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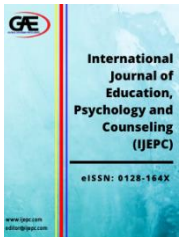

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DETERMINING THE INJURY PATTERN AND ASSOCIATED RISK FACTOR OF INJURY AMONG FRISBEE ATHLETES IN MALAYSIA

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Abstract:

Ultimate Frisbee is a non-contact sport gaining popularity in Malaysia. As a physically demanding competition, it can result in unavoidable injuries. However, data on injury profiles in Malaysia remain lacking, and the severity of injuries remains unknown. Therefore, this study aims to determine the injury pattern, anatomical location, severity, and associated risk factors for Ultimate Frisbee athletes in Malaysia. A cross-sectional survey was conducted using an online self-reported questionnaire from athletes registered under the Malaysian Ultimate Frisbee Association in 2022. Data were collected on types of injury (new or recurrent; soft tissue or hard tissue), location, nature, severity, and risk factors (self-induced, third-party, equipment, or environment). 137 athletes responded voluntarily (60% male, 40% female); mean participant age was 24.84 (±4.68) years, and mean Body Mass Index (BMI) was 21.44 (±1.99) kg/m². 95.2% participated actively in Frisbee competitions in the previous year at university (52.4%), national (13.8%), and international (4.1%) levels. Most injuries occurred during competition or training (n = 130), and more than 62% of injuries caused athletes to stop playing. The most common sites of injury for the lower limbs were the knee and ankle, followed by the wrist, shoulder, and elbow/upper arm for upper limbs. Only 3.5% reported spinal injuries, and 7 cases reported injuries to the head/face. 62% of reported cases were recurrent injuries, and 8% involved fractures and dislocations. Risk factors associated with injury included body composition, inadequate warm-up, lack of equipment safety, opponents, and playing surface. In conclusion, this study

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demonstrated that most injuries occur in the lower limbs, with minor injuries but a high rate of recurrence. The findings suggest that not only is on-site emergency treatment needed, but also prolonged, complete sports rehabilitation programs to reduce the incidence of recurrent injuries and lessen the likelihood of injury severity.

Keywords:

Ultimate Frisbee, Injury Pattern, Risk Factor, Recurrence Injury

Introduction

Ultimate Frisbee has become national and international popular and the participant that involve in the competition rapidly increasing worldwide and this include Malaysia. The World Flying Disc Federation (WFDF) reported an annual growth rate of 11% during the last decade, with more than 170,000 active members worldwide and total participant from Malysia that involve in the international competition is estimated around 100 athletes (Fajardo Pulido & Lystad.,2020). In Malaysia, data from World Flying Disc Federation (WFDF) show a total of 63 record count with a total of 369 games for 2019 in AOUGC event (retrieve from: https://wfdf.sport/player_stats). Although the registered number of athletes at the national level is considered low, the number of recreational players is likely higher, particularly in school and university settings. Total number of participants remains undisclosed due to the lack of a centralized data collection platform. Frisbee, like many other sports, is classified as a non-contact sport but still demands high physical intensity (Krustrup & Mohr, 2015). Despite the lack of intentional contact, players are exposed to a significant risk of injury due to the sport's dynamic nature. Identifying and reporting the severity of sports injuries is crucial in prevention research. This injury data informs the development of effective injury prevention strategies and rehabilitation protocols where the ultimate role in sport injury prevention in reducing the global burden of musculoskeletal disorders (Emery & Pasanen., 2019).

Several studies have documented the pattern and injury profiling in Frisbee sports (Akinbola, Logersted, Hunter-Giordano & Snyder-Mackler (2015); Gabriela, Slawomir, Krzysztof Kolodziej, Anna Skubal & Barbara, 2017; Swedler, Nuwer, Nazarov, Hou & Malevanchik (2015). The pattern of injury in Frisbee is undoubted is similar to other team sports that involve high intensity running with focus on upper limbs usage. This includes the strain and sprain to the knee, thigh, ankle, and shoulder (Fajardo Pulido & Lystad.,2020). In study conducted by Gabriela and her colleagues (2015) more than 140 injuries from 461 reported injury related to ultimate Frisbee, where the female athletes represent 71% of injury case compered to male counterpart (29%). In their study, they found that sex has been highly correlate with the injury occurrence where the female reported more than twice reporting injury than male. Female athlete also significantly injured the foot/ankle ($p < 0.001$) than men and have more injury to the lumbar/ flank than men ($p = 0.022$).

Despite the growing popularity of Frisbee worldwide, there is limited published literature on the sport's specific injury profile. Furthermore, there is a scarcity of information regarding the associated risk factors and injury mechanisms in Frisbee sports in Malaysia. Based on authors knowledge only one available published article on injury pattern among university's Frisbee athletes (Baharuddin, Karim & Aminudin, 2022). In Baharuddin study, (2022) found that the most common type of injuries is muscle strains (28.53 %), followed by wound injuries (26.32

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%) and sprain injuries (26.04 %) and this finding is in line has been reported in previous literature (Fajardo Pulido & Lystad (2020). Therefore, the purpose of this study is to establish the pattern of injury among Frisbee ‘s athletes in Malaysia; characterize the injury types (new or recurrence); location and injury severity and also identify possible risk factor for occurrence of injury.

Literature Review

Reported Injury Pattern in Frisbee from 2020 to 2024

Recent epidemiological investigations into Ultimate Frisbee injury patterns between 2020 and 2022 have been limited to three studies (Hess et al., 2020; Fajardo & Lystad, 2020; Baharuddin et al., 2022). Despite Ultimate Frisbee's growing global popularity, including its emergence in Malaysia, research examining injury patterns remains limited. However, the documented injury distribution patterns align with those observed in other running and throwing sports, where player-to-player contact is predominantly associated with injury occurrence. The consistency in injury patterns across these studies suggests that Ultimate Frisbee exhibits similar biomechanical injury risk factors to other field-based team sports, despite its limited research base (Table 1).

Table 1. Evidence Matrix on Frisbee Athletes (n =3) from 2020 to 2024.

Authors	***Years***	***Study Design***	***Population***	***Findings***
Hess, M. C., Swedler, D. I., Collins, C. S., Ponce, B. A., & Brabston, E. W.	2020	Descriptive epidemiology	Professional Frisbee	- Injury distribution highest at knee, foot/ankle, and lumbar region. - Women injured more frequently as twice as men.
Baharuddin, M. Y., Karim, M. T., & Aminudin, S. N. A. Injury Profile of Ultimate Frisbee in University Athletes.	2022	Cross sectional survey	University athlete	- Injury distribution highest at lower limb, upper limb, head, trunk and spinal. - Strain and sprain is the commonest injury. - Cause of injury because of improper warmup, intensive training and wrong techniques.
Fajardo Pulido, D., & Lystad, R. P.	2020	Systematic Review.	Athletes	- Injury incidence rate estimates ranged from 0.4 to 84.9 injuries per 1000 athlete-exposures. - Lower limb, with the knee and thigh being the most frequently injured.

Methodology

Study Design

Descriptive retrospective epidemiology, observation study. This cross-sectional study investigates injuries sustained from athletes that playing Ultimate Frisbee in Malaysia during

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2022. The data was collected through an online survey conducted using the Google Forms platform.

Participants and Informed Consent

Participants were recruited from the Malaysian Ultimate Frisbee Association. Eligible participants include all Ultimate Frisbee players who competed in at least one event between 2021 and 2022, as well as members of Malaysia-based teams in professional, club, college, or recreational leagues. The selected respondents are athletes who have been involved in Ultimate Frisbee for more than one year and are active members of the Malaysian Flying Disc Association. Prior to data collection each respondent gave a consent and participate voluntarily.

Injury Definition

In this study we used a similar injury definition used by Hess et al., (2020) that reportable injury in the Ultimate Frisbee. In this study, an injury was defined as any physical harm that occurred while the player was participating in an Ultimate Frisbee competition or training session, and which caused the player to miss part of that competition or training session. New injury was defined as injury meeting any of the following criteria: (1) first time an injury occurred at a given location, regardless of the mechanism of injury and determination; (2) first time a given injury was determined at the involved location; or (3) an injury occurred at this location previously, but the present injury had a completely difference mechanism of injury. Recurrence injury was defined as any acute onset or overuse injury of a previous injury when either (1) six or more weeks had elapsed since the previous injury or (2) the athlete stated he had fully recovered from the previous injury and no evidence of lingering injury existed (Hess et al., 2020).

Data Collection

This research used adopted questionnaire from the previous study (Kolodziej, 2017) and the survey was collected using the google form platform from 1 October 2022 to 1 September 2022. The questionnaire consists of three sections; section A (participant demography), section B (body region), and section C (type of injury). As in Malaysia, there was 804 active Ultimate Frisbee player registered at Malaysian Flying Disc Association in 2017. Herein, sample size of 260 and more survey is needed to have a 90% confident level, a 10% margin of error, and an estimated injury proportion of 50% in ultimate frisbee players in Malaysia. Upon retrieval of data from Goolfe form, each data was screened and analysed separately to reduce the protentional interference. Similarly in previous study, we also collected data on (1) whether an injury occurred during a competition or practice, (2) the mechanism of injury, (3) the anatomic location of the injury, (4) the injury determination, (5) the injury type, and (6) injury severity and (8) other associated factors. We used injury determination. We used report from athlete on how many absence days following the injury occurrence to determine the injury severity. Time-loss injury severity categories include minor (<8 days lost), moderate (8 to 21 days lost), and severe (>21 days lost) (Dompier, Powell, Barron and Moore, 2007). Each injury data was remained confidential to that athlete and were assigned a code for reference. The institutional internal ethics committee has been reviewed the study protocol and examine the methodology following the standard procedure.

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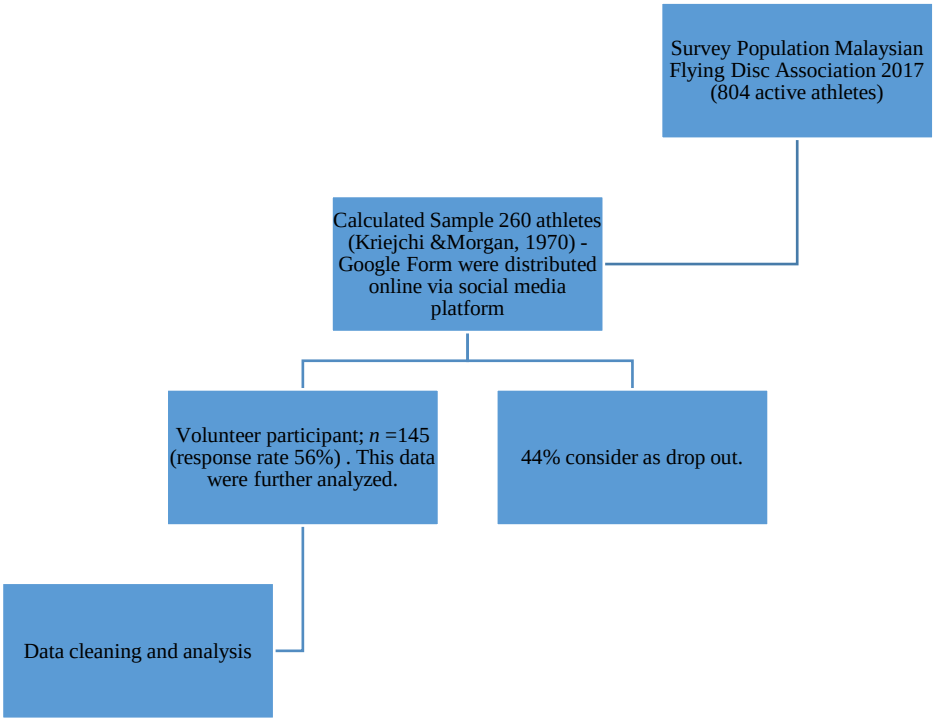

Figure 1: Data Collection Procedure

Statistical Analysis

The data was collected, exported, and downloaded from the Google Form platform. The data was then screen and organized using SPSS for Windows version 25. Responses with missing data were excluded from the analysis. Descriptive statistical (mean, standard deviation, and percentage) was used to analysis the study variables according to the objective. Statistical significance was set at a p-value of ≤ 0.05 (two tailed).

Results

Participants

A total 145 participants were responding to the questionnaire. The study demography consisting of 40.90% female and 59.10% male athletes. The athlete's age was 24.84 (4.68). The mean weight was 61.28 (7.66) kg for the athletes. On the other hand, the mean height was 168.87 (7.48) cm for the athletes, and the mean Body Mass Index (BMI) was 21.44 (1.99) Kg/m2 (normal category) for the athletes (Table 3).

Table 3. Demographic Details of Malaysia Ultimate Frisbee Athletes (n =145).

Variables	Mean (SD)
Age (years)	24.84 (4.68)
Weight (Kg)	61.28 (7.66)
Height (cm)	168.87 (7.48)
Body Mass Index (BMI) Kg/m^2	21.44 (1.99)

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Anatomical Location

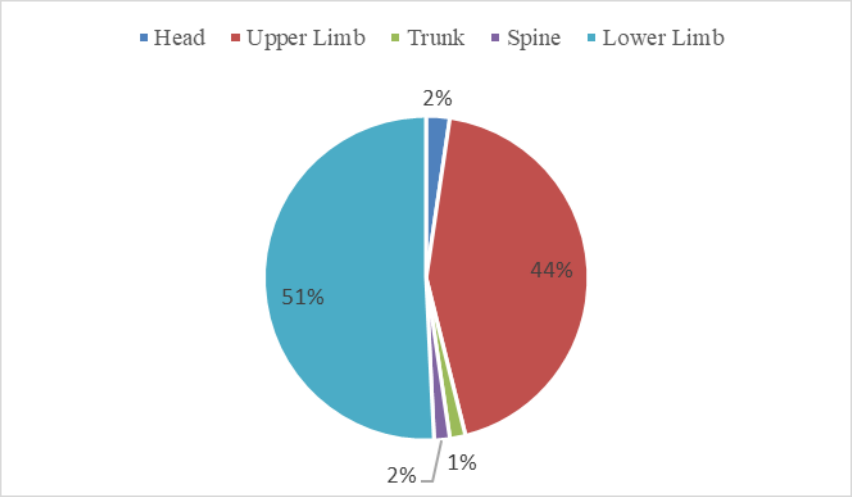

Figure 1. The Distribution Injury According To Anatomical Location (Head, Upper Limb, Trunk, Spine And Lower Limb) among Frisbee Athletes (n=145).

In this study, the injury mostly occurred in the lower limb (51%), followed by the upper limb (44%), spine and head (2%) and trunk (1%). The result showed that the most common body region injury for males and females was the lower limb, but the least common body region injury incident for males was head and spine with (n=3), but for females, it was trunk (n=0) (Figure 2).

Type of Injury

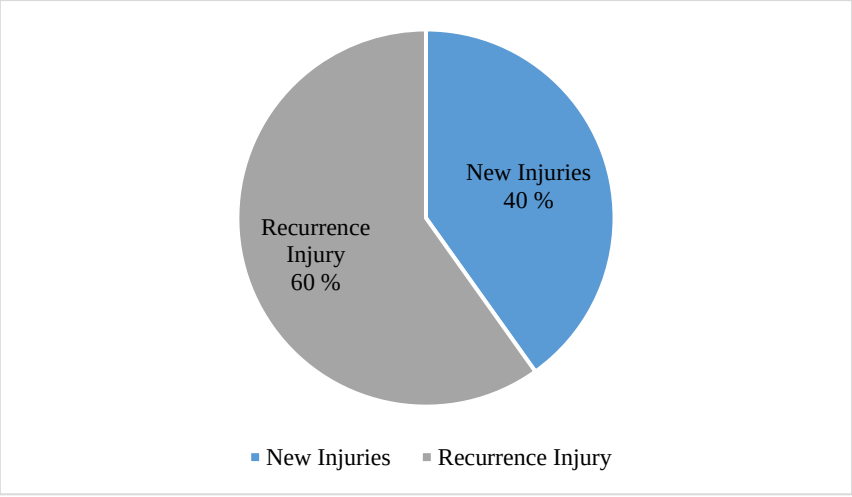

Figure 2: The Distribution Of Type Of Injury (New Or Recurrence Injury) Among Frisbee Athletes (n=145)

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The most types of injury were recurrence injuries (60%) followed by new injury (40%). Males are more likely to get recurrence injuries. However, females have the same tendency to get both new injuries and recurrence injuries.

Anatomical Location

The most common reported injury anatomical location according to body region is lower limb, followed by upper limb injury and head, trunk and spinal injury as reported frequency is 7,5, 4 cases respectively. Male reported more injuries than female athletes. Most of the injuries is recurrence injuries in nature followed by new injuries and this pattern is similar both in male and female athletes. Minor injuries are the commonest injuries reported in this study (Table 2). More detailed description of injuries according to body location (refer supplementary file: Appendix 1)

Table 2. Frequency And Distribution Of Reported Injury According To Body Region, And Type Of Injury.

Parameter	Total	Male	Female
	n=145	n=87	n=58
***Body region**			
Head injuries	7	4	3
Upper limb injuries	166	126	40
Trunk injuries	4	0	4
Spinal injuries	5	1	4
Lower limb injuries	218	165	53
Type of Injury			
New injury	60	32	28
Recurrence injury	85	55	30

**From 145 athletes, total reported injuries according body region are 401 cases indicating single athlete experience more than single injury with a ratio of 1 athlete: 2.7 occurrences of injuries.*

Injury Severity

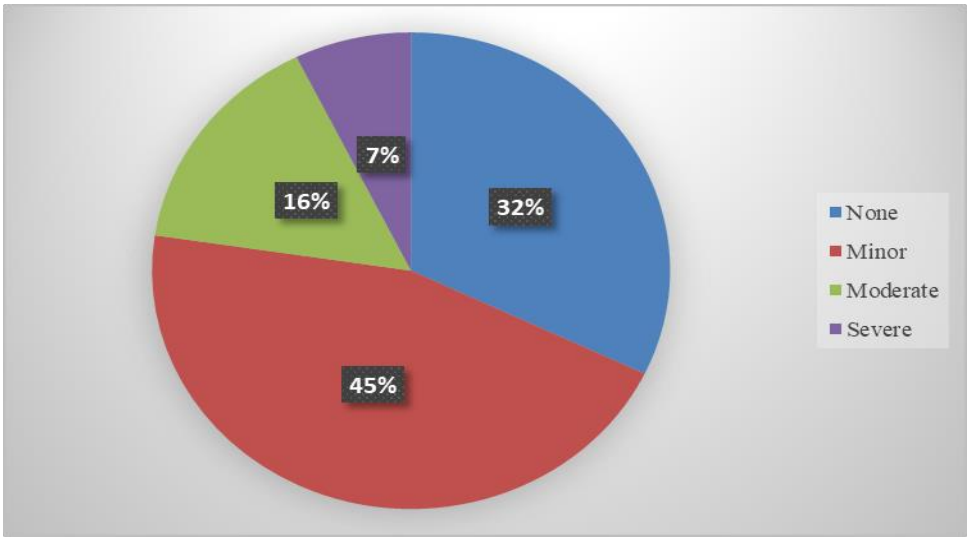

Figure 3: The Distribution Of Injury Severity (Minor, Moderate And Severe) Among Frisbee Athletes (n=145).

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Minor injury severity occurred more frequently (45%) followed by moderate and severe injury, 16% and 7%, respectively. The pattern of injury severity is similar between gender. 10 cases were reported for fracture and dislocation, and more than 60% is sprain and/ or strain type of injury.

Possible Risk of Injury

The risk of injury in this study categorized under 4, that are self-induced; equipment's; third party; and environment. In the category of self-induced, the commonest reported injury occurs may be due to inappropriate body composition (43.4%); Lack of warm up (42.8%), inadequate fitness (35.9%); lack of recovery (29%); inadequate skills (29%); history of previous injury 27.6%); attitude (17.2%) and breaking rules (12.4%), and others (i.e. accident before the game, collision with other players, positioning, menstrual period each 1%, respectively). Under the category of equipment, participant has reported that lack of equipment safety (47.6%), inappropriate clothing (40.7%), and inappropriate footwear as the commonest reason for injury in these sports. In Third Party, the opponent (62.1%), audience (30.3%) and referee (15.9%) as the main risk of injury reported by participant in this study. However, under sub heading environment, the commonest injury, the commonest risk of getting injury because of surface of the field (78%) and weather (35%). Other reason has been minimally cited for less than 1%

Discussion

This study presents a comprehensive analysis of injury patterns and associated risk factors among Malaysian athletes that play Frisbee. To date, it represents the largest dataset collected for this sport in Malaysia. The results provide a significant overview of the types and frequencies of injuries sustained by participants in Frisbee competitions and recreational play within the country. Ultimate Frisbee is categorized as a non-contact or limited-contact sport due to its unique athletic demands. These include endurance sprinting, rapid cutting, pivoting, jumping, precision throwing, and even diving headfirst to make spectacular one-handed catches. Despite minimal intentional contact, these dynamic movements can lead to significant physical strain and potential injury risks (Swedler, Nuwer, Nazarov, Huo, & Malevanchik., 2015).

In study by Baharuddin, Karim & Aminuddin (2022), they reported the main injury occurred at lower limb injuries (49%), followed by upper limb (27%), head (12%), trunk (7%), and spinal injuries being the least common (5%). Similarly in previous literature, we also found a higher prevalence of lower limb (knee and ankle) injury, upper limb (shoulder, wrist and elbow) and head injury (back of head, nose and teeth) followed by trunk and spinal with the less common site for injury occurrance.This pattern of injury also similar in trend from study by Akinbola, Longerstedt, Hunter –Giordano & Snyder-Mackler (2015), where they also reported that the body part most commonly affected was the knee, accounting for 50 (35%) injuries, followed by foot/ankle at 33 injuries (23.1%), 11 (7.7%) each of lumbar/flank, hamstrings & shins/Achilles related injuries, 10 (7%) hip/groin injuries, 7 (4.9%) calf/leg injuries, 4 (2.8%) quad/thigh injuries, and 3 (2.1%) each of shoulder & wrist/hand injuries. But, in their study, no injury reported for head region.

In addition, our study reported 62% of injury occurs is recurrence injuries with major injuries happen in soft tissue that involve strain and sprains, and only 7% involve hard tissues injuries (2.8% fracture; 4.1% dislocation). From all the reported injuries, 62% case of injuries make athletes stop from competition or training with average of mild to moderate injury severity.

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However, this outcome is contrary to that of (Pang, Man,Ling, & Yung, 2021) who found the majority of reported injuries are new (57.4%), followed by recurrent (29.6%) and exacerbation (13%) occurrences of prior injuries (Hess, Swedler, Collins, Ponce & Brabston, 2020). Their study showed that the most type of injury are new injuries (n=205 injuries) followed by exacerbation (51 injuries), recurrence injuries and unsure of injury origin (n=3 injuries). Injury prevention and a complete and comprehensive injury rehabilitation including return to sports (RTS) is equally important. The possible explanation on why this study found a higher recurrence injury could be due to Frisbee athlete in Malaysia has a low rate of consulting medical team or sports therapist for diagnosing and complete rehabilitation program to support the healing process (Pang et al., 2021). Another possible factor could be the limited medical support available during training sessions and after competitions. However, our study did not investigate athletes' preferences for seeking medical help or their compliance with rehabilitation programs. Further research is needed to clarify athletes' behaviour following injury, particularly regarding their pursuit of appropriate diagnoses and adherence to rehabilitation programs before returning to sport (RTS). The discussion on this aspect remains incomplete until such studies are conducted. Returning to competition before complete recovery from previous injury with possible deficit in physical fitness component may increase the risk of exacerbate previous injury.

As Frisbee has been acknowledge as non-contact sports with high physical demand as most players required to have an ability torun, cut, guard, jump, throw, catch, and dive in a fully outstretched position in order to catch the disc and advance to score a point, in which are often involved in the mechanism of sports injury (Emery, Meeuwisse, & McAllister .,2006; Fajardo Pulido & Lystad., 2020). The required task have been described as a possible factor in this sport because of incidental collision during gameplay and considerable biomechanical stresses that similar to other sports to soccer or lacrose that place the athletes at risk for overuse injuries (Fajardo Pulido, D., & Lystad, R. P. (2020). Establishing the causes and mechanisms of sports injuries necessitates a comprehensive account of multiple factors including, intrinsic, extrinsic and inciting event factors (Bahr & Krosshaug, 2005; and Meeuwisse et at., 2007). In intrinsic risk factors, such as age and previous injury history, as well as extrinsic risk factors, including game conditions, playing surface characteristics, and the competitive significance of the match. Additionally, factors related to the inciting event must be considered including the specific playing situations like throwing skills, cutting manoeuvres, and the impact of fatigue; athlete and opponent interactions such as jumping contests, collisions, and diving attempts; and biomechanical aspects of movement, particularly high-stress actions like sprinting and pivoting. A thorough examination of this diverse array of factors in Frisbee sports injury is crucial for developing a comprehensive understanding of sports injury risk and occurrence in these sports.

This study's data were categorized into intrinsic risk factors (Self-Induced and Attire) and extrinsic risk factors (Third Party, Environment, and Equipment) as previously outlined (Choo, Baharudin & Sankaravel, Fairus Fariza, 2018). It is crucial to highlight the findings from Choo and colleagues as a preliminary study examining injury risk factors in athletes participating in both contact and non-contact sports. Their research, based on self-reported status, revealed that among self-induced factors, body composition posed the highest risk at 51.1%, followed by body status to play at 41.7%, self-attitude at 5.8%, and age difference at 1.4%. Regarding attire factors, injuries were most frequently attributed to not wearing appropriate protective gear (47.5%), followed by inappropriate footwear (34.5%), and inappropriate clothing (18.0%).

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Among extrinsic factors involving third parties, injuries were predominantly caused by opponents (89.2%), with a smaller proportion due to referees (10.8%), and none attributed to audiences. Notably, no injuries were reported due to playing equipment. Environmental factors played a significant role, with playing surface reported as the highest contributor (75.5%), followed by weather conditions (24.5%). As the only study available reflecting Frisbee athletes in this geographical location, our research also reported a similar trend in risk factors for Malaysian Frisbee athletes.

With regard to self-induce factors, most reported reason of injury is due to body composition, lack of warm up, inadequate fitness, inadequate recovery, lack of skills and history of previous injury. Lacking in ideal body composition may cause the Frisbee athletes less competence in high demand sports. With the lack of balance and postural stability, it may result in fall with a greater load thus causing greater force and lead to injury to anatomical structure. Interestingly in Tropp et al., (1984) study has found that soccer players with poor balance had almost four times the number of ankle injuries than players with normal balance. This could be a reason why Frisbee athlete have more injury on knee and ankle and there is possible that this athlete has poor balance prior to injury occurrence. More substantial evidence is required in the form of intervention study to examine the association between balance ability and injury risk among Frisbee athletes. From biomechanical perspective a single study examined the characteristics of cutting manoeuvres in women's Frisbee athletes. It found that competitive teams demonstrated greater kinematic risk factors, including lower knee angles, higher cut speeds, and higher approach acceleration (Slaughter & Adamczyk., 2020). Higher levels of play may increase injury likelihood, as players on advanced teams tend to be more athletic and participate in more intense competitions. Generally, these athletes may be exposed to a higher risk of lower limb injuries, especially to the anterior cruciate ligament (ACL). This increased the risk is due higher body composition (Choo et al., 2018), and a higher speeds and accelerations involved, which amplify the load on the ACL during cutting manoeuvres.

Current study also noted lack of warm up and inadequate fitness that led to their injury occurrence. As been explain in Choo et al (2008), many previous research documented in these two risk factors of injury. Athletes with in adequate fitness level may experience the symptom of fatigue, loss of attention and reduce performance during competition and this may lead to injury occurrence. Although athlete has recognized lack of warm up as factor for risk of injury, yet the awareness and change in behaviour to practice adequate warm up prior to training of competition is still lacking. The possible explanation of this could be due to the correct culture of doing warm up since school toward university setting is no practice regularly, with or without coach supervision. An athlete who did not do proper warm up and stretching pose a greeted risk of injury compared to player who practice it. The diminished of cardiorespiratory endurance can cause athlete to fatigue and therefore less accurate in performing high demand task and thus lead to injury. Additionally, in regards to environmental factors, playing surface and weather has been reported as common cause of injuries in this sport. In study by Hess et al., 2020, they found that 34% and more injuries occurred on turf than on grass with significance difference. Unfortunately, in current study, we did not have data to show the hours of training or competition using grass or turf. But, study by Meyers (2013) in men’s collegiate soccer competitions reported less injury occurrence in turf compared to grass field. Turf offers a more consistent playing surface than grass and is designed to drain water more efficiently.

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Injury prevention research should start with analysing the severity of injury and suggest the recommendation tailored to specific groups of population. This study has showed that the lower limb injury and upper limb showing increase pattern for Frisbee athlete, Recurrence injury is highest, most of the athlete report a minor severity of injury. Future research on Ultimate Frisbee injuries should: 1) Obtain a larger, equally-represented sample of male and female athletes; 2) Incorporate on-site observation during training and competitions to supplement self-reported data; and 3) Collect detailed information on risk factors (e.g., playing surface, environmental conditions) and analyze their relationship with injury type, severity, and body region affected. These methodological improvements can provide a more comprehensive understanding of injuries in Ultimate Frisbee, informing targeted prevention strategies to enhance athlete safety and long-term participation in the sport.

Conclusion

The findings of this study revealed a predominant pattern of lower extremity injuries among Ultimate Frisbee athletes compared to upper extremity injuries. Epidemiological analysis demonstrated that these athletes face significant injury risks, emphasizing the necessity for on-site sports rehabilitation personnel. A notable finding was the high rate of injury recurrence, although most reported injuries were classified as minor in severity. Sex-specific analysis revealed that while both male and female athletes experienced upper and lower extremity injuries, males demonstrated a higher propensity for recurrent injuries, despite similar injury severity patterns between sexes.

These findings have significant implications for clinical practice and future research directions. The data provide a foundation for developing targeted prevention strategies, treatment protocols, and rehabilitation programs for Ultimate Frisbee athletes. Sports medicine professionals, including physiotherapists, athletic trainers, and coaches, can utilize this information to implement evidence-based injury prevention and management strategies. Furthermore, the injury patterns documented in this study can inform the planning and preparation of medical coverage during both training sessions and tournaments. Future research should investigate potential barriers to timely injury management among Ultimate Frisbee athletes, as these may contribute to the observed high recurrence rates. Additionally, both retrospective and prospective studies are warranted to establish comprehensive injury severity classifications and enhance understanding of sport-specific injury mechanisms.

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