Original Article

Injury characteristics of Indonesian para-athletes prior to Tokyo Olympics 2020: a cross-sectional study

Características de lesões em paratletas da Indonésia antes das Olimpíadas de Tóquio em 2020: um estudo transversal

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ABSTRACT | BACKGROUND: Sports for people with disabilities and injuries have been the subject of discourse in the professional literature in the fields of traumatology and sports medicine. **OBJECTIVE:** This research aims to elucidate the injury characteristics of athletes in the Indonesian national team. The subject of this study were nine athletes (male=5, female=4) with males around the age of 28±9.13 and females 28±5.66 years. **METHOD:** The method approach is descriptive with a cross-sectional study technique using a questionnaire about injury history, types of injury, injury factors, and injury management for Indonesian Para Athletics Athletes who have competed in the 2020 Tokyo Olympics. Data analysis is depicted in numbers and percentages and Fisher's exact test is used to determine the relationship between variables. **RESULTS:** The study results reported that Indonesian athletes suffered injuries of the lower limbs (70%), part of the body that is frequently injured was the thigh (28%) and the type of injury that was often experienced sprain/twist. **CONCLUSION:** The injury characteristics in the sprint (track) category form a pattern of injuries to the thigh, Achilles tendon, ankle, and knee. There appears to be no correlation between gender, training frequency, injury share, match number, and warm-up type. The implication is that injury management is necessary before and during competition by considering biomechanics, pathophysiology, and psychosocial problems. Injury prevention strategies by coaches and medical teams should lead to more significant injury reduction and optimize athletes' health, safety, and well-being.

KEYWORDS: Characteristics. Injury. Thigh. Ankle. Lower limb. Parathlete.

RESUMO | OBJETIVOS: Esta pesquisa tem como objetivo elucidar as características das lesões em atletas da seleção da Indonésia. **MÉTODOS:** Os sujeitos deste estudo foram nove atletas (masculino = 5, feminino = 4) com homens em torno da idade de 28 ± 9,13 e mulheres 28 ± 5,66 anos. A abordagem do método é descritiva com uma técnica de estudo transversal usando um questionário sobre histórico de lesões, tipos de lesões, fatores de lesões e gerenciamento de lesões para atletas indonésios que competiram nos Jogos Olímpicos de Tóquio em 2020. A análise de dados é representada em números e porcentagens e o teste exato de Fisher é usado para determinar a relação entre as variáveis. **RESULTADOS:** Os resultados do estudo relataram que os atletas indonésios sofreram lesões nos membros inferiores (70%), a parte do corpo que frequentemente sofre lesões foi a coxa (28%) e o tipo de lesão que frequentemente sofreu foi entorse / torção. **CONCLUSÃO:** As características da lesão na categoria sprint (pista) formam um padrão de lesões na coxa, tendão de Aquiles, tornozelo e joelho. Parece não haver correlação entre gênero, frequência de treinamento, proporção de lesões, número de partidas e tipo de aquecimento. A implicação é que o gerenciamento de lesões é necessário antes e durante a competição, considerando a biomecânica, a fisiopatologia e os problemas psicossociais. As estratégias de prevenção de lesões por treinadores e equipes médicas devem levar a uma redução mais significativa de lesões e otimizar a saúde, segurança e bem-estar dos atletas.

PALAVRAS-CHAVE: Características. Lesão na coxa. Tornozelo. Membro inferior. Paratleta.

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Introduction

A scientific approach should be implemented to improve athlete performance and select outstanding athletes and training programs for elite sports.[1] One of the most critical steps of the scientific approach is the systematic collection of empirical data on various phenomena. Several previous studies have examined various characteristics such as physical fitness, kinanthropometry, psychology, and motor function in elite athletes.[2-4] Elite athletes are examined because it is assumed that they are the best examples of varsity players, especially in their physical fitness, kinanthropometry, psychological well-being, and sports performance skills. The purpose is to optimize their sports performance in an ideal form. This approach also applies to athletes with disabilities.

Athletics is one of the types of sport that are competed in the Paralympics. International Paralympic Committee is behind the idea of developing and organizing world and continental championships. The classification of athletes with disabilities includes 1) athletes with visual impairment, 2) athletes with intellectual disabilities, 3) athletes with amputations, and 4) athletes with cerebral palsy using a manual wheelchair.[5] In addition, there is a classification, namely (T), which stands for the track, and (F), which means field.[5] Track and field are divided into several categories. Athletics involves the largest and most diverse number of athletes participating in the Paralympics.[6] During the 2012 London Paralympics, 26% of the 4302 athletes competed in athletics. As dictated by the International Paralympic Committee (IPC)[7], Paralympic athletes compete in track and field events, catering to several different impairment categories. That includes athletes with amputations, spinal cord injuries, cerebral palsy (CP), visual impairment, and intellectual impairment.

Sports for people with disabilities and injuries have been the subject of discourse in the professional literature in traumatology and sports medicine.[8-10] Doing sports with a healthy body, especially team games, for people with disabilities, it is necessary to comprehend the characteristics of injuries, especially in athletics in the Paralympics. For coaches, it is critical to determine the injury characteristics of their athletes. The goal is none other than to make correct decisions to prevent injury. Injuries in sports are a scourge for coaches and, most importantly, for athletes. Injury has the potential to force the athlete to take a break from competing or even prevent them from competing forever. (permanent injury or early retirement).[8]

Several injury control studies in athletic sports have been conducted in international and national competitions[11-13], with a greater focus on the benefits of injury prevention programs. In studies conducted at the International Association of Athletics Federations' World Athletics Championships in 2007, 2009, and 2011, the incidence proportion ranged from 97.0 to 153.4 injuries per 1000 athletes enrolled.[11-13] This reveals an overall incidence rate of 12.7 injuries per day from 1000 athletes when considering all sports. Athletics has been shown to have the sixth-highest injury rate.[14]

Previous studies concentrating on injuries in Paralympic athletics have been limited by predominantly retrospective or cross-sectional surveys with data reflecting athletes' self-reports of injury[15] compared basal metabolic rate (BMR)[16] and limited the incidence of injury in visually impaired athletes.[17]

This research will disclose the injury characteristics of the Indonesian national team of 9 athletes with various injury categories. This study limits the causes of injury in stretching both before and after training sessions and matches. The stretches offered in the research question are static stretching and dynamic stretching so that the discussion of the occurrence of injury is only related to the type of stretching. The achievements of the Indonesian National Team in athletics in the Paralympic championships are outstanding. In the 9th ASEAN Para Games 2017, they won 40 gold medals from 51 categories, both T and F, that were competed. However, the success of the Indonesian national team cannot be separated from the incidents of injuries suffered by Paralympic athletes.

Therefore, this research aimed to determine the injury characteristics of the Indonesian national team Para-Athletics athletes experienced by athletes from 2017 to 2020. In addition, we sought to explore injury patterns based on the number of matches and whether potential risk factors such as gender, type of warm-up, frequency of training, number of matches (Track and Field) were associated with increased injury rates in this study.

Methods

Study Design and Participants

This study was a cross-sectional survey using a web-based questionnaire (Google Forms) consisting of close-ended questions to examine the history, types, factors, and treatments of injuries experienced by adolescent basketball athletes. This study was conducted in Para-Athletics athletes who are members of the Indonesian National Training (Pelatnas) with nine athletes with both Track (T) and Field (F) numbers. All the participants involved have experienced injuries, which is the scope of this research. Athletes and coaches gave consent to be involved in this study after being informed about the study's objectives, agreed to participate in the interview, and signed the Informed Consent. Participants were chosen randomly, according to the following inclusion criteria: 1) all ages, 2) male and female, 3) has experienced an injury during their time at the Indonesian National Training (Pelatnas), 4) players who perform at least once in 6 months, and 5) who at least have more than 12 months of experience were included in the study. And as exclusion criteria, athlete who did not have the discretion to answer the questionnaires or who did not agree to sign the free and informed consent form.

The Ethical Review Board approved this study at Poltekkes MoH Semarang, Indonesia. All participants were informed of the benefits and risks of participating before giving their written consent for inclusion.

Procedure

Nine athletes filled out a questionnaire that tracked injury history, type of injury, injury factors, and injury management. The research instrument is a questionnaire adopted and modified from Nowak and Hanief & Umar.[18,19] The Aikens test validated the questionnaire by involving three panelists with a validation test score of 0.81 (high). The definition of sports injury taken for this study is as follows: A sports injury is a physical illness from a match or training that forces an athlete to suspend or change their regular training plan for at least one unit of training.[20,21] The authors received ethical approval on June 16, 2021, and have only recruited participants after that. The process of recruiting participants has been carried out since June 23, 2021, by conveying the aims and objectives of the study. On July 7, 2021, an online meeting was held using a zoom meeting to convey information to participants regarding the procedure for filling out questionnaires through Google Forms. Then, a link to the questionnaire was sent to all participants through an Email on July 7, 2021. The data collection period starts from 7-14 July 2021. The data were analyzed descriptively, systematized in tables and graphs with the help of the Excel program of Microsoft Corporation (2007).

Statistical analysis

Statistical analysis used is Microsoft Excel and IBM SPSS Statistics 23. The results of data analysis represent numbers and presentations. Fisher's test was used to determine whether potential risk factors such as gender, warm-up type, training frequency, track and field number were associated with increased injury rates in this study. The level of significance is assumed at the level of $p < 0.05$.

Result

The athlete has an age profile of 28±6.87, height 1.71±0.08, weight 62.33±11.41, and body mass index of 21.43±3.79. As for the class, three athletes were in class 47 (Ambulant), one in class T 55, 56 (Wheelchair), one in class T 37 (Cerebral Palsy), one in class T 52, 53 (Wheelchair), one in class T 42 (Ambulant), one in class T 13 and one in class F 13. Therefore, seven of the nine athletes competed in the Tokyo 2020 Paralympics from 24 August to 5 September 2021. The data demonstrated that injuries experienced by 9 participants resulted in 66.7% of athletes training 5-6 times a week. In detail, the results of these answers can be seen in Table 1.

Table 1. Competition and injury parameters experienced by Indonesia elite Para-athletic athletes

Question	Answer	Number of answers (N)	Percentage of answers (%)
How many times a week do you train?	1-2 times per week	1	11.1
	3-4 times per week	0	0
	5-6 times per week	6	66.7
	7 times per week	2	22.2
	Total	9	100
What part of your body was injured?*	Head	1	10
	Back	0	0
	Chest and/or stomach	0	0
	Upper limb	2	20
	Lower limb	7	70
	Total	10	100
If you have experienced an injury to the lower limb, which part was injured?*	Hip joint and groin	2	18
	Thigh	3	28
	Knee	2	18
	Lower leg and/or Achilles tendon	2	18
	Ankle joint	2	18
	Feet and/or toes	0	0
	Total	11	100
Have you had the same injury before?	Yes	4	44.44
	No	5	55.56
	Total	9	100
How many weeks have you stopped training because of an injury?	Less than a week	7	77.78
	1-2 weeks	1	11.11
	3-4 weeks	0	0
	More than 4 weeks	1	11.11
	Total	9	100
How severe is your injury?	Cannot train for more than a day	9	100
	Cannot compete for more than a day	0	0
	In need of operation	0	0
	Total	9	100
How much time do you spent warming up before you got injured?	10 minutes	1	11.11
	10-20 minutes	2	22.22
	20-30 minutes	4	44.45
	More than 30 minutes	2	22.22
	Total	9	100
What kind of warm-up did you do before the injury?	Static stretching	4	44.44
	Dynamic stretching	5	55.56
	Total	9	100

*Participants could mark more than one answer

Athletes trained 5-6 times a week (66.7%), and 70% of them experienced injuries in the lower limb, specifically in the thigh (28%), which caused them to be unable to train for less than a week (77.78%) as seen in Table 1. Athletes who did dynamic stretching were five (55.56%), and 44.45% of athletes stretched for 20-30 minutes before they were injured (Table 1). A detailed explanation of the types of injuries can be seen in Table 2.

Table 2. Parameters of the types of injuries experienced by Indonesian elite Para-athletic athletes

Question	Answer	Number of answers (N)	Percentage of answers (%)
Which part of the body is injured?	Bone	0	0
	Joints and/or ligament	2	22.22
	Muscle and/or tendon	6	66.67
	Skin	0	0
	Nerve	1	11.11
	Total	9	100
What type of injury did you have?*	Sprain/twist	5	50
	Contusion/Bruises	2	20
	Strain (a torn muscle and/or tendon)	3	30
	Fractured bone	0	0
	Dislocation (bone shifts out of its normal position)	0	0
	Total	10	100
Are you having trouble participating in regular training and competitions because of an injury?	Full participation without any conflicts	2	22.22
	Full participation but with injuries	6	66.67
	Less participation due to injuries	1	11.11
	Unable to participate due to injuries	0	0
	Total	9	100

*Participants could mark more than one answer

Based on Table 2, participants reported that 66.67% of the injured body tissues were muscles and/or tendons, and they reported that the type of injury that most often experienced was sprain/twist (50%), causing them to participate in an injury condition (66.67%). Regarding the factors causing the injury, it can be seen in Table 3.

The muscle and/or tendon (66.67%) are the body structure that experiences most of the injuries, with sprain/twist as the most frequently experienced type of injury (50%), as seen in Table 2. Such a condition also forced 66.67% of the athletes to participate in the injury fully. The factors that caused the injuries are presented in Table 3.

Table 3. Parameters of the factors for injury experienced by Indonesian elite Para-athletic athletes

Question	Answer	Number of answers (N)	Percentage of answers (%)
How did you get injured?	Fell/ got hit by an object	2	22.22
	Physically come in contact with other athletes	0	0
	Overuse	7	77.78
	Total	9	100
When did you get the injury?	Throughout the training session	9	100
	During the match session	0	0
	Total	9	100

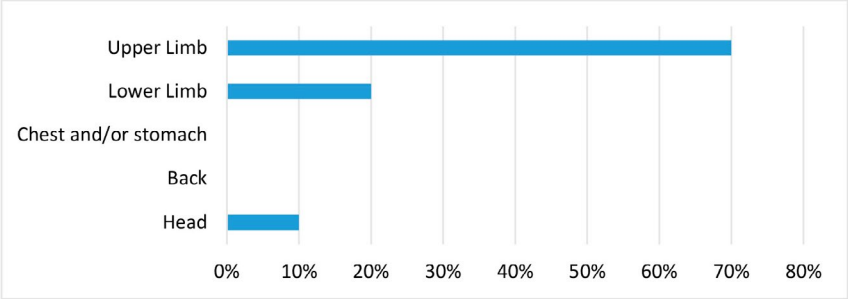
The most frequent cause of the injuries is overuse with an object (77.78%), whereas falling/getting hit by an object (22.22%) also reported other causes (Table 3), albeit not primary. These athletes also reported how they treated their injuries (Table 4).

Table 4. Parameters of the injury management experienced by Indonesian elite Para-athletic athletes

Question	Answer	Number of answers (N)	Percentage of answers (%)
To what extent have you stopped training due to injuries?	No cutback in training	1	11.11
	Kind of cutback a little from training	6	66.67
	Most of the time, did not train	0	
	The majority of the time did not train	2	22.22
	Unable to participate in any training	0	0
	Total	9	100
To what extent has the injury affected your performance?	No effect	1	11.11
	It kind of affected the performance	5	55.56
	To a moderate extent	1	11.11
	The majority of the time, it affected the performance	2	22.22
	It affected significantly, unable to participate	0	0
	Total	9	100
What type of warm-up do you do after an injury?	Static stretching	7	77.78
	Dynamic stretching	2	22.22
	Total	9	100
Was your warm-up longer or shorter after your injury?	A lot longer	7	77.78
	A lot shorter	0	0
	No change	2	22.22
	Total	9	100
Do you do stretch exercises before a training session or match?	Yes, always	8	100
	Yes, sometimes	0	0
	No	0	0
	Total	8	100
Do you stretch after sports activities?	Yes, always	7	77.78
	Yes, sometimes	2	22.22
	No	0	0
	Total	9	100
Do you use a post-workout recovery strategy?	Yes	9	100
	No	0	0
	Total	9	100
How do you treat your injury?	I treat it by myself	5	55.56
	I was treated by a doctor or physiotherapist	4	44.44
	Total	9	100
Do you think that your injury is weakening your fitness?	Yes	8	88.89
	No	1	11.11
	Total	9	100

A total of five athletes treated their injuries themselves (55.56%) (Table 4). Despite the injury, the athletes continued to exercise with a kind of cutback a little from training (66.67%). They realized that in order to prevent injury, it was necessary to warm up sufficiently by increasing the duration of warm-up after an injury (77.78%).

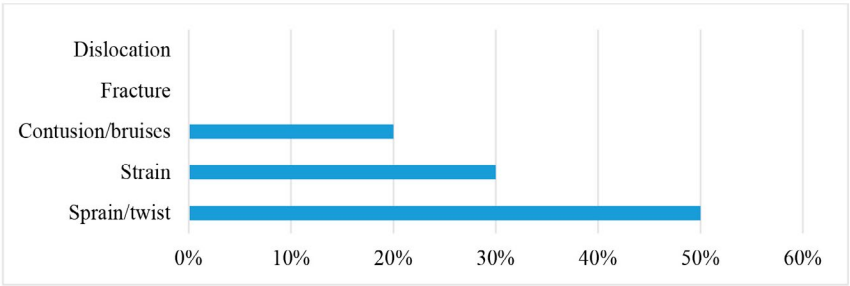
Figure 1. Distribution of injuries by body segment in para-athletic athletes



Many Para-Athletics (70%) suffered injuries to the lower limbs, as seen in Figure 1. The number of injury cases based on sex, there are 6 and 4 injury cases on male and female athletes, respectively. Both have experienced injuries in the thigh (30%), ankles (20%), and hip (20%). Male athletes also suffered injuries to their Achilles; while female athletes had never had this injury, only female athletes had knee injuries.

The injured segments/body parts include the head (10%), upper limb (20%), and low limb (70%), as seen in figure 1. The lower limb is the segment most frequently injured. The thigh (28%) is the segment/part with the most injuries experienced by para-athletic athletes. The types of injuries experienced by athletes vary. As many as 50% of athletes experience sprains.

Figure 2. Distribution of the type of injury



The Fisher Exact test performed to determine the relationship between variable components, which can be seen in Table 5.

Table 5. Comparison of Gender, Type of Warm-up Before Injury, Match Number, Frequency in Exercise with Part of Injury

Variables		N	%	Part of Injury			p-value
				Upper Limb	Lower Limb	Head	
Gender	Male	5	56	0	4	1	1.0
	Female	4	44	1	3	0	
Type of warm-up before injury	Static stretching	4	44	0	4	0	1.0
	Dynamic stretching	5	56	1	3	1	
Match number	Track	8	89	1	6	1	1.0
	Field	1	11	0	1	0	
Frequency in exercise	1-2 times per week	1	11	0	1	0	1.0
	5-6 times per week	6	67	1	4	1	
	7 times per week	2	22	0	2	0	

Based on Table 5, the p-value of all components of the variables tested are above 0.05 (P-Value > 0.05), so it can be concluded that there is no relationship between gender, warm-up, number of matches, training frequency and injury part.

Discussion

The analysis results depicted that major Indonesian Para-Athletics athletes suffered injuries to the lower limbs, the segment most frequently injured was the thigh, and the type of injury that was often experienced was sprain/twist. Most injuries were due to overuse (Table 3), as many as seven athletes (77.78%). Most overuse injuries in elite Para-athletic athletes affected the lower limb, with the thigh being the most injured part, although it also occurs in the knee, hip joint and groin, lower leg, and/or Achilles tendon, and ankle joint. This study also supports the results of studies that state that the incidence of injury in elite para-athletic athletes has a greater risk of lower limbs.[14,23,24] Overuse injuries in sport are thought to have a diverse and multifactorial etiology[25,26], but this is true only when overuse injury is defined at the whole-body, or systems, and level.

It was reported that non-disabled athletic athletes experienced various injuries, mainly in the running, hurdling, jumping, combination numbers, and fast walking events. At the same time, for running marathons, they suffered lower leg muscle injuries, lower leg skin injuries in the middle- and long-distance running.[27] The authors report the results of the study of Edouard et al. for information that non-disabled athletic athletes are at risk of injury, especially athletes with disabilities. Para-athletic athletes already have medical challenges related to their disorders that can predispose them to injury[28], just as the combined impact of daily wheelchair use and sports wheelchair use puts an athlete at an excessive risk of injury.[29] This is demonstrated in a study conducted by Derman et al., who stated that athletes with limb deficiency reported the highest proportion of injuries.[23] Derman et al. also asserted incidents of injury incidents in the pre-competition period and the 2016 Rio Summer Paralympics competition that there had been 510 injury incidents over 14 match days.[23] Caudel et al. also reported in their study that athletes with visual impairment experienced the highest rate of injuries, and prevention programs must focus on.[28] Fagher et al. also reported in their study that the risk of injury is also caused by behavioral and psychological aspects and pain and drug use.[29]

Most injuries were due to overuse (Table 3), as many as seven athletes (77.78%). Most overuse injuries in elite Para-athletic athletes affected the lower limb, with the thigh being the most injured site, although it also occurs in the knee, hip joint and groin, lower leg, and/or Achilles tendon and ankle joint. This study also supports the results of studies that state that the incidence of injury in elite para-athletic athletes has a greater risk of lower limbs.[14,23,24] Overuse injuries in sport are thought to have a diverse and multifactorial etiology[25,26], but this is true only when overuse injury is defined at the whole-body, or systems, and level.

Injury characteristics described the specific boundaries of each category class. This research involved eight athletes in the track category and one athlete in the field category. In summary, past research proved that athletes participating in sprints suffer more thigh/hamstring injuries[30–36], tendon Achilles[32,33,35,36], ankle[34], and/or knee.[33,35,36] The location of the injury in that study was similar to the findings of our research. That means certain categories lead to certain obstacles and injuries.[27]

Injuries experienced by athletes can result in the inability to participate in training sessions or competitions[37], and athletes could even stop participating for good.[38] Coaches and the medical team need to carry out injury prevention management according to the class characteristics of the category from the results of the previous paragraph study. Trainers can adopt Prevent injury and Enhance Performance (PEP) to prevent injury.[39]

This research also analyzed the relationship between gender and injury, the type of warm-up and the injured team, the number of matches and the injury section, and the frequency of training and the injury section, all of which concluded that there was no correlation (Table 5). This is inferred because the number of subjects involved in this research is minimal, and only a few athletes joined the Indonesian national team. We hope that further studies can include more subjects to enhance these findings. A previous study of a 2-year analysis of injury surveillance in male and female basketball athletes reported that women had a higher risk of injury than men with this type of sprain injury.[40]

So, what is the new finding?

• Para-athletic athletes tend to have lower limb injuries.

• The injury characteristics in the track (sprint category) are usually in the thigh, Achilles tendon, ankle, and knee.

• There is no correlation between gender, training frequency, injury share, match number, and warm-up type.

• Continuing injuries occur because there is no prevention of training in athletes who are injured.

• The mechanism of overuse injury occurs due to training errors, one of which is doing too much physical activity too often (the frequency of exercise is too frequent).

What should be done?

Injury management should be undertaken before and during the match by considering biomechanical, pathophysiological, and psychosocial aspects.

Research Limitations

• This study limits the causes of injury in stretching both before and after training sessions and matches. The stretches offered in the research question are static stretching and dynamic stretching so that the discussion of the occurrence of injury is only related to the type of stretching.

• The use of Google Form prevents respondents from filling out the online questionnaire multiple times. Furthermore, this study was carried out for a short time with inadequate cost.[41,42] The research was also limited to poor internet access because the subject studied came from various regions spread throughout Indonesia with various types of network providers.

Conclusion

Characteristics of injuries in Indonesian Para-Athletics athletes are primarily in the lower limbs. The segment most frequently injured is the thigh, with a sprain/twist type of injury often experienced. Therefore, trainers and medical teams need to effectuate prevention management by considering biomechanics, pathophysiology, and psychosocial problems.

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Author contributions

Hanief YN was responsible for designing the study, interpreting the results, and writing the conclusions. Widiawati P was responsible for conceiving the methods and analyzing the data. Supriatna was responsible for analyzing the data and interpreting the results. Abdullah A and Sumartiningsih S were responsible for interpreting the results and drafting the final version.

Competing interests

No financial, legal, or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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