

Original Article

ASSOCIATION OF EXERCISE-RELATED INJURIES WITH BODY COMPOSITION AND AEROBIC CAPACITY IN AMATEUR ATHLETES

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ABSTRACT:

This study was conducted to evaluate the association of exercise-related injuries with body composition and aerobic capacity in amateur athletes. In this cross-sectional study 374 participants were recruited including both male and female amateur athletes; from Shoaib Akhtar and Abdul Qadir Cricket Academy, Lahore Pakistan. The study duration was four months, from September 2024 to January 2025. The participants of the study were recruited by using a non-probability convenient sampling technique. Participants' hip and waist dimensions were measured and Cooper's test assessed their aerobic capacity values. Additionally, responses for injury incidence rate and psychological readiness values were derived from their respective questionnaires. The study showed that males had a slightly higher waist-to-hip ratio (W/H ratio) than females (0.906 versus 0.896), while females showed better aerobic fitness compared to males (Cooper value: 12.89 versus 12.33). Muscle cramps were the most common injury, followed by fractures and concussions. Weak negative correlations were found between injury incidence and both aerobic fitness and W/H ratio. Injury incidence also showed a slight inverse relationship with age. However, no strong relationships were established between BMI, fitness levels, or demographic factors and injury incidence. The study concluded that as the injury incidence rate increases, aerobic capacity decreases. Waist-to-hip ratio and age had a slight inverse relationship with injury incidence rate while BMI and psychological readiness didn't have a significant correlation with injury incidence rate.

Keywords: Aerobic capacity, Amateur athletes, Athletic performance, Body composition, Physical fitness, Risk of injury

INTRODUCTION

Physical inactivity is a global public health issue, responsible for 3.2 million deaths annually and ranking as the fourth leading risk factor for a number of diseases. If physical inactivity were entirely eliminated, it could potentially reduce major non-communicable diseases by 6% to 10% (1). Sports play a vital role in maintaining physical fitness, health, and well-being. Athletes engage in regular physical activities and sport-specific trainings to achieve performance goals, making sports popular. Understanding the factors contributing to exercise-related injuries is crucial for developing effective prevention strategies and improving athlete well-being. Body composition and aerobic performance are two key variables that have been implicated in injury risk (2).

The effects of varying levels of physical activity are well-documented, and promoting physical activity is a fundamental aspect of modern public health. While engaging in sports, recreation, and physical activity is generally beneficial for health, the injuries sustained during these activities can have significant short- and long-term negative consequences. These injuries play a crucial role in overall disease morbidity (3). In 2019, eighty-four percent of the participants who actively participated in sports, experienced an injury, out of which, 39% of participants experienced injuries in previously injured areas. The average injury rate was approximately 2.64 per 1000 hours. Soccer had the highest number of incidents and injuries (7.21%). Common injuries included lumbar muscle strain (12.32%), ankle sprain (11.95), and fracture (9.46%). The most affected body parts were ankles (36.12%), knees (19.32%), and shoulders (6.47%). Injuries occurred more frequently during practice sessions (59.28%) than in competitions or peri-competitions (40.72%).

Additional factors contributing to injury rates included, excessive weekly practice hours, lack of warm-up exercises, poor-quality facility construction and inadequate equipment, age group of 14 to 17, imbalance and overuse in training regimens, lack of preventive measures to address inactivity, improper sports performance mechanics without guidance from a qualified trainer and inappropriate sports attire(4).

The intricate relationship between exercise-related injuries, body composition, and aerobic performance in amateur athletes has been investigated. Previously reported studies suggest that body composition plays a significant role in injury risk, with excessive body fat and insufficient muscle mass being identified as potential contributing factors. Studies show that young athletes need a combination of endurance, agility, and strength to excel in sports. However, these needs can change as players get older and their bodies mature. For example, younger players might need more speed, while older players might need more stamina. These differences can also depend on a player's body type (5-9).

Regular aerobic exercise is a valuable tool for enhancing endurance performance and improving overall cardiovascular health. By increasing the efficiency of the cardiovascular and respiratory systems, aerobic training enables the body to deliver oxygen more effectively to working muscles. This enhanced oxygen delivery capacity, measured by VO₂ max, is crucial for sustaining high-intensity exercise for extended periods. In addition to improving endurance, regular aerobic exercise offers numerous health benefits. It can reduce the risk of heart disease, stroke, and type 2 diabetes. It can also help manage weight and improve mental health (10-15). The study aimed to evaluate the association of exercise-related injuries with body composition and aerobic capacity in amateur athletes.

METHODS:

This was a cross-sectional study, including 374 participants who were selected using the non-probability convenience sampling technique. The data was collected from Shoaib Akhtar Cricket Academy and Abdul Qadir Cricket Academy Lahore, Pakistan. The study was conducted over four months, from September 27, 2024, to January 2025. The Faculty of Allied Health Sciences, Riphah International University, Lahore, Pakistan, approved the study.

The participants included in this study regardless of gender aged between 19 to 30 years, and they were actively involved in sports for the part years. The participants with chronic illnesses which could affect their physical performance and those who suffered exercise-related injuries in last three months were excluded.

Those who met the inclusion criteria of the study were informed about the study's objectives, the study procedure and protocols, and the benefits of the study, and had all of their queries resolved. After giving informed consent, they gave the required data for the study. The following methods were used to get the required data for the study.

Cooper test:

The Cooper Test, a 12-minute run test, evaluates an individual's aerobic capacity, or the body's ability to deliver oxygen to working muscles. Participants warm up, run for 12 minutes, and then cool down. The distance covered is used to predict VO₂ max, the maximum oxygen consumption rate (12).

Psychological Readiness of Injured Athlete to Return to Sport (PRIA-RS):

The PRIA-RS questionnaire is a reliable and effective tool for evaluating an athlete's mental state during recovery from an injury. It measures confidence, individual perception, insecurity, and fear of re-injury.

The participants filled out the questionnaire by marking the options that most accurately reflect their thoughts, conditions, or beliefs, which normally takes 2-5 minutes. Their responses were evaluated by the researchers afterward.

Body composition parameters:

Body composition parameters include age, height (m), weight (Kg), waist (cm), hip (cm), BMI (kg/m²), waist-to-hip ratio (W/H ratio), body fat percentage, and VO₂ max (ml/kg/min). The participants wrote their values on the Questionnaire.

Injury Incidence Rate (IIR):

The injury rate was recorded according to the type of injury. A self-conducted survey included the most common injuries in sports. The participants marked all of the injuries that they suffered from.

Statistical analyses

Data was analyzed using SPSS 21. Demographic information was analyzed by using suitable frequency tables and graphs. Histograms and pie charts were made for the age, gender, and BMI of participants. Pearson's correlation coefficients were applied to establish the relationships among the variables measured, a p-value <0.05 was used to evaluate significance.

RESULTS:

This study involving 374 participants, out of which 80.2% were males and 19.8% were females. The mean age of the participants was 21.4 years, with an age range of 19 to 30 years. The average BMI was 21.37, indicating a generally healthy weight range among the participants. The W/H ratio was slightly higher in males (mean 0.906) than in females (mean 0.896). Females also had a slightly higher average Cooper value (12.89) compared to males (12.33), suggesting slightly better aerobic fitness. The most common injury was multiple 2 (bruise, laceration, muscle cramps) with a frequency of 61 (16.3%) while concussion was the least common injury with a frequency of 17 (4.5%), a summary of the injuries is presented in Table 1. IIR and aerobic capacity (Cooper value) have a weak negative correlation (Table 2). IIR has a weak negative correlation with W/H ratio and age, while BMI doesn't have any relationship with IIR (Table 3).

Table 1. Pattern of injury reported in the participants of the study

	Frequency	Percent
Concussion	17	4.5
Fracture	29	7.8
Strain	20	5.3
Sprain	15	4.0
Bruise	11	2.9
Meniscus	7	1.9
Arthritis	2	0.5
Laceration	18	4.8
Muscle cramp	58	15.5
Tendinopathy	10	2.7
Dental injury	14	3.7
Impingement	8	2.1
Others	13	3.5
Multiple 1 (concussion, meniscus, fractures)	39	10.4
Multiple 2 (bruise, laceration, muscle cramps)	61	16.3
Multiple 3 (strain, sprain, impingement, other)	42	11.2
Multiple 4 (arthritis, tendinopathy, dental injury)	10	2.7
Total	374	100.0

Table 2. The correlation between IIR and Cooper value

Correlations			
		IIR	Cooper
IIR	r	1	-.118*
	p-value		.022
Cooper	r	-.118*	1
	p-value	.022	

Table 3. The correlation between IIR, BMI, W/H ratio and age

Correlations					
		IIR	BMI	W/H Ratio	age
IIR	Correlation coefficient (r)	1	-.042	-.110*	-.105*
	p-value		.420	.033	.043
BMI	Correlation coefficient (r)	-.042	1	-.085	.223**
	p-value	.420		.101	.000
Ratio	Correlation coefficient (r)	-.110*	-.085	1	.021
	p-value	.033	.101		.683
age	Pearson Correlation	-.105*	.223**	.021	1
	Sig. (2-tailed)	.043	<0.001	.683	

DISCUSSION

This cross-sectional study was aimed to investigate the frequency of exercise-related injuries among amateur athletes and to examine the relationship between injuries, body composition, and aerobic capacity. The results revealed a mean BMI of 21.37, with a minimum BMI of 14.20 and a maximum of 36.96, aligning with previous research conducted by Neeraj Kumar et al. (16), who highlighted the importance of maintaining a balanced BMI for optimal athletic performance, particularly in sports requiring both aerobic capacity and agility. Body composition was further analyzed through waist-to-hip ratio, waist circumference, and hip circumference. Significant gender differences were found, with males exhibiting higher W/H ratio, indicating more abdominal fat, while females showed larger hip circumferences, which is typical of their lower body fat distribution. These findings are consistent with studies by Bouchard et al. and Pasco et al. (17), who noted similar gender-based differences in body fat distribution.

Regarding injury prevalence, lower extremity injuries, including ligament sprains and muscle strains, were the most common, resulting in significant time loss. This finding corroborates the work of Johannes Weishorn et al. (18), who also observed the high impact of lower extremity injuries on recovery. The current study also examined the psychological factors influencing recovery, revealing that athletes at risk of re-injury had lower PRIA-RS scores, indicating the importance of addressing psychological readiness in rehabilitation. This aligns with the findings by Pedro Gómez-Piqueras et al. (13), who emphasized the role of psychological factors in successful rehabilitation and the prevention of re-injury.

In terms of aerobic capacity, the study found that younger, fitter athletes had better Cooper test scores, indicating higher aerobic capacity. This is consistent with the study by FB Souza et al. (19), which found that more experienced athletes showed higher VO₂ max levels than their less experienced counterparts. However, the study also revealed that aerobic capacity did not have a significant influence on injury risk, suggesting that factors such as training intensity and environment may play a more critical role. Gender differences in sports participation were also observed, with males representing a significantly higher proportion of athletes, which is in line with findings by Robert O. Deaner et al. (20) who found that females participate in fewer sports than males.

Furthermore, the study found a weak inverse relationship between injury incidence and Cooper test scores, supporting previous research by Galih Yogi Handarou et al. (21), which suggested that higher aerobic capacity may be associated with a lower risk of injury. However, no statistically significant correlation was found between BMI and injury incidence, which aligns with the studies by E. Kelmer et al. (22), who found no significant relationship between BMI and sports injuries. The study also indicated that younger athletes were more susceptible to injury than older athletes, which is consistent with the findings of Ljubica Bačanac et al. (23). They identified age as a significant risk factor for injury.

Lastly, the psychological readiness to return to play was found to negatively affect recovery, although this relationship was not significant in the younger athletes studied. This finding is consistent with studies by Andre Frank et al. (24), which emphasized the role of psychological readiness in rehabilitation and injury recovery. Finally, the study found a weak negative correlation between W/H ratio and injury incidence, suggesting that athletes with better fat distribution and core stability are less likely to sustain injuries. This finding is in line with research by Md. Hamidur Rahman et al. (25), who emphasized the role of W/H ratio in injury prevention, particularly in high-intensity sports.

CONCLUSION

This study concluded that; an increase in BMI didn't significantly affect an increase in the incidence rate of injury (IIR). Aerobic capacity and IIR have a statistically significant but weak correlation, suggesting that as IIR increases the aerobic capacity decreases significantly. The W/H ratio has a weak, statistically significant inverse relation with IIR. Age also had a statistically significant weak negative relation with IIR, while PRIAS had a weak negative correlation that is not significant.

This study opens a window for future research including other anthropometric characteristics and physiological factors. Athletes should also be recommended to improve functional fitness, such as power, strength, flexibility, and balance, to enhance performance and reduce injury risk. Clinicians should always focus on collaborating with coaches, nutritionists, physiotherapists, sports medicine physicians, psychologists, etc. to work to fulfill the individual needs of athletes and make evidence-based decisions.

Conflict of Interest

Authors declare no conflict of interest.

Ethical consideration

The study was approved by the local Ethical Review Committee.

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