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Body Composition and Injury Prevalence in Mexican University Athletes

Composición Corporal y Prevalencia de Lesiones en Atletas Universitarios Mexicanos

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SUMMARY: The epidemiology of injuries and their relationship with body composition is a crucial aspect for sports medicine teams to analyze, as it enables the organization of actions for injury prevention during the competitive season. This study aimed to compare body composition with injury prevalence among injured and non-injured university athletes, categorized by sex and sport. Sports injuries and anthropometric characteristics were analyzed in 771 competitive-level athletes (374 women and 397 men) from university teams in Mexico. Body composition was assessed using anthropometry, and injury classification and prevalence were determined by a sports medicine team. Injury prevalence was 65.6 %, with the highest prevalence observed in cheerleading (9.2 %), athletics (8.8 %), and taekwondo (8.7 %). No associations were found between sex and injury occurrence ($\chi^2 = 0.04$, df = 1, p = 0.825), nor were there differences in injury rates between sports ($\chi^2 = 11.45$, df = 11, p = 0.406). No relationships between body composition and injuries were identified, suggesting that other unmeasured factors in this study may have a greater influence on injury occurrence. It is concluded that injury prevalence is high in this group of athletes and that body composition and sex do not influence the occurrence of injuries. This study is significant as it motivates university sports medicine teams to consider other variables influencing injury occurrence.

KEY WORDS: University athletes; Body composition; Injury prevalence; Sports injuries: Epidemiology; Sex differences; Sports medicine.

INTRODUCTION

Injuries are currently a public health concern, negatively impacting both sports and society (Prieto-González *et al*., 2021; Rey-Mota *et al*., 2025). Monitoring the prevalence of injuries is crucial, as athletes who sustain injuries undergo detraining and lose physical conditioning. This often manifests as a reduction in muscle mass or bone mineral density, leading to additional physical and mental health problems, as well as increased healthcare costs (Kimura *et al*., 2023). While engaging in sports activities generally enhances physiological health (Fiuza-Luces *et al*., 2013; Thompson *et al*., 2020), psychological well-being, and social connections (Eime *et al*., 2013; Redondo-Flórez *et*

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al., 2022; Khasanova & Henagan, 2023), injuries can undermine these long-term benefits.

Various studies have revealed differences in the types of injuries depending on the sport and sex (Rey-Mota *et al*., 2024). Scientific evidence suggests that sports participation offers numerous health benefits. However, high-intensity sports activities are associated with an elevated risk of musculoskeletal injuries. This is because the acceleration of body mass increases the forces generated, thereby contributing to a higher likelihood of injury (Lemoyne *et al*., 2017). Furthermore, sports injuries can lead to decreased participation in sports, increased morbidity from various causes, overweight/obesity, and post-traumatic osteoarthritis (Richmond *et al*., 2013). They also result in significant reductions in physical activity levels, which may lead to negative health outcomes in the future (Hind *et al*., 2020), thereby adversely affecting athletes' psychological, physical, and economic well-being.

In addition, these injuries may increase the probability of re-injury and cause mental health issues such as guilt, impatience, fear of performance, and pressure to return to training (Haraldsdottir & Watson, 2021). These factors can also have economic consequences for athletes due to the direct and indirect costs of injuries, affecting not only elite athletes but also recreational athletes of all ages, as injuries can impair their health and ability to work (Schmikli *et al*., 2009).

To minimize the risk of injuries, various strategies can be employed, including modifying rules, mandating protective equipment, educating athletes and coaches, adjusting training regimens, and developing injury prevention programs (Putukian *et al*., 2014). Literature provides evidence of the prevalence of injuries among university athletes. Teahan *et al*. (2021), reported that more than one-quarter of student-athletes sustained an injury during the academic season, with male athletes showing higher injury rates than females, predominantly affecting the lower limbs. In a study by Kimura *et al*. (2023), the prevalence of injuries among Japanese collegiate athletes was found to be high, with most injuries requiring significant time away from training and competition, indicating their severity. Additionally, this study reported that second-year and senior university athletes with overweight or obesity, who trained more frequently per week and had greater sports experience, were more likely to sustain an injury in the previous year (Kimura *et al*., 2023).

Therefore, it is essential to conduct studies that analyze the epidemiology of injuries to establish effective prevention strategies (Hind *et al*., 2020). Such analyses provide critical insights into identifying risk factors, understanding injury mechanisms, and designing targeted interventions tailored to specific athletic populations. University athletes, in particular, face unique challenges due to the high physical and psychological demands they encounter in competitive sports environments. These demands often stem from rigorous training schedules, academic responsibilities, and the pressure to perform, all of which can contribute to an elevated prevalence of injuries within this population. Consequently, addressing injury prevention among university athletes is a key research priority, as it holds the potential to guide the development of evidence-based strategies in both educational and sports policies at the university level (Kerr *et al*., 2014).

This study aims to bridge a critical knowledge gap by examining the relationship between body composition and injury prevalence among university athletes. Specifically, the research focuses on comparing body composition metrics between injured and non-injured athletes, considering variations by sex and sport. By doing so, it seeks to identify potential patterns or associations that could inform tailored prevention strategies, ultimately contributing to the long-term well-being and performance of university athletes.

MATERIAL AND METHOD

Participants. The study analyzed sports injuries and anthropometric characteristics in a cohort of 771 competitive-level athletes (374 women and 397 men) who were part of university teams in Tlaquepaque, Jalisco, Mexico. Average age of the participants was 20.7 years. Inclusion criteria consisted of athletes who were members of representative teams from 2021 to 2023, had experienced at least one musculoskeletal injury during that period, and had undergone body composition evaluations through anthropometric assessments within the same timeframe. Exclusion criteria included athletes who did not have anthropometric evaluations conducted during the specified period.

Evaluations. All evaluations were conducted during the academic year by a dedicated Sports Medicine team within the facilities of the university hospital.

Anthropometry. During January and August of each year, the university's representative teams underwent morphofunctional evaluations, during which anthropometry was performed.

Anthropometric measurements were performed by an ISAK Level 3-certified anthropometrist and two ISAK Level 1-certified anthropometrists. Measurements were conducted in the Science Laboratory from August 2021 to May 2023.

Evaluations. The evaluations were conducted within the university's Applied Sports Science Laboratory, adhering to the restricted profile protocol established by the International Society for the Advancement of Kinanthropometry (ISAK). Participants were instructed to attend the assessments without prior physical activity and wearing appropriate attire. Body mass was measured using a bioelectrical impedance device (InBody® model 230), while height was recorded with a portable stadiometer (SECA® model 213). Skinfold thickness was assessed using a Harpenden calliper, circumferences with a Lufkin measuring tape, and bone diameters with a Smartmet anthropometer.

Body composition analysis was performed using specific equations for four components: muscle mass (percentage and kilograms) calculated with Lee's equation, fat mass (percentage and kilograms) using Faulkner's equation, the sum of six skinfolds (mm), the muscle-bone index (MBI), and the FAT-muscle index (FMI). The body mass index (BMI) was also computed. Anthropometric data were recorded and analyzed using the 5-Component® software.

Injury Prevalence. Data on musculoskeletal injuries were collected from the twelve representative university sports teams, based on records from sports medicine consultations conducted between August 2021 and November 2023. Diagnoses were clinically determined by a sports medicine physician certified by the National Council of Sports Medicine in Mexico.

For database creation, injuries documented during the initial medical consultations were classified according to the affected region. Three scenarios were defined: upper limbs, lower limbs, or both regions affected in the same case.

Ethical Considerations. Upon joining the university's representative teams, athletes signed an informed consent form, which was reviewed and approved by the appropriate institutional ethics committee. This document outlined the evaluations to be conducted and informed participants that their data could be used for research purposes while ensuring confidentiality. All procedures adhered to the principles outlined in the Declaration of Helsinki for research involving human participants (World Medical Association, 2013).

Statistical Analysis. The data analysis was conducted rigorously to ensure the appropriateness of statistical methods. Normality of anthropometric data and injury prevalence was assessed using the Kolmogorov-Smirnov test, which indicated a non-normal distribution ($p<0.001$). Consequently, medians and interquartile ranges were used for descriptive statistics. The Kruskal-Wallis test was employed to identify potential differences across sports, followed by Dunn's post hoc analysis to pinpoint specific inter-sport differences. Statistical analyses were performed using IBM SPSS software, version 23.0 (IBM Corp., Armonk, NY, USA). A significance level of $p \leq 0.05$ was applied to all statistical tests to ensure robust and meaningful results.

RESULTS

In Table I, the means and interquartile ranges of the groups divided by sex and injury prevalence (injured and non-injured groups) are shown. When comparing variables based on injury prevalence, no differences were observed in anthropometric variables between the groups ($p > 0.05$). Differences were found between women and men when comparing results by sex, with the latter showing higher muscle mass ($p < 0.001$), higher bone-muscle index ($p < 0.001$), lower body fat percentage ($p < 0.001$), lower sum of skinfolds ($p < 0.001$), and a lower fat-muscle index (FMI) than women. In Table II, the medians and interquartile ranges of different anthropometric variables are presented, showing differences among athletes from all studied sports disciplines.

The differences in key variables, including age, height, weight, body mass index (BMI), muscle mass, fat mass, the sum of 6 skinfolds, muscle-bone index (MBI), and fat-muscle index (FMI), were analyzed across various sports disciplines. These differences are detailed in Table III, highlighting how the specific demands and characteristics of each sport influence the physical attributes of the athletes.

Table IV presents the location and frequency of injuries for the total sample and by sex. In the total sample, 37.9 % of injuries occurred in both the upper and lower body, 22.8 % in the upper body, and 39.3 % in the lower body. Among men, 22.7 % of injuries affected both the upper and lower body, 11.3 % occurred in the upper body, and 19.3 % in the lower body. For women, 15.2 % of injuries were reported in both the upper and lower body, 11.5 % occurred in the upper body, and 19.5 % in the lower body.

Table V presents the injury prevalence results categorized by sex and sport. The findings revealed no significant differences in injury rates across different sports ($\chi^2 = 11.45$, df = 11, $p = 0.406$). Similarly, when evaluating the association between sex and injury occurrence, no differences were found between groups ($\chi^2 = 0.048$, df = 1, $p = 0.825$). A Pearson correlation analysis identified a weak but significant positive relationship between the number of injuries and muscle mass ($r = 0.084$, $p = 0.020$), as well as between the number of injuries and body weight ($r = 0.078$, $p = 0.030$). However, it is important to note that the magnitude of these correlations is small, suggesting that other unmeasured factors in this study may have a more substantial influence on injury occurrence.

Table I. Anthropometric characteristics by Injury status and sex.

	Women						Men							
	Injured (n=130)		Non-injured (n=244)		Δ	*p*	Injured (n=135)		Non-injured (n=262)		Δ	*p*	Sex differences	ε^2
	x	IQR	x	IQR			x	IQR	x	IQR				
Age	20.5	20.0 - 21.0	20.6	20.0 - 22.0	0.1	0.604	21.0	20.0 - 22.0	21.1	20.0 - 22.0	0.1	0.793	<.001	0.017
Height	164.7	160.0 - 170.0	163.6	159.0 - 169.0	1.1	0.124	178.6	173.0 - 184.0	177.1	173.0 - 182.0	-1.5	0.119	<.001	0.526
Weight	62.5	54.6 - 66.4	62.0	54.6 - 66.9	-0.5	0.962	76.7	68.5 - 82.9	76.5	67.3 - 82.3	-0.2	0.461	<.001	0.330
BMI	24.5	20.8 - 24.2	23.1	21.1 - 24.8	1.4	0.398	24.0	21.7 - 25.4	24.9	21.7 - 25.9	0.9	0.677	<.001	0.023
LBM (kg)	22.4	20.4 - 23.8	22.5	20.4 - 23.8	0.1	0.996	32.9	30.6 - 35.0	32.8	30.1 - 35.1	-0.1	0.483	<.001	0.691
LBM (%)	36.3	34.3 - 38.4	36.4	34.6 - 38.6	0.1	0.928	43.3	40.9 - 45.8	43.4	41.4 - 45.9	0.1	0.627	<.001	0.101
SMM (kg)	14.5	10.7. - 16.3	14.2	10.7. - 16.3	-0.3	0.644	11.6	8.1 - 14.2	12.1	8.4 - 13.1	0.5	0.588	<.001	0.532
MM (%)	22.6	18.4 - 25.3	22.3	19.0 - 24.7	-0.3	0.817	14.7	11.3 - 17.1	15.2	11.8 - 17.0	0.5	0.400	<.001	0.431
Σ6SF	107.0	82.2 - 126.0	102.8	81.5 - 120.0	-4.2	0.365	79.1	53.8 - 99.9	82.2	55.2 - 98.0	3.1	0.599	<.001	0.152
MBI	2.4	2.2 - 2.6	2.4	2.3 - 2.6	0.0	0.126	2.7	2.5 -2.9	2.8	2.5 - 2.9	0.1	0.088	<.001	0.238
FMI	0.635	0.5 - 0.7	0.614	0.5 - 0.7	-0.21	0.458	0.344	0.3 - 0.4	0.355	0.3 - 0.4	0.11	0.619	<.001	0.477

Abbreviations: Σ6SF=Sum of 6 skinfolds; BMI=body mass index; FMI=fat-muscle index; IQR=interquartile range; LBM=Lean Body Mass; MBI=muscle-bone index; MM=muscle mass; SMM=Skeletal Muscle Mass.

DISCUSSION

The objective of this study was to compare body composition with injury prevalence among university athletes, differentiated by injury status, sex, and sport. The findings revealed no significant differences in body composition between injured and non-injured athletes, regardless of sex. Furthermore, no associations were found between sex and injury occurrence. Inferential analyses also demonstrated no significant differences in injury rates among various sports.

In a study conducted by Lemoyne *et al*. (2017), the prevalence and patterns of sports injuries over a one-year period in 82 university athletes were analyzed. The study suggested that the injury profile varied depending on the type of sport: Acute injuries were more prevalent in team sports, while overuse injuries were more common in individual sports. This indicates that injuries are likely influenced by multiple factors, including exercise intensity, the nature of the sport, training programs, and other variables. In our study, the highest injury incidence was observed in cheerleading, athletics, and taekwondo. Kimura *et al*. (2023), examined the prevalence and associated factors of sports injuries in 11,000 Japanese collegiate athletes. Their findings indicated a high prevalence of injuries, with the majority requiring athletes to take significant time off from training and competition, underscoring the severity of these injuries. Additionally, second-year or senior university athletes who were overweight or obese, trained more frequently per week, and had greater sports experience were more likely to sustain injuries in the previous year. Similarly, Danes Daetz *et al*. (2020), monitored 84 university athletes of both sexes from soccer, basketball, and volleyball teams over a six-month period. They recorded all injuries that occurred and found that injuries were more frequent in men, predominantly affecting the lower limbs, particularly the ankle joint, followed by the knee and wrist-hand region. In our study, while no differences were observed

Table II. Anthropometric characteristics of injured and non-injured athletes by sport.

	A (n=101)		ATL (n=98)		BF (n=38)		BV (n=54)		FF (n=83)		FV (N=68)		R (n=59)		T (n=46)		TKD (n=96)		VP (n=24)		VSF (n=52)		VSV (n=52)	
	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR	x	IQR
Age	21	22.0-20.0	20.5	22.0-20.0	20	21.0-19.0	20	21.8-20.0	20	22.0-20.0	20.5	21.3-19.0	21	22.0-20.0	21	22.0-20.0	21	23.0-20.0	21	21.0-20.0	21	21.3-19.0	21	23.0-21.0
Height	169.6	173.1-158.1	173.0	180.9-165.0	170.3	175.5-167.0	182.0	185.5-175.7	161.0	164.4-157.6	175.3	182.8-171.5	176.0	181.8-171.9	164.5	171.6-161.6	168.0	174.6-160.8	173.4	176.5-161.4	169.5	173.5-164.0	184.1	187.9-179.6
Weight	61.9	70.7-56.3	65.8	72.4-57.2	77.8	86.6-64.8	76.3	80.6-69.2	59.1	63.4-53.3	72.3	76.5-68.2	81.6	95.8-74.5	66.0	70.5-62.3	63.3	70.6-56.2	63.5	67.5-56.7	64.6	67.6-61.6	76.3	80.8-72.2
BMI	22.7	25.3-21.4	21.8	24.1-19.9	26.5	28.6-23.3	22.8	24.1-21.9	23.0	24.9-20.5	23.3	24.4-22.1	27.3	31.0-25.1	23.9	25.5-22.3	22.3	25.4-20.8	21.4	23.4-19.8	21.9	25.0-21.0	22.6	25.1-21.7
MM (kg)	23.6	29.9-28.0	28.3	32.8-31.27	25.35	27.7-23.9	32.9	34.1-31.2	21.8	23.4-20.5	31.4	33.4-30.2	36.0	38.7-33.4	24.2	30.3-21.5	24.8	30.0-20.2	22.7	31.0-19.9	23.1	23.8-22.3	33.5	34.9-31.6
MM (%)	39.1	43.3-36.4	42.3	46.1-37.7	34.7	38.1-32.05	43.3	45.8-41.5	37.4	39.3-35.7	43.9	45.6-41.4	43.2	45.1-39.5	36.0	43.3-34.3	37.3	40.7-35.7	40.4	42.8-35.6	35.5	37.3-33.8	43.4	44.9-41.2
FM (kg)	11.3	15.8-9.0	8.8	12.3-7.1	19.8	27.1-13.4	9.8	11.3-8.4	12.1	14.7-10.2	9.7	11.4-8.8	13.2	22.8-10.5	14.9	16.8-10.7	12.1	16.7-9.9	10.8	13.0-7.5	14.5	16.3-12.3	9.6	12.9-8.7
FM (%)	19.4	22.6-15.3	14.7	20.3-10.8	25.7	31.4-21.3	12.7	15.6-11.5	20.8	23.2-18.7	13.8	15.6-12.5	16.9	22.6-14.3	20.1	26.8-15.8	20.5	23.4-16.8	17.2	19.5-14.2	22.3	24.6-20.3	13.0	14.8-12.1
∑6SF	92.1	114.6-67.0	70.7	92.9-45.2	124.3	153.5-86.6	60.6	85.8-55.6	94.2	109.9-80.8	69.8	87.5-63.2	95.9	137.8-71.3	110.0	132.9-82.9	103.1	128.6-76.4	80.1	91.7-57.1	104.8	122.6-88.0	64.2	82.9-55.8
MBI	2.6	2.8-2.4	2.6	2.8-2.3	2.4	2.5-2.3	2.6	2.8-2.5	2.5	2.7-2.4	2.7	2.8-2.5	3.0	3.2-2.8	2.6	2.7-2.4	2.5	2.8-2.2	2.4	2.5-2.3	2.3	2.4-2.2	2.5	2.7-2.4
FMI	0.5	0.6-0.4	0.4	0.5-0.2	0.8	1.0-0.5	0.3	0.4-0.3	0.5	0.6-0.5	0.3	0.4-0.3	0.4	0.6-0.3	0.5	0.8-0.3	0.5	0.6-0.4	0.4	0.5-0.3	0.6	0.7-0.5	0.3	0.4-0.3

Abbreviations: BMI=Body Mass Index; FM=fat mass; FMI=fat-muscle index; IQR=interquartile range; MM=muscle mass; MBI=muscle-bone index; ∑6SF=sum of 6 skinfolds (triceps, subscapular, supraspinal, abdominal, mid-thigh, and calf); ε^2=epsilon squared effect size; x=median; A=cheerleading; ATL=athletics; BF=women's basketball; BV=men's basketball; FF=women's soccer; FV=men's soccer; R=rugby; T=tennis; TKD=taekwondo; VP=beach volleyball; VSF=women's indoor volleyball; VSV=men's indoor volleyball.

between sexes regarding injury occurrence, the prevalence of injuries was higher in individual sports. However, similar to Danes Daetz *et al*. (2020), our findings showed a greater frequency of lower limbs injuries, primarily in men. Contrary to these findings, other studies have reported a higher injury frequency in women (Tenforde *et al*., 2013; Brant *et al*., 2019). This has been attributed to anatomical differences (Schilaty *et al*., 2018), hormonal variations (Tenforde *et al*., 2013), and neuromuscular disparities between sexes (Flaxman *et al*., 2014). Women are generally found to have higher risk factors for injuries (Danes Daetz *et al*., 2020), which highlights the need for further investigation into sex-specific factors contributing to injury prevalence.

In our study, acute injuries in cheerleading often resulted from scenarios such as catching a falling teammate or landing on the ground after being tossed by team members. In this sport, axial loads generated by jumps and stunts are critical factors to consider when analyzing injuries. It is plausible to suggest that the nature of cheerleading, with its exposure to high-impact and contact situations, could be a contributing factor to the differences in injury patterns observed among athletes.

For instance, athletes involved in individual sports, which typically involve lower contact risk, such as athletics in our study, undergo highly repetitive training regimes. This repetitive nature may explain the higher incidence of overuse injuries in such sports (Renström & Johnson, 1985). Shields & Smith (2009), examined the epidemiology of injuries in cheerleading and calculated injury rates by team type and event. Their findings indicated that injury rates in cheerleading were lower than those reported for other high school and collegiate sports. However, many injuries in cheerleading could be prevented, with lower limb injuries being the most common, followed by upper limb injuries. Most injuries occurred during gymnastic maneuvers, partner stunts, and pyramids (Shields & Smith, 2009).

Table III. Differences between sports.

	H	df	*p*	ε^2	Post hoc comparisons
Age	33.2	11	<.001	0.043	ATL-VSV, BF-VSV, BV-BSV, FF-VSV, VSF-VSV
Height	317	11	<.001	0.411	A-ATL, A-BV, A-FF, A-FV, A-R, A-VSV, ATL-BV, ATL-FF, ATL-T, ATL-TKD, ATL-VSV, BF-BV, BF-FF, BF-FV, BF-R, BF-VSV, BV-FF, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-T, FF-TKD, FF-VP, FF-VSF, FV-T, FV-TKD, FV-VSF, R-T, R-TKD, R-VSF, R-VSV, T-VSV, TKD-VSV, VP-VSV, VSF-VSV
Weight	237	11	<.001	0.307	A-BV, A-FV, A-R, A-VSV, ATL-BF, ATL-BV, ATL-FF, ATL-FV, ATL-R, ATL-VSV, BF-FF, BF-TKD, BV-FF, BV-R, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-T, FF-VSF, FF-VSV, FV-R, FV-T, FV-TKD, FV-VP, FV-VSF, R-T, R-TKD, R-VP, R-VSF, T-VSV, TKD-VSV, VP-VSV, VSF-VSV
BMI	117	11	<.001	0.152	A-BF, A-R, ATL-BF, ATL-FV, ATL-R, ATL-T, BF-BV, BF-FF, BF-FV, BF-TKD, BF-VP, BF-VSV, BV-R, FF-R, FV-R, R-T, R-TKD, R-VP, R-VSF, R-VSV,
MM (kg)	329	11	<.001	0.427	A-BV, A-FF, A-FV, A-R, A-VSV, ATL-BV, ATL-FF, ATL-FV, ATL-R, ATL-VSF, ATL-VSV, BF-BV, BF-FF, BF-FV, BF-R, BF-VSF, BF-VSV, BV-FF, BV-R, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-VSF, FV-R, FV-T, FV-TKD, FV-VP, FV-VSF, R-T, R-TKD, R-VP, R-VSF, R-VSV, T-VSV, TKD-VSV, VP-VSV, VSF-VSV
MM (%)	254	11	<.001	0.330	A-BF, A-BV, A-FV, A-VSF, A-VSV, ATL-BF, ATL-FF, ATL-T, ATL-TKD, ATL-VSF, BF-BV, BF-FF, BF-FV, BF-R, BF-TKD, BF-VP, BF-VSV, BV-FF, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-VSF, FF-VSV, FV-T, FV-TKD, FV-VP, FV-VSF, R-T, R-TKD, R-VSF, T-VSV, TKD-VSF, TKD-VSV, VP-VSF, VSF-VSV
FM (kg)	150	11	<.001	0.195	A-ATL, A-BF, A-VSF, ATL-BF, ATL-FF, ATL-R, ATL-T, ATL-TKD, ATL-VSF, BF-BV, BF-FF, BF-FV, BF-T, BF-TKD, BF-VP, BF-VSV, BV-FF, BV-R, BV-T, BV-TKD, BV-VSF, FF-FV, FF-VSF, FV-R, FV-T, FV-TKD, FV-VSF, R-VP, R-VSV, T-VP, T-VSV, TKD-VSV, VP-VSF, VSF-VSV
FM (%)	263	11	<.001	0.341	A-ATL, A-BF, A-BV, A-FV, A-VSF, A-VSV, ATL-BF, ATL-FF, ATL-T, ATL-TKD, ATL-VSF, BF-BV, BF-FF, BF-FV, BF-R, BF-TKD, BF-VP, BF-VSV, BV-FF, BV-R, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-T, FF-VP, FF-VSV, FV-R, FV-T, FV-TKD, FV-VSF, R-VSF, R-VSV, T-VSV, TKD-VSV, VP-VSF, VSF-VSV
∑6SF	169	11	<.001	0.220	A-ATL, A-BF, A-BV, A-FV, A-VSV, ATL-BF, ATL-FF, ATL-R, ATL-T, ATL-TKD, ATL-VSF, BF-BV, BF-FF, BF-FV, BF-VP, BF-VSV, BV-FF, BV-R, BV-T, BV-TKD, BV-VSF, FF-FV, FF-VSV, FV-R, FV-T, FV-TKD, FV-VSF, R-VSV, T-VP, T-VSV, TKD-VSV, VP-VSF, VSF-VSV
MBI	167	11	<.001	0.217	A-BF, A-R, A-VSF, ATL-R, ATL-VSF, BF-BV, BF-FV, BF-R, BV-R, BV-VSF, FF-FV, FF-R, FF-VSF, FV-R, FV-TKD, FV-VP, FV-VSF, R-T, R-TKD, R-VP, R-VSF, R-VSV, T-VSF, TKD-VSF, VSF-VSV
FMI	268	11	<.001	0.349	A-ATL, A-BF, A-BV, A-FV, A-VSF, A-VSV, ATL-BF, ATL-FF, ATL-T, ATL-TKD, ATL-VSF, BF-BV, BF-FF, BF-FV, BF-R, BF-T, BF-TKD, BF-VP, BF-VSV, BV-FF, BV-R, BV-T, BV-TKD, BV-VP, BV-VSF, FF-FV, FF-R, FF-VP, FF-VSV, FV-R, FV-T, FV-TKD, FV-VSF, R-VSF, R-VSV, T-VSV, TKD-VSF, TKD-VSV, VP-VSF, VSF-VSV

df=degrees of freedom; BMI=body mass index; FM=fat mass; FM=fat mass; MBI=muscle-bone index; MM= muscle mass; ∑6SF=sum of 6 skinfolds (triceps, subscapular, suprailiac, abdominal, mid-thigh, and calf). A=cheerleading; ATL=athletics; BF=women's basketball; BV=men's basketball; FF=women's soccer; FV=men's soccer; R=rugby; T=tennis; TKD=taekwondo; VP=beach volleyball; VSF=women's indoor volleyball; VSV=men's indoor volleyball; ε^2=epsilon squared effect size.

Table IV. Injury location by sex.

Sex	Injury location	Total injuries	Percentage of total by sex	Percentage of total
Men	Upper body	99	21.1	11.3
	Lower body	173	36.8	19.8
	Both	198	42.1	22.7
Women	Upper body	100	24.8	11.5
	Lower body	170	42.2	19.5
	Both	133	33,0	15.2
Total	Upper body	199	-	22.8
	Lower body	343	-	39.3
	Both	331	-	37.9

Table V. Injury prevalence by sex and sport among university athletes.

Sex	total	% of total	Number of injured athletes	% of total	Prevalence (%)	95% IC
Both	771	100	506	65.66	65.66	62.2 – 68.9
Men	397	51.5	262	34.01	65.99	61.3 - 70.6
Women	374	48.5	244	31.66	65.24	60.4 - 70.1
Sport						
A	101	13.1	71	9.2	70.3	60.4 - 78.9
ATL	98	12.7	68	8.8	69.4	59.3 - 78.3
BF	38	4.9	27	3.5	71.1	54.1 - 84.6
BV	54	7.0	30	3.9	55.6	41.1 - 69.1
FF	83	10.8	55	7.1	66.3	55.1 - 76.3
FV	68	8.8	44	5.7	64.7	52.2 - 75.9
R	59	7.7	43	5.6	72.9	59.7 - 83.6
T	46	6.0	27	3.5	58.7	43.2 - 73.0
TKD	96	12.5	67	8.7	69.8	59.6 - 78.7
VP	24	3.1	15	1.9	62.5	40.6 - 81.2
VSF	52	6.7	30	3.9	57.7	43.2 - 71.3
VSV	52	6.7	29	3.8	55.8	41.3 - 69.5

Abbreviations: CI=confidence interval; A=cheerleading; ATL=athletics; BF=women's basketball; BV=men's basketball; FF=women's soccer; FV=men's soccer; R=rugby; T=tennis; TKD=taekwondo; VP=beach volleyball; VSF=women's indoor volleyball; VSV=men's indoor volleyball.

These findings highlight that the causes of injuries are multifactorial and dependent on the type of sport, training loads, and other factors not controlled for in this study. Therefore, it is crucial to conduct further research to analyze additional variables, such as nutritional quality, sleep patterns, complementary training, and psychological factors. Such studies would provide a more comprehensive understanding of the variables influencing injury prevalence to a greater or lesser extent.

Taekwondo is a combat sport that emphasizes direct contact between participants, particularly through kicks, creating an ambiguous relationship between health and sports due to its potential for adverse effects (Lystad *et al*., 2015). In a review, Ávila Botello (2023) highlighted that most injuries in taekwondo involve the lower limbs, with few reports of injuries to the upper limbs, head, or other body areas. However, this does not imply that injuries to other regions do not occur. Most authors agree that contusions are the most common injuries in taekwondo, attributing this to the high likelihood of impact inherent in this contact sport (Ávila Botello, 2023). In another study, Fortina *et al*. (2017) investigated injuries sustained during a university taekwondo championship in Italy. The research revealed that 18 out of 127 participants (7.1 %) reported an injury, with 15 % being men and women. Approximately 89 % of these injuries were bruises, primarily affecting the lower limbs, and occurred during elimination rounds, particularly in the second round. Key risk factors for injuries included late initiation of the sport, limited weekly training hours, male sex, lower belt rank, elimination rounds, first combat of the day, and second rounds. There is compelling evidence that excessive training and insufficient recovery may increase the risk of injuries. These findings underscore the importance of evidence-based training programs and recovery strategies to mitigate injury risks and optimize performance outcomes in this population. In contrast, reports of injuries in university athletics are limited. Silva-Sarabia *et al*. (2024), noted that injuries in athletics were reported exclusively outside the university setting, with a low prevalence among the cases studied.

Limitations

Several limitations of our study should be acknowledged. First, we included only injuries treated in the university's sports medicine department, excluding those managed externally when athletes opted for alternative care providers. This exclusion may have resulted in an underrepresentation of the total injury burden within the studied population. Furthermore, the classification of injuries into acute and overuse categories was not performed, nor was the specific tissue involved in each injury identified. These omissions limit the granularity of our findings, preventing a more detailed understanding of prevalent injury types in this population.

Additionally, the cross-sectional design of this study restricts the ability to observe trends or changes over time, as it does not allow for the longitudinal tracking of injury cases. This limitation also precludes the establishment of causal relationships between the analyzed variables and injury occurrence, further underscoring the need for more robust designs in future research.

Despite these limitations, this study provides valuable and contextualized insights into the relationship between body composition and the epidemiology of sports injuries in a specific university athlete population. These findings contribute to the foundation for developing more effective prevention and management strategies tailored to university athletes.

Future Research Directions

To build on these findings, future research should prioritize longitudinal designs to track injuries over time and analyze long-term trends in injury incidence and outcomes. This approach would also enable the identification of risk factors with greater precision and help establish causal relationships. Additionally, studies should incorporate detailed injury profiling, including acute versus overuse categorization and identification of the affected tissue, to better understand the nature and mechanisms of injuries.

Further investigations should also explore external factors influencing injury prevalence, such as nutrition, sleep quality, psychological stress, and training load management. Expanding research to include athletes from various institutions and regions would provide a broader perspective, facilitating the development of generalizable prevention strategies. Finally, intervention studies focused on evidence-based training programs and recovery protocols are essential to reduce the risk of injuries and optimize performance outcomes in university athletes.

This integrated approach will help address current knowledge gaps and support the advancement of injury prevention and management in sports medicine.

Practical Applications

The findings of this study provide valuable insights for sports medicine practitioners, coaches, and university athletic departments. By demonstrating that body composition and sex do not significantly influence injury prevalence, efforts can be redirected towards addressing other modifiable risk factors, such as training load, recovery protocols, and injury prevention strategies. The high prevalence of injuries in individual sports and lower limbs underscores the need for sport-specific preventive measures, such as tailored strength and conditioning programs and biomechanical assessments to minimize the risk of overuse injuries.

Additionally, the results highlight the importance of implementing comprehensive injury surveillance systems within university athletic programs. Such systems can improve the early detection and management of injuries, ensuring timely intervention and reducing downtime for athletes. Educational initiatives aimed at enhancing athletes' understanding of injury prevention, proper technique, and the importance of recovery are also critical to mitigating injury risks.

Finally, these findings can guide policymakers in developing evidence-based health and wellness policies within university sports settings, promoting a safer and more sustainable athletic environment for student-athletes.

CONCLUSION

In conclusion, this study found no significant differences in body composition between injured and non-injured university athletes, nor were there associations between sex and injury occurrence or injury rates across different sports. These findings suggest that factors beyond body composition and sex may play a more substantial role in the occurrence of injuries. Overuse injuries, in particular, represent a significant burden for university athletes, emphasizing the importance of proactive measures to monitor and address their health status.

To mitigate injury risks and enhance athlete well-being, it is strongly recommended that universities establish dedicated sports medicine teams. These teams should focus on implementing evidence-based injury prevention strategies, providing tailored guidance on training and recovery, and fostering a culture of health and safety within athletic programs. This approach will not only reduce the injury burden but also support the long-term performance and health of university athletes.

RANGEL-GARCÍA, I.; VILLALOBOS-CABRERA, Y.; CORTÉS-ROCO, G.; VASQUEZ-BONILLA, A.; GARCIA-CARRILLO, E.; AGUILERA-MARTÍNEZ, N.; HERRERA-AMANTE, C.; CLEMENTE-SUÁREZ, V. J.; OLIVARES-ARANCIBIA, J. y YÁÑEZ-SEPÚLVEDA, R. Composición corporal y prevalencia de lesiones en atletas universitarios mexicanos. *Int. J. Morphol., 43(3)*:766-774, 2025.

RESUMEN: La epidemiología de las lesiones y su relación con la composición corporal es un aspecto importante que los equipos de medicina deportiva deben analizar, ya que permite organizar acciones para la prevención de lesiones durante la temporada competitiva. Este estudio tuvo como objetivo comparar la composición corporal con la prevalencia de lesiones en atletas universitarios lesionados y no lesionados, clasificados por sexo y deporte. Se analizaron lesiones deportivas y características antropométricas en 771 atletas de nivel competitivo (374 mujeres y 397 hombres) de equipos universitarios en México. La composición corporal se evaluó mediante antropometría, y la clasificación y prevalencia de lesiones fueron determinadas por un equipo de medicina deportiva. La prevalencia de lesiones fue del 65,6 %, con la prevalencia más alta observada en porristas (9,2 %), atletismo (8,8 %) y taekwondo (8,7 %). No se encontraron asociaciones entre el sexo y la ocurrencia de lesiones ($\chi^2 = 0.04$, gl = 1, p = 0,825), ni hubo diferencias en las tasas de lesiones entre deportes ($\chi^2 = 11.45$, gl = 11, p = 0,406). No se identificaron relaciones entre la composición corporal y las lesiones, lo que sugiere que otros factores no medidos en este estudio pueden tener una mayor influencia en la ocurrencia de lesiones. Se concluye que la prevalencia de lesiones es alta en este grupo de atletas y que la composición corporal y el sexo no influyen en la ocurrencia de lesiones. Este estudio es importante, ya que motiva a los equipos universitarios de medicina deportiva a considerar otras variables que influyen en la incidencia de lesiones.

PALABRAS CLAVE: Atletas universitarios; Composición corporal; Prevalencia de lesiones; Lesiones deportivas: Epidemiología; Diferencias de sexo; Medicina deportiva.

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