

The Musculoskeletal Injury Profile of Aquatic Sports Athletes: A Case Study in UPSI

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Abstract In recent years, aquatic sports (AS) have become more popular, especially for those who enjoy the adventurous sports activities. However, the AS have the possibility of injury, although the activities are performed in the water media. This study aimed to determine the musculoskeletal injury profile and incidence among AS athletes in Sultan Idris Education University (UPSI) from 2018-2020. A total of 62 staff and students who are AS athletes participated in this study. The injuries of athletes were assessed based on the type, location and cause of injuries within the last two years of competition events or training sessions and through an online survey method by Sport Injury Reporting Questionnaire. The AS were swimming, kayaking, canoeing, dragon boating, and rowing. The study recorded 102 injury cases in total. The results showed muscle cramps were the most common injury, followed by abrasion contusion and muscle strain. The most common body location injury specifically in swimming was the shoulder injury, followed by forearm, hip and thigh. In addition, overuse and chronic were the highest injury causes, followed by poor paddling technique and low level of strength and only a few of the respondents reported a lack of proper warm-up and cool-down. These findings revealed the injuries probably occurred in the upper body, which was caused by overuse training and inappropriate technique, particularly in swimming strokes and boating. These

findings may be useful when developing future training program that aims to prevent sport injuries in aquatic sports.

Keywords Musculoskeletal Injury Profile, Aquatic Sports, Athletes, UPSI, Staff, Students

1. Introduction

Aquatic sports (AS) are activities that involve water media, which also called water sports. The aquatic sports are popular and contested at the highest levels such as the Olympics, the SEA Games, and the Southeast Asian Games with the second largest athletes' participation. There are six types of AS including swimming, diving, high diving, artistic swimming, water polo, and open water swimming which currently FINA superintend all of their competitions [1]. In addition, the aquatic sports are increasingly being enjoyed by people both domestically and internationally from recreational to the elite level, which produced many exciting water sports activities throughout the whole lifespan [2, 3].

Meantime, water-based sports is although safer than land-based sports activity due to water properties, there are still some high risks of sports injuries extra of subsequent

fear of drowning [2]. However, there are several categories of water sports in water, on water and underwater. While each aquatic sport has different disciplines and rules depending on the types of sports being contested [4], aquatic sports are less well-known in terms of injury history and injury patterns associated with the sports.

Since injuries were defined as overuse injuries (caused by chronic overload and progressive in nature) or acute, traumatic injuries, a sport injury was classified as recurrent when the athlete reported the same type of injury in the same anatomical location [5, 6]. Additionally, sports injuries mean the injury that happens suddenly either during a training session or competition sports events which caused reducing normal body function or structure. In that, the injuries can be acute, traumatic, or chronic overload and progressive in nature and classified based on cause and type of injury, anatomical location or soft and hard-tissues injury [6-8].

In aquatic sports, the most common causes included the environment where the weather is not suitable for outdoors aquatic activity, poor equipment used, lack of skills and training, and poor fitness levels. Even though, every part of the human body is vulnerable to injury in aquatic sports, the upper body is higher than the lower for most aquatic sports injuries [9].

Further, previous studies declared that the most frequently injury among AS athletes is shoulder location, followed by a high prevalence of head and hand injuries in water polo, knee pain in breaststroke swimmers and low back pain among diving athletes [1, 10, 11].

However, the aquatic style significantly can affect body location injuries. In swimming as a most popular aquatic sport and the essential skills for the other aquatic sports, the stroke techniques have a great deal of influence in the occurrence of injuries reported that 33.3% of butterfly swimmer and 22.2% of breaststroke swimmers experienced low back pain, while 86% had at least one incident of breaststroke related to knee pain [8].

Furthermore, the injuries symptoms in aquatic sports commonly associated with shoulder pain, elbow pain, low back pain, and knee pain. These injuries occurred due to poor technique, and minimal fitness levels that contribute to injury in aquatic sports. In addition, overuse and maximum repetition in swimming can also lead to injury [3].

Based on the previous studies, the body regions in which most injuries occurred among elite swimmers were the upper limb (35.9%), followed by the lower limb (31.0%), the trunk (24.5%), and the head and neck (8.7%) [1].

The recent study also investigates the potential of gender in aquatic injuries. According to an 8-year prospective epidemiological study, aquatic style and technique significantly influenced for both male and female and there was no significant difference for body location and severity in both genders. Meanwhile, swimming shoulder pain was higher among males (55%) compared to females (38%) [9]. Similarly, based on Australian Institute of Sport (AIS), females' rower reported 1.58 injuries and males 0.85 injuries

per participant per year for incidence rates, while for kayaking and canoeing the most incident was in males (85%) compared than females (10.1%) [12].

According to Mukherjee et al. (2014) study, also the majority of musculoskeletal injuries (28.2%) sustained by female's dragon boats during water training, while (21.3%) in males reported during their landside strength training. They reported that female's dragon boats had a higher injury rate than males since the athlete's exposure and number of training hours [13].

Additionally, while sports injuries for various sports well-documented in some population, no studies have recorded data on injury profiles among aquatic sports athletes, like Sultan Idris Education University (UPSI), where has adequately aquatic sports environment, facilities, outdoors aquatic activity events and adventure opportunities for all of staff and students. Since aquatic sports have been interestingly concerned in UPSI, it is essential to identify all the common features, types and risk factors that make it easy for effective injury prevention for the future.

Therefore, this study aimed to determine the injury profile and prevalence of musculoskeletal sport injuries of aquatic sports athletes among UPSI staff and students based on types, location and cause of injuries. This study was an effort and a step towards prevention future risks by referring to the cause that occurs among aquatic sports athletes.

2. Materials and Methods

2.1. Sample Size

There were 115 athletes who participated in aquatic sports at UPSI including swimming, kayaking, canoeing, dragon boat, water polo in both genders from 2018-2020. Finally, of 75 respondents, 62 athletes (19-55 years old); staffs (n=25) and students (n=37), who had a minimum of four years aquatic sports involvement and injury experience, voluntarily completed the online survey questionnaire.

2.2. Outcome Measurements

This study data was carried out using an online questionnaire (online survey Google form). The questionnaire also was modified from Sport Injury Reporting Questionnaire as a common self-reported questionnaire [14], based on one used previously by FINA competition into two sets of questions [1]. The first set included the basic demographics information of the athlete such as gender, age, type of sport involved, duration of involvement, highest level of involvement, training information (how often, and how long of training time) the process of warming up and cooling down before and after training.

The second set consisted of the injury history including types (soft and hard tissues), body location and causes of injuries during their aquatic sports involvement. However,

often any injury research based on self-reported data, relying on the participants' truthful memory of events and the relation between injury history and injury risk should consider the validity of the self-report injury histories [15, 16]. It should be mentioned that soft-tissues injuries including damage to muscles and neural, tendons, ligaments, and hard tissues injuries were bones, joints with ligaments, and teeth damage. In order to protect and ensure the privacy and confidentiality of the respondents "Google Forms" created a "Consent Form Section" without name or any personal identification at the first step and the participants were volunteer to respond it. The incident of the self-reported injuries was recorded from January 2018 till September 2020.

2.3. Data Analysis

All data were recorded in the Excel file sheets and analyzed with descriptive statistics using SPSS (version 23.0). Statistical procedures applied were descriptive by mean, standard deviation percentage, frequencies and cross-tabulations.

3. Results

Table 1 shows the basic demography information of UPSI aquatic sports (AS) athletes (n=62) in both genders, who participated in the study including age, weight, height, BMI and AS involvement background. Table 2 also illustrates the distribution of athlete's sports by the type of aquatic sports.

3.1. Types of Injuries

Table 3 shows the number (frequency and percentage) of injuries according to types of injury as the most common injures among aquatic sports athletes in UPSI. The majority of reported injury was muscle cramp with 43 cases (42.2%) followed by abrasion 16 cases (15.7%) and contusion with 15 cases (14.7%) muscle strain by 8 cases (7.82%). In addition, for laceration, dislocation, ligament strain, ankle twist, tendon sprain reported less than 5 cases and for concussion and bursitis injury (3.2%) there was only one case report.

Table 1. Basis Demographic Data of the AS athletes (n=62)

VARIABLE	(Mean±SD)
Age (years)	33.55±8.52
Weight (kg)	59.42±9.66
Height (cm)	164.01±8.69
BMI (m.kg ⁻²)	23.38±3.4
AS involvement (years)	9.41±6.3

Table 2. The Participants Types of Aquatic Sports (n=62)

Types of Sport	Frequency & percentage: n (%)
Students Athletes	37 (59.7)
Staff Athletes	25 (40.3)
Swimming	26 (42)
Kayaking	15 (24.2)
Dragon Boat	9 (14.5)
Canoe	5 (8.1)
Water polo	4 (6.4)
Rowing	3(4.8)

Table 3. Types of Injury; frequency and percentage

Types of injuries	Type of injured tissue	n (%)
Muscle cramp	Muscle & neural	43 (42.2)
Abrasion	Soft tissue	16 (15.7)
Contusion	Soft tissue	15 (14.7)
Muscle Strain	Muscle & tendon	8 (7.84)
Laceration	Soft tissue	5 (4.9)
Ligament sprain	Ligament	4 (3.92)
Ankle twist	Ligament	4 (3.92)
Tendon sprain	Tendon	3 (2.94)
Dislocation	Bone, Joint, ligaments	2 (1.96)
Concussion	Brain tissue & neural	1 (1)
Bursitis	bursa	1(1)
Total Injury Cases		102 (100)

Table 4. Body location that involved in the aquatic sports injuries

Body location/ sports		Swimming	Kayaking	Dragon Boat	Canoe	Rowing	Water polo	Total cases & (%)
Upper extremity	Shoulder	18	6	8	3	2	2	39 (38.2)
	Forearm	5	5	3	3	-	-	16 (15.7)
	Elbow	2	-	-	-	-	-	2 (1.96)
	Wrist	-	3	-	-	-	-	3 (2.94)
	Hand	-	2	2	-	-	-	4 (3.92)
	Fingers	-	3	-	-	2	-	5 (4.9)
Lower extremity	Hip	4	3	-	2	1	-	10 (9.8)
	Thigh	6	-	-	1	-	-	7 (6.86)
	Knee	-	1	-	-	-	-	1 (.98)
	Calf	3	1	-	-	-	-	4 (3.92)
	Ankle	-	-	2	-	-	-	2 (1.96)
	Toes	3	1	-	-	-	-	4 (3.92)
Thoracic	Low back	-	-	-	-	-	3	3 (2.94)
Cranial	Head	-	2	-	-	-	-	2 (1.96)
Total cases		41	27	15	9	5	5	102 (100)

Table 5. Self- Reported causes of the injuries

Cause of injury	n (%)
Overuse and chronic	38 (37.25)
Poor paddle or technique	34 (33.3)
Low level of fitness	15 (14.7)
Improper warm-up & cool-down	5 (4.9)
Twist	5 (4.9)
Direct impact	4 (3.9)
Temperature related	1 (1)
Total cases	102 (100)

3.2. Body Location

In this study body location was divided based on anatomical location of injuries including cranial (cervical), upper extremity, thoracic and lower extremity. As table 4 illustrates the most body location injury in swimming, which the shoulder (18%), thigh (6%), forearm (5%), toes and calf (3%), while hip and elbow (2%) shared the same percentage. Kayaking was the second highest body location while shoulder (6%), followed by forearm (5%), hip and wrist (3%), the lowest was finger, hand, and head (2%). Besides, the highest was also shoulder (8%), forearm (3%) while the lowest was hand and ankle (2%) in dragon boat. Lastly, in canoe athletes, shoulder and forearm injuries were equal with (3%), followed hip (2%), while only finger injury (2%) was reported for rowing.

3.3. Injury Causes

The self-reported data of this study found that the

respondents sustained probably the causes of injuries for all types of aquatic sports, as Table 5 shows.

4. Discussion

The purpose of this study was to investigate the incidence, type and causes of the injuries that occurred among aquatic sports athletes (students and staff) in UPSI. Based on the study findings, muscle cramps (42.2%) were the most common type of injury as the respondents reported in all of AS. Muscle cramps were continuous, painful, localized contraction, involuntary of an entire muscle group, or selected muscle fibers. In addition, after muscle cramp, abrasion (15.7%), contusion (14.7%) and muscle Strain (7.8%) were the common type of injuries among the respondents.

The previous study conducted by FINA World Championship reports (2009, 2013, 2015) was recorded the most common injury types of the relevant AS

competitions were sprains (19.9%, 12.4%, 19.3%) and strains (15.7%, 16.3%, 14.8%). There was also a high incidence of finger/ thumb injuries (9.5%) and tendinosis (16.3%), at the reports in 2013 [1].

This study also showed that the injury mostly contributed by extrinsic factor, due to overuse and chronic which was the most causes, followed by poor paddling technique and the lowest no warm-up & cool-down. According to Hosea and Hannifin, (2012) findings, repetitive nature leads to overuse injury of shoulder paddling, but may be the cause of higher injury and load of training from rowing itself, while poor paddling technique also affected wrist and hand injuries in kayaking and canoeing according to previous study. Hence, the common cause of rowing is also by overuse associated to the stress of the rowing stroke technique related to the amount of training and techniques. It can probably occur because of the emphasis of repetitive and continuous movement in the various anatomical areas involved, which depended on the stroke phase [17].

In addition, there are two causes namely extrinsic cause; a direct injury by external factors such as collision with opponent, and intrinsic cause when there is an indirect injury like poor technique, fatigue and lack of physical fitness [18]. In this study, mostly cause of overuse occurred when there was the muscle fatigue, maximum repetitive, muscle imbalance and the poor paddling technique. Based on the previous study in swimming, several causes that resulted to the injuries were over-training as a consequence of muscle fatigue in shoulder, ankle, knee, elbow and the other lower extremities [1, 8].

It has been also reported that muscle imbalance, highly repetitive and difficulty in treating shoulder inflammation can be progressively effect on the anatomical structure as the causes of injuries [19, 20]. Besides, the causes of kayaking, canoeing and rowing injuries were repetitive nature of shoulder paddling, training load and also poor paddling technique, which also affected wrist and hand injuries as well. Consistent with previous research, striking an object in the river (40%), followed by 'traumatic stress' with the effect of water on the body or equipment (25%) and overuse (25%) were the commonest mechanism of injury [18]. According to Toohey et al. (2019) findings that stated "lost-Time" from training and competition was common following injury, with more than one quarter of the time-loss injuries resulting in more than 28 days of "lost-Time" from training or competition [3].

In line with these findings, the most causes of injuries for dragon boat that supported by the respondents were poor technique, low level of strength, imbalance of strength, repetitive movement and overuse injuries, which led to acute (58.7%) and chronic (63.8%) injuries [13], similarly among rowing athletes [17]. Thus, considering previous evidence and this study findings, the common

causes of AS injuries emphasize the need to improve the athletes' techniques as an effective prevention injury during training sessions and competitions specially for the swimming strokes techniques.

In addition, the findings of this study were based on the respondents from UPSI only whatever results obtained were referred to this group. Meanwhile, this research has provided a baseline data about AS musculoskeletal injuries profile that can assist the professional concern groups to have sufficient and accurate knowledge about AS injuries to identify the proper advice for AS athletes training. Further research in large scale involving other population should be carried out to generalize widely.

However, the self-reported injury research can be considered as a limitation of this musculoskeletal injury profile study and further investigations are needed to be relied highly upon confidence.

5. Conclusion

Based on this study findings, muscle cramps were the most common injury types that happen during swimming, kayaking, dragon boats and others. Besides that, shoulder injury was the most frequents injured body part, which occurred relating to overuse, improper technique and fitness level among aquatic sports athletes in UPSI. It seems, while aquatic sports from recreational to the elite level and as adventure and outdoor opportunities are willingly developing among the university staff and students', further studies are essential to improve prevention strategy particularly on upper extremity, over-training injures and poor techniques.

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