, J., Koper, M., Wieczorek, J., Urbański, P., & Tasiemski, T. (2015). Sports injuries in wheelchair rugby–a pilot study. *Journal of human kinetics*, *48*, 123.

Bragaru, M., Dekker, R., Geertzen, J. H., & Dijkstra, P. U. (2011). Amputees and sports: a systematic review. *Sports medicine*, *41*(9), 721-740.

Busch, A., Kubosch, EJ, K. (2021). Health Problems in German Paralympic Athletes Preparing for the 2020 Tokyo Paralympic Games. *German Journal of Sports Medicine/Deutsche Zeitschrift fur Sportmedizin*, *72*(4).

Clarsen, B., Bahr, R., Myklebust, G., Andersson, S. H., Docking, S. I., Drew, M., ... & Verhagen, E. (2020). Improved reporting of overuse injuries and health problems in sport: an update of the Oslo Sport Trauma Research Center questionnaires. *British journal of sports medicine*, *54*(7), 390-396.

Clarsen, B., Rønsen, O., Myklebust, G., Flørenes, T. W., & Bahr, R. (2014). The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes. *British journal of sports medicine*, *48*(9), 754-760.

Dehghansai, N., Lemez, S., Wattie, N., & Baker, J. (2017). A systematic review of influences on development of athletes with disabilities. *Adapted physical activity quarterly*, *34*(1), 72-90.

Derman, W., Blauwet, C., Webborn, N., Schwellnus, M., Van de Vliet, P., & Lazarovski, D. (2018). Mitigating risk of injury in alpine skiing in the Pyeongchang 2018 Paralympic Winter Games: the time is now!. *British journal of sports medicine*, *52*(7), 419-420.

Derman, W., Runciman, P., Jordaan, E., Schwellnus, M., Blauwet, C., Webborn, N., Lexell, J., Van De Vliet, P., Kissick, J., Stomphorst, J., Lee, Y. H., & Kim, K. S. (2020). High incidence of injuries at the Pyeongchang 2018 Paralympic Winter Games: a prospective cohort study of 6804 athlete days. *British Journal of Sports Medicine*, *54*(1), 38–43. https://doi.org/10.1136/bjsports-2018-100170

DOI: https://doi.org/10.17509/jpjo.v10i2.88953
p- 2797-2038 e- ISSN 2614-5626

Derman, W., Runciman, P., Schwellnus, M., Jordaan, E., Blauwet, C., Webborn, N., ... & Stomphorst, J. (2018). High precompetition injury rate dominates the injury profile at the Rio 2016 Summer Paralympic Games: a prospective cohort study of 51 198 athlete days. *British journal of sports medicine*, *52*(1), 24-31.

Derman, W., Schwellnus, M., Jordaan, E., Blauwet, C. A., Emery, C., Pit-Grosheide, P., ... & Willick, S. E. (2013). Illness and injury in athletes during the competition period at the London 2012 Paralympic Games: development and implementation of a web-based surveillance system (WEB-IISS) for team medical staff. *British Journal of Sports Medicine*, *47*(7), 420-425.

Ebrahimi, V. M., Alizadeh, M. H., Rajabi, R., & Minoonejad, H. (2020). *Comparing two sports injury surveillance systems: A novel systematic approach*.10(3).

Engebretsen, L., Soligard, T., Steffen, K., Alonso, J. M., Aubry, M., Budgett, R., ... & Renström, P. A. (2013). Sports injuries and illnesses during the London Summer Olympic Games 2012. *British journal of sports medicine*, *47*(7), 407-414.

Fagher, K., Ahmed, O. H., Pernheim, N., & Varkey, E. (2019). Prevalence of sports-related injuries in Paralympic judo: an exploratory study. *Journal of science and medicine in sport*, *22*(8), 902-906.

Fagher, K., Dahlström, Ö., Jacobsson, J., Timpka, T., & Lexell, J. (2020). Injuries and illnesses in Swedish Paralympic athletes—A 52-week prospective study of incidence and risk factors. *Scandinavian Journal of Medicine & Science in Sports*, *30*(8), 1457-1470.

Fagher, K., Jacobsson, J., Timpka, T., Dahlström, Ö., & Lexell, J. (2016). The Sports-Related Injuries and Illnesses in Paralympic Sport Study (SRIIPSS): a study protocol for a prospective longitudinal study. *BMC sports science, medicine and rehabilitation*, *8*(1), 28.

Fapojuwo, O., Kareem, R., & Bejide, O. (2022). Prevalence, pattern, and risk factors of musculoskeletal injuries among wheelchair athletes in Lagos, Nigeria. *Human Movement*, *23*(4), 156-164.

Finch, C. F., Bahr, R., Drezner, J. A., Dvorak, J., Engebretsen, L., Hewett, T., ... & Verhagen, E. (2017). Towards the reduction of injury and illness in athletes: defining our research priorities. *British journal of sports medicine*, *51*(16), 1178-1182.

Gajardo, R., Aravena, C., Fontanilla, M., Barría, M., & Saavedra, C. (2019). Injuries and illness prevalence prior to competition in Goalball players. *Journal of Visual Impairment & Blindness*, *113*(5), 443-451.

Gawroński, W., Sobiecka, J., & Malesza, J. (2013). Fit and healthy Paralympians—medical care guidelines for disabled athletes: a study of the injuries and illnesses incurred by the Polish Paralympic team in Beijing 2008 and London 2012. *British journal of sports medicine*, *47*(13), 844-849.

Gutiérrez-Santiago, A., Prieto-Lage, I., Martín, A., & Ayán, C. (2020). Sport injuries in elite paralympic judokas: Findings from the 2018 world championship. *Journal of physical activity and health*, *17*(11), 1162-1170.

Gutiérrez-Santiago, A., Prieto-Lage, I., Martín, A., & Ayán, C. (2020). Sport injuries in elite paralympic judokas: Findings from the 2018 world championship. *Journal of physical activity and health*, *17*(11), 1162-1170.

Hanief, Y. N., & Umar, F. (2020). The characteristics of Indonesian para-cycling athletes' injuries. *Advances in Rehabilitation*, *34*(3), 37–46.

DOI: https://doi.org/10.17509/tegar.v9i1.91417
p-2614-5626 e- ISSN 2614-5626

Heneghan, N. R., Heathcote, L., Martin, P., Spencer, S., & Rushton, A. (2020). Injury surveillance in elite Paralympic athletes with limb deficiency: a retrospective analysis of upper quadrant injuries. *BMC sports science, medicine and rehabilitation*, *12*(1), 36.

Hirschmüller, A., Fassbender, K., Kubosch, J., Leonhart, R., & Steffen, K. (2021). Injury and illness surveillance in elite para athletes: an urgent need for suitable illness prevention strategies. *American Journal of Physical Medicine & Rehabilitation*, *100*(2), 173-180.

Hollander, K., Kluge, S., Glöer, F., Riepenhof, H., Zech, A., & Junge, A. (2020). Epidemiology of injuries during the wheelchair Basketball world Championships 2018: a prospective cohort study. *Scandinavian journal of medicine & science in sports*, *30*(1), 199-207.

Igolnikov, I., Gallagher, R. M., & Hainline, B. (2018). Sport-related injury and pain classification. *Handbook of clinical neurology*, *158*, 423-430.

Jarraya, M., Blauwet, C. A., Crema, M. D., Heiss, R., Roemer, F. W., Hayashi, D., ... & Guermazi, A. (2021). Sports injuries at the Rio de Janeiro 2016 Summer Paralympic Games: use of diagnostic imaging services. *European radiology*, *31*(9), 6768-6779.

Kasińska, Z., Urbański, P. K., & Tasiemski, T. (2022). Sports injuries among players of the polish national team in amputee football in the annual training cycle. *Journal of human kinetics*, *81*, 211.

Kong, P. W., & Yam, J. W. (2022). Shoulder biomechanics of para-table tennis: a case study of a standing class para-athlete with severe leg impairment. *BMC Sports Science, Medicine and Rehabilitation*, *14*(1), 143.

Ma, L. L., Wang, Y. Y., Yang, Z. H., Huang, D., Weng, H., & Zeng, X. T. (2020). Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: what are they and which is better?. *Military Medical Research*, *7*(1), 7.

Martin, J. J. (2013). Benefits and barriers to physical activity for individuals with disabilities: a social-relational model of disability perspective. *Disability and rehabilitation*, *35*(24), 2030-2037.

Oh, H., Johnson, W., & Syrop, I. P. (2019). Winter adaptive sports participation, injuries, and equipment. *Sports medicine and arthroscopy review*, *27*(2), 56-59.

P. Chandan, & Dubon, M. E. (2019). Clinical Considerations and Resources for Youth Athletes with Intellectual Disability: a Review with a Focus on Special Olympics International. *Curr. Phys. Med. Rehabil. Reports*, *77*(2), 116–125.

Park, H., & You, J. S. H. (2022). Sports Injury and Physiotherapy Services in the 2018 PyeongChang Winter Paralympic Games: Considerations and Potential Recommendations for Future Paralympics. *Archives of Physical Medicine and Rehabilitation*, *103*(3), e32.

Pinheiro, L. S. P., Ocarino, J. M., Madaleno, F. O., Verhagen, E., de Mello, M. T., Albuquerque, M. R., ... & Resende, R. A. (2021). Prevalence and incidence of injuries in para athletes: a systematic review with meta-analysis and GRADE recommendations. *British journal of sports medicine*, *55*(23), 1357-1365.

Pristianto, A., Andini, R. M., & Naufal, A. F. (2022). Kejadian Cedera Muskuloskeletal Saat Melakukan Exercise Selama Masa Pandemi Covid-19: Incidence Of Musculoskeletal Injury In Exercise During The Covid-19 Pandemic. *Quality: Jurnal Kesehatan*, *16*(1), 73-81.

DOI: https://doi.org/10.17509/jpjo.v10i2.88953
p- 2797-2038 e- ISSN 2614-5626

Rahman, F., & Budi, I. S. (2022). Dapatkah Latihan Intensitas Sedang Mengoptimalkan Sistem Imun?: Does Exercise Improve Immune System?. *Medical Sains: Jurnal Ilmiah Kefarmasian*, *7*(1), 145-154.

Rudolph, L., & Willick, S. E. (2018). *Review of injury epidemiology in Paralympic sports.* In A. J. De Luigi (Ed.), *Adaptive Sports Medicine: A Clinical Guide*,51–58.

Sá, K., Costa e Silva, A., Gorla, J., Silva, A., & Magno e Silva, M. (2022). Injuries in wheelchair basketball players: a systematic review. *International journal of environmental research and public health*, *19*(10), 5869.

Slocum, C., Blauwet, C. A., & Anne Allen, J. B. (2015). Sports medicine considerations for the paralympic athlete. *Current Physical Medicine and Rehabilitation Reports*, *3*(1), 25-35.

Soligard, T., Steffen, K., Palmer, D., Alonso, J. M., Bahr, R., Lopes, A. D., ... & Engebretsen, L. (2017). Sports injury and illness incidence in the Rio de Janeiro 2016 Olympic summer games: a prospective study of 11274 athletes from 207 countries. *British Journal of Sports Medicine*, *51*(17), 1265-1271.

Steffen, K., Clarsen, B., Gjelsvik, H., Haugvad, L., Koivisto-Mørk, A., Bahr, R., & Berge, H. M. (2022). Illness and injury among Norwegian Para athletes over five consecutive Paralympic Summer and Winter Games cycles: prevailing high illness burden on the road from 2012 to 2020. *British journal of sports medicine*, *56*(4), 204-212.

Tenforde, A. S., Brook, E. M., Broad, E., Matzkin, E. G., Yang, H. Y., Collins, J. E., ... & Blauwet, C. A. (2019). Prevalence and anatomical distribution of bone stress injuries in the elite para athlete. *American Journal of Physical Medicine & Rehabilitation*, *98*(11), 1036-1040.

Tuakli-Wosornu, Y. A., Mashkovskiy, E., Ottesen, T., Gentry, M., Jensen, D., & Webborn, N. (2018). Acute and chronic musculoskeletal injury in para sport: a critical review. *Physical Medicine and Rehabilitation Clinics*, *29*(2), 205-243.

Van de Vliet, P. (2012). Paralympic athlete's health. *British journal of sports medicine*, *46*(7), 458-459.

Webborn, N., & Emery, C. (2014). Descriptive epidemiology of Paralympic sports injuries. *PM&R*, *6*, S18-S22.

Webborn, N., Cushman, D., Blauwet, C. A., Emery, C., Derman, W., Schwellnus, M., ... & Willick, S. E. (2016). The epidemiology of injuries in football at the London 2012 Paralympic Games. *PM&R*, *8*(6), 545-552.

Webborn, N., Willick, S., & Emery, C. A. (2012). The injury experience at the 2010 winter paralympic games. *Clinical journal of sport medicine*, *22*(1), 3-9.

Weiler, R., Van Mechelen, W., Fuller, C., & Verhagen, E. (2016). Sport injuries sustained by athletes with disability: a systematic review. *Sports medicine*, *46*(8), 1141-1153.

Willick, S. E., Webborn, N., Emery, C., Blauwet, C. A., Pit-Grosheide, P., Stomphorst, J., ... & Schwellnus, M. (2013). The epidemiology of injuries at the London 2012 Paralympic Games. *British journal of sports medicine*, *47*(7), 426-432.

DOI: https://doi.org/10.17509/tegar.v9i1.91417
p-2614-5626 e- ISSN 2614-5626

Table 3. Included Articles

NO	PARALYMPIC GAMES	TOTAL SAMPLE	TOTAL NUMBER OF INJURIES GENDER	AGE	ANATOMICAL REGION	SPORTS	COMPETITION SESSION	ONSET
			WINTER PARALYMPIC					
1.	Vancouver 2010 (Webborn et al., 2012)	505 athletes	Tidak disebutkan	not specified	not specified	Sledge hockey: 40 injuries Alpine skiing: 41 injuries Nordic skiing : 26 injuries Wheelchair curling: 9 injuries	**Pra-kompetisi:** 31 injuries (25,8%) **Kompetisi:** 39 injuries (32,5%)	**Acute traumatic:** 49 injuries (40,8%) **Acute on chronic:** 1 injuries (0,8%) **Acute overuse:** 69 injuries (57,5%)
2.	Sochi 2014 (Derman et al., 2016)	547 athletes	**Female:** (n=129) 40 injuries IR: 25,8 **Male:** (n=418) 134 injuries IR: 26,7	**13-25 years old:** (n=45) IR: 21,8 **26-34 years old:** (n=1249) IR: 26,1 **>35 years old:**	Upper limb: 8,5 Shoulder/arm/elbow: 6,4 Wrist/hand/ finger: 2,1 Lower limb: 8,4 Knee: 3,8 Ankle/foot/toe: 1,8 Lower leg: 1,1 Thigh/stump: 0,9	Alpine skiing/ snowboarding: 41,1 Cross-country skiing/ biathlon: 8,4 Ice sledge hockey: 26,5 Wheelchair curling: 16,7	Tidak disebutkan	**Acute traumatic:** 117 injuries IR: 17,8 **Acute on chronic:** 25 injuries IR: 4,9 **Chronic overuse:** 32 injuries

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				(n=1174) IR: 31,5	Hip/groin/pelvis: 0,8 Head/face/neck: 4,7 Spine: 2,9 Chest/trunk/ abdomen: 1,1			IR: 3,8
3.	Pyeong Chang 2018 (Derman et al., 2020)	576 athletes	**Female:** (n=134) 30 injuries IR: 24,3 **Male:** (n=433) 82 injuries IR: 19,8	**13-25 years old:** (n=161) IR: 17,6 **26-35 years old:** (n=216) IR: 23,2 **36-75 years old:** (n=190) IR: 21,2	Upper limb: 7,9 Shoulder/arm/elbow: 5,7 Wrist/hand/finger: 2,2 Lower limb: 7,1 Knee: 1,6 Ankle/foot/toe: 1,9 Lower leg: 1,0 Thigh/stump: 1,5 Hip/groin/pelvis: 1,0 Head/face/neck: 4,3 Spine: 0,9 Chest/trunk/abdomen: 0,7	Para snowboard : 40,5 Para alpine skiing : 23,1 Para ice hockey : 22,8 Para Nordic skiing: 13,6 Wheelchair curling : 6,9	**Pra competition:** 33 injuries IR: 19,4 **Competition:** 109 injuries IR: 21,4	**Acute traumatic:** IR: 16,2 **Acute on chronic:** IR: 1,5 **Chronic overuse:** IR: 3,2

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				SUMMER PARALYMPIC				
4.	London 2012 (Willick et al., 2013)	4176 athletes	**Female:** (n=1218) 196 injuries IR: 11,5 **Male:** (n=2347) 437 injuries IR: 13,3	**<25 years old:** (n=1142) IR: 11,3 **26-34 years old:** (n=1249) IR: 14,5 **>35 years old:** (n=1174) IR: 12.1	not specified	Football 5-a-side: 22,4 Powerlifting: 19,3 Goalball: 19,5 Wheelchair fencing: 18,0 Wheelchair rugby: 16,3 Athletics: 15,8 Judo: 15,5 Wheelchair tennis: 12,8 Table tennis: 12,6 Wheelchair basketball: 12,0 Football 7-a-side: 11,2 Seated volleyball: 10,7 Cycling track: 9,3 Equestrian: 9,3 Swimming: 8,7 Archery: 8,4 Boccia: 8,0 Cycling road: 6,7 Sailing: 4,1 Rowing: 3,9 Shooting: 2,2	**Pra competition:** IR: 14,8 **Competition:** IR: 12,1	**Acute traumatic:** 51,5% **Acute on chronic:** 16,7% **Chronic overuse:** 31,8%

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6.	Rio 2016 (Derman et al., 2018)	3657 athletes	**Female:** (n=1389) 183 injuries IR: 10,7 **Male:** (n=2268) 258 injuries IR: 9,5	**12-15 years old:** (n=996) 104 injuries IR: 8,6 **26-34 years old:** (n=1320) 168 injuries IR: 10.4 **35-75 years old:** (n=1341) 169 injuries IR: 10.6	Head and face: 0,1 Neck: 0,7 Shoulder: 1,8 Upper arm: 0,1 Elbow: 0,4 Forearm: 0,2 Wrist, hand and finger: 1,0 Chest wall: 0,2 Trunk and abdomen: 0,1 Thoracic spine: 0,2 Lumbar spine: 0,6 Pelvis/buttock: 0,2 Hip/groin: 0,2 Thigh : 0,6 Stump: 0,0 Knee: 0,7 Lower leg: 0,5 Ankle/foot/toe: 0,9	Football 5-a-side: 22,5 Wheelchair fencing: 15,9 Judo: 15,5 Football 7-a-side: 15,3 Wheelchair rugby: 14,9 Wheelchair basketball: 12,8 Sitting volleyball: 11,8 Wheelchair tennis: 11,4 Para Powerlifting: 11,1 Para Athletics: 10,1 Archery: 10,1 Triathlon: 9,9 Canoe: 9,6 Tabble tennis: 8,6 Sailing : 8,5 Rowing: 7,3 Para Swimming: 7,1 Cycling (track and road): 7,0 Equestrain: 7,0 Shooting Para Sport: 6,6 Goalball: 5,6 Boccia: 4,3	**Pra competition:** 141 injuries IR: 12,9 **Competition:** 369 injuries IR: 9,2	**Acute traumatic:** IR: 5,2 **Acute on chronic:** IR: 1,4 **Chronic overuse:** IR: 3,4

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