The Journal of Foot & Ankle Surgery 58 (2019) 288–290

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Investigation of the Association Between the Acute Ankle Injury Caused by Fall From Own Height and Body Mass Index

Carlos Acosta-Olivo, MD, PhD[1], Yadira Tamez-Mata, MD[1], Jorge Elizondo-Rodriguez, MD[1], Raymundo Rodriguez-Torres, MD[2], Adrian Diaz-Valadez, MD[2], Victor Peña-Martinez, MD, PhD[1]

[1] *Professor, Universidad Autónoma de Nuevo León, Facultad de Medicina, Hospital Universitario, Departamento de Ortopedia y Traumatología, Monterrey, NL, México*
[2] *Resident 4th Year, Universidad Autuonoma de Nuevo Leon, Facultad de Medicina, Hospital Universitario, Departamento de Ortopedia y Traumatología, Monterrey, NL, Mexico*

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
ankle fracture
ankle sprain
Danis–Weber classification
fall
obesity

ABSTRACT

In the emergency settings, increased body mass index (BMI) is a risk factor for traumatic orthopedic injuries. The aim of this study was to assess the association between the acute ankle injuries (sprain or fracture) and BMI. This prospective cohort study included patients ≥18 years of age with acute traumatic ankle injuries (either sprain or fracture) caused by fall from own height when walking at ground level and who received primary treatment at the emergency room of a university hospital between May and October 2017. Of the 107 patients who met the inclusion criteria, 58 (54%) patients experienced acute ankle sprains and 49 (46%) experienced acute ankle fractures. No significant association was detected between fracture severity (as assessed by the Danis–Weber classification) and BMI ($p = .860$). The most frequent ankle injury in patients with normal BMI was ankle sprain. In our cohort, obesity was not the primary determinant of the severity of ankle injury. However, age was a key determinant of the type of injury; patients >30 years of age were 20% more likely to suffer an ankle fracture.

Obesity, a multifactorial and chronic disease, is a global health problem, with a continuously increasing prevalence (1). According to the World Health Organization, an estimated 1.9 billion adults worldwide were affected by an increased body mass index (BMI) in 2016 (2). BMI is calculated as weight in kilograms divided by the square of the height in meters. Individuals with a BMI between 25 and 29.9 are considered overweight, and those with a BMI of >30 are considered obese. A BMI of >40 indicates morbid obesity (3). According to Sabharwal et al (3), obese patients are susceptible to more severe fracture patterns. This finding is attributable to the increased amount of energy transferred to the distal parts of the body (extremities) in obese individuals. Even low-speed impact in obese individuals tends to dissipate energy and displace certain types of fractures (3).

In the emergency setting, increased BMI is a risk factor for traumatic orthopedic injuries. Previous studies have shown an association between BMI and the risk of ankle sprains or fractures (4–8).

The aim of this study was to assess the association between ankle injuries (sprain or fracture) and BMI. We hypothesized that patients with a higher BMI would tend to experience more severe ankle injuries.

Patients and Methods

This study was approved by our institutional ethics committee. All patients with traumatic ankle injuries who attended the emergency room (ER) of our university hospital between May and October 2017 were eligible for inclusion. Data pertaining to medical history, clinical evaluation of injury, radiologic investigations, and treatment details were collected. The inclusion criteria were age ≥18 years, presence of acute ankle injury (sprain or fracture), injury caused by fall from own height when walking at ground level, and completion of primary treatment. The exclusion criteria were previous ankle injury, recurrent ankle sprain, previous surgery, or the presence of neurologic disease, diabetes mellitus, or inflammatory joint disease. Data pertaining to age, sex, and BMI were collected. The patients were divided into 2 groups on the basis of diagnosis: patients with an ankle sprain (as assessed using the American College of Foot and Ankle Surgeons classification) (9) and patients with ankle fracture (as assessed using the Danis–Weber classification) (10).

Statistical Analysis

The Kolmogorov–Smirnov test was performed for independent samples to assess the distribution of variables ($p < .05$). A Student's t test was performed to assess the between-group differences (sprain vs fracture) in parametric variables, and the Mann–Whitney U test was performed to assess differences in nonparametric variables ($p < .05$). The χ^2 test was used for nominal variables. SPSS Statistics version 20 for Mac (IBM® SPSS® Inc, Armonk, NY) was used for all statistical analyses.

Financial Disclosure: None reported.
Conflict of Interest: None reported.
Address correspondence to: Carlos Acosta-Olivo, Universidad Autónoma de Nuevo León, Ortopedia y Traumatología; Ave Madero y Gonzalitos, S/N, Mitras Centro, CP64480, Monterrey, NL, México.
E-mail address: dr.carlosacosta@gmail.com (C. Acosta-Olivo).

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https://doi.org/10.1053/j.jfas.2018.08.037

Results

A total of 188 patients with acute ankle injury were treated in the ER during the study period. Of these, only 107 patients qualified the inclusion criteria, of which 58 (54%) experienced acute ankle sprain and 49 (46%) experienced acute ankle fracture. Demographic data are presented in Table 1. In total, 55 (51%) patients had a normal BMI and 32 (30%) were overweight. The median patient age was 31 (interquartile range 23 to 45) years. Patients in the ankle fracture group were significantly older compared with those in the ankle sprain group ($p \leq .005$). A relative risk analysis regarding age and ankle fracture revealed a value of 1.6 and an attributable risk of 20%.

In this analysis, patients >30 years of age were 20% more likely to suffer an ankle fracture. In the ankle fracture group, no significant association was observed between fracture severity (Danis–Weber classification) and BMI ($p = .05$; Table 2).

Discussion

Obese patients who visit the ER with an acute ankle injury are generally perceived to have a greater likelihood of having a more severe injury. The treating surgeon tends to be more apprehensive of the severity of ankle injury in obese patients regardless of the mechanism of injury. Several studies have demonstrated a direct association between BMI and the severity of ankle injury. Obese patients with ankle injury who require surgery tend to present with a higher risk of complications, longer hospital duration of stay, and generally higher medical expenses (3,11–13).

The continuously increasing global prevalence of obesity warrants greater awareness of types of injuries that obese individuals are vulnerable to even in the case of fall from own height, among adults (mean age of 52 years) ankle fractures account for 13.6% of all fractures caused by this mechanism of lesion (14).

We performed a short-term cohort study to characterize the patients who attended the ER at our university hospital because of ankle injuries caused by fall from own height. We also compared our results with those of previous studies on this subject. Some notable findings of our study are worth mentioning. Approximately one third of the patients in this study presented with some degree of obesity, which is consistent with the findings of Chaudry et al (15); however, in their study, 34% of the patients with ankle fracture were overweight or obese, whereas a majority of patients in our study experienced ankle sprains. Women accounted for the majority of patients (60%) in our study, which is similar to that reported by Court-Brown et al (14); in their study, females aged 20 to 29 years accounted for >50% of fractures caused by a fall. Although most of the patients in our study experienced ankle sprain, those who experienced fracture mainly presented with type B fractures according to the Danis–Weber classification.

Interestingly, the only significant difference between patients with sprained ankle and those with ankle fractures was with respect to age. Patients with an ankle fracture were significantly older than those with an ankle sprain, with a mean age of 27 years. The small sample size is the key limitation of our study. Like all observational investigations, we recognize several limitations that could threaten the validity of our conclusions. We realize that we did not undertake explanatory analyses that could have shed some light on the potential influence of unmeasured variables that could have influenced whether or not a patient presented with a sprain or a fracture, and we are therefore unaware of potential confounding variables (eg, activity level or comorbidity such as osteoporosis). Instead, we chose to focus solely on the straightforward association of a limited number of exposures with the ankle injury, and we were not able to confirm our hypothesis that higher BMI, in particular obesity, would be associated with sustaining a fracture rather than a sprain.

Conversely, a strength of our study is that we analyzed patients with a specific mechanism of injury (fall from own height) because our main objective was to assess the population that attends the ER with an ankle injury and not its mechanism.

In conclusion, in our cohort, ankle sprain was the most common ankle injury in patients with normal BMI. Moreover, obesity was not the main factor that influenced the severity of ankle injury. However, age was strongly associated with the type of injury since patients >30 years of age were more susceptible to ankle fracture than to ankle sprain.

Table 1
Demographic data of patients with acute ankle injury

	Ankle Sprain (n = 58)	Ankle Fracture (n = 49)	Total (n = 107)	*p* Value
Age (y)	27 (22-36)	38 (25-57)	31 (23-45)	.003*
Gender				
Male	26 (45)	18 (37)	44 (41)	.435†
Female	32 (55)	31 (63)	63 (59)	
BMI	24 (21-27)	25 (23-27)	24 (21-27)	.190*
Underweight	5 (9%)	3 (6)	8 (7)	.388‡
Normal	30 (52)	25 (51)	55 (52)	
Overweight	18 (30)	14 (29)	32 (30)	
Obese				
I	5 (9)	3 (6)	8 (7)	
II	0 (0)	1 (2)	1 (1)	
III	0 (0)	3 (6)	3 (3)	

Data are presented as median (interquartile range) and frequency (%).
Abbreviation: BMI, body mass index.
* Mann-Whitney U test.
† Fisher exact test.
‡ Pearson χ^2 test.

Table 2
Acute ankle fractures according Weber Classification (A, B, or C)

	Ankle Fracture Type				
BMI	Weber A (n = 5)	Weber B (n = 31)	Weber C (n = 13)	Total (n = 49)	*p* Value
Underweight	0 (0)	2 (7)	1 (8)	3 (6)	.860*
Normal	2 (40)	15 (48)	8 (62)	25 (51)	
Overweight	3 (60)	8 (29)	3 (23)	14 (29)	
Obese					
I	0 (0)	2 (7)	1 (8)	3 (6)	
II	0 (0)	1 (3)	0 (0)	1 (2)	
III	0 (0)	3 (10)	0 (0)	3 (6)	

Data are presented as n (%).
Abbreviation: BMI, body mass index.
* Pearson $\chi 2$ test.

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