RESEARCH

Relationship Between Low-Energy and High-Energy Wrist Fracturesand BMI in Postmenopausal Women

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Abstract: Although several studies have showed that a high body mass index (BMI) provides protection against wrist fracture, contrasting studies have argued that BMI does not affect the risk of wrist fracture. This study aims to evaluate the relationship between BMI and wrist fracture. In the present study, results of a total of 121 postmenopausal women who had been diagnosed with wrist fracture in our clinic from 2015 to 2020 were analysed retrospectively. Patients were divided into two groups, low-energy and high-energy wrist fractures, by a single orthopaedist. Age, BMI, bone mineral density (BMD), trauma types and fracture types of the patients were evaluated. A total of 121 patients were included in the study. Mean age of the patients was 72.0±8.6 and mean BMIwas 25.9±7.7. Of all the patients 52.1% had high-energy fractures while %62.0 had fragmented fractures. In the low-energy fracture group, BMI values were statistically significantly lower(24.5±7.9 vs 28.0±6.0). Osteoporosis was statistically significantly higher in the low-energy fracture group (53.4%) compared with the high-energy group (15.9%). It was also revealed that as BMI increased, the risk of fragmented fracture statistically significantly decreased. The results of the present study showed that BMI was lower in low-energy wrist fractures. In addition, the risk of fragmented fracture increased in the group with lower BMI.

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INTRODUCTION

Wrist fracture is the most common upper extremity fracture in women aged 50 or over and constitutes 22% of all fractures[1]. Its annual incidence is approximately 8-10%[2]. Wrist fracture reduces vital functions in postmenopausal women by more than 50% and its mortality is higher when compared with controls who do not have fractures[3]. Studies on wrist fractures have showedthat the pharmacological treatment for osteoporosis reduces the risk of future “fragility fracture” [4]. Bone mineral density (BMD) is the main measurable risk factor for “fragility fracture” in postmenopausal women[5]. Althoughcertain features which affect BMD such as genetic, advanced age, white race, chronic oestrogen deficiency can not be changed,features such as eating habits, sedentary life style, body composition, cigarette consumption, inadequate exposure tosunlight, long term corticosteroid use and, excessive alcohol and coffee consumption can be changed[6].

Wrist fractures are typically grouped into two as low-energy fractures and high-energy fractures, known as “osteoporotic fractures” or “fragility fractures”. While high-energy fractures are associated with fall from high, traffic accidents or industrial accidents, low-energy fractures result from structural changes which weaken the bone and predispose the patient to fractures[7]. It is known that low-energy fractures cause significant morbidity and mortality in postmenopausal women. Studies onthe differences between the two groups are still in progress. However, the relationship between risk factors and body mass index (BMI) has not fully been explained yet. A review of literature reveals that the effects of BMI on fractures is a disputable subject. It is argued that low BMI increases the risk of hip fracture in particular. In addition, objections to the view that high BMI decreases the risk of fracture have increased recently.In a study conducted on postmenopausal women with low trauma fracture, the frequency of obesity was found as 28%[8]. Studies have reported a specific relationship between obesity and ankle fracture, upper and lower leg fractures[9], humerus fracture[10] and spine fractures[11] in postmenopausal women. Although several studies have showed that wrist fractures are less commonly observed in obese individuals with high BMI is[12], contrasting studies on the subject have showed that BMI does not affect the risk of wrist fractures[10].

The present study aims to compare the BMI in postmenopausal women with low-energy and high-energy fractures, which is a disputable subject.

MATERIALS and METHODS

In the present study, the records of 150 postmenopausal female patients treated with the diagnosis of wrist fracture inour orthopaedic clinic from 2015 to 2020 were analysed retrospectively. Inclusion criteria were a documented history of falling from at least a distance of standing height, an interval of less than oneweekbetween the date of trauma and diagnosisand a recorded BMI measure within one year before or after the diagnosis. The patients were then grouped into two by a single orthopaedist as low-energy Group 1 and high-energy Group 2 wrist fracture. Low-energy fracture was defined to result of falling from standing height or less, while high-energy fracture was defined as any other type of trauma (e.g. falling from height higher than standing height or motor vehicle accident) and BMD of the patients were reviewed from their file records. The patients whose records did not provide any information about the risk factors were contacted by telephone and were delivered with the survey questions. Accordingly, the data of these patients were obtained. The patients who failed to provide adequate date from the records and surveys were excluded from the study. Of the 150 patients initially included in the study, 29 were excluded due to inadequate data, which ultimately left 121 patients for the study.

SPSS/PC version 18 was used forthe analysis of data. According to the characteristics of the data, correlation analysis, one way analysis of variance- One Way Anova (F Test), Significance test of the difference between two means, and SPSS/PC version 11,5 in independent analysis were used in evaluation. According to the characteristics of the data, correlation analysis, one way analysis of variance- One Way Anova (F Test), Sample t test and Mann Whitney U Test were used in evaluation.

RESULTS

A total of121 patients were included in the study. Mean age of the patients was 72.0±8.6 while their mean BMI was 25.9±7.7. Of all the patients, 52.1% had high-energy fracture while 62.0% had fragmented fracture. The BMD results of the patients revealed that osteoporosis was 33.9%. Sociodemographic information of the patients is summarized in Table 1.

Table 1. Sociodemographic data

Study Parameters		Mean.±SD (min-max)	N
Age		72.0±8.6 (54-92)	121
Body Mass Index		25.9±7.7 (17-41)	121
Type of trauma	Low energy	47.9%	58
	High energy	52.1%	63
Cigarette use		62.8%	76
Bone mineral density	Normal	42.1%	51
	Osteopenia	24.0%	29
	Osteoporosis	33.9%	41
Type of fracture	Simple	38.0%	46
	Fragmented	62.0%	75

When ankle fractures were grouped according to the way they occurred, it was found that low-energy fractures occurred in patients who wereofsignificantly higher age and lower BMI. In the low-energy fracture group, BMI values were statistically significantly lower (24.5±7.9 vs 28.0±6.0). In addition, patients with low-energy fractures were found to have significantly higher osteoporosis. Osteoporosis was statistically significantly higher in the low-energy fracture group (53.4%) compared with the high-energy group (15.9%). Table 2 shows the comparison of both groups.

Table 2. Comparison of low and high-energy traumas

Study Parameters		Low energy (n:58)	High energy (n:63)	Statistic	p
Age		76.6±8.4	68.7±7.4	T:4.790	0.001*
Body Mass Index		24.5±7.9	28.0±6.0	T:4.860	0.001*
Cigarette use		58.6%	66.7%	χ^2:0.834	0.234
Bone mineral density	Normal	27.6%	55.6%	χ^2:19.352	0.001*
	Osteopenia	19.0%	28.6%		
	Osteoporosis	53.4%	15.9%		
Type of fracture	Simple	44.8%	31.7%	χ^2:2.193	0.098
	Fragmented	55.2%	68.3%		

Variables were analyzed with T-test and Chi-Square Test.*p<0.05

Logistic regression model was used to calculate the risk factors predicting fragmented bone formation and groups were form edaccording to the type of fracture. Sociodemographic (age, gender, BMI, cigarette use) and clinic variables (bone mineral density, type of trauma) added model with stepwise method. The model was found to be statistically significant (χ^2: 56.868, p: 0.014). According to this model, it was found that high-energy trauma increased fragmented bone formation 5.7 times while presence of osteoporosis increased 23.5 times. Similarly, presence of osteopenia increased 11.3 times. It was found that there was 0.9 times increase with each unit increase in BMI and thatincrease in BMI had a decreasing effect on fragmented fracture occurrence. The results are summarized in Table 3.

Table 3. Determination of risk factors for fragmented fracture occurrence with logistic regression

	χ^2	R^2	B	OR	CI (95%)	p
Model	56.868	0.510				0.014*
High energy trauma			1.757	5.792	1.866-17.982	0.020*
Osteoporosis			3.159	23.535	80.775-5.553	0.001*
Osteopenia			2.425	11.308	50.914-24.12	0.001*
Body Mass Index(each unit increase)			-0.059	0.942	0.621-.0.990	0.040*
Constant			4.440	0.012		0.012*

Variables remaining in model are showed.OR: Odds Ratio, CI: Confidence Interval. *p<0.05

DISCUSSION

A total of 121 postmenopausal women who received treatment with the diagnosis of wrist fracture were included in the present study. Mean age was 72.2 years and mean BMI was 25.9 In the present study, mean age and osteoporosis rate were statistically significantly higher in the low-energy fracture group compared with the high-energy fracture group. Osteoporosis is a metabolic bone disease which causes deterioration in bone microarchitecture as a result of decreases in BMD. Therefore, it has a high fracture risk; with the increase in bone cycle in postmenopausal period, BMD decreases and the frequency of osteoporotic fracture increases[13].

In the present study, BMIs of the patients in the low-energy fracture group were statistically significantly lower compared with those of the patients in the high-energy fracture group. In a study conducted on fragility, obesity was significantly associated with reduced major osteoporotic fracture risk in non-fragile postmenopausal women[14]. Similarly, a review of studies on the effect of BMI on bone formation in other parts of the body reveals that although the risk of ankle and upper leg fracture risk is higher in obese individuals, the risk of wrist fracture is lower[15]. The cause of differences in fracture risk by body regions in obese patients has not been clearlyexplained yet. One effective factor may be the increase in soft tissue amount in obese individuals, which may provide mechanical protection in areas such as the pelvis and the hip[16]. The same factor may applyfor the wrist. In addition, obese patients often tend to fall backwards or sideways. It is assumed that this difference in direction can protect the wrist against impacts despite a weakening in protective reactions against falling[17].

The most important purpose in determining the risks for fracture formation is to find out the patients with high risk of fracture and to determine the ways preventing fractures before they occur. When the results of thepresent study were examined, in terms of the risk factors predicting fragmented fracture occurrence, it was found that high-energy fracture increased fragmented fracture occurrence 5.7 times while the presence of osteoporosis increased the risk 23.5 times. Similarly, the presence of osteopenia increased the risk 11.3 times. Although some studies argued that there was an inverse relationship between visceral fat tissue and BMD, the effect of regional fat distribution on BMD is still controversial. In fact, it is believed that the available methods for predicting the risk of fracture in obese patients, who make up an important part of the elderly population, are uncertain. The uncertainty in literaturemay result from the fact that most of the studies are conducted by using dual-energy X-ray absorptiometry technique which cannot fully distinguish between subcutaneous and visceral fat[18]. Another factor may be the fact that studies are conducted on different races and ethnic groups. This is because some studies comparing different races show that there may be significant differences in the relationship between groups in terms of body fat percentage and BMI[19, 20]. In the present study, the increase in BMI statistically significantly reduced the risk of fragmented fracture. This result is in compliance withthose of other studies[17, 21].

In literature, studies show that there is an increased risk of ankle, other extremity and humerus fractures and a decreased risk of hip, pelvis and wrist fractures with obesity in postmenopausal women[8]. In a study conducted on postmenopausal women in Italy, it was reported that increased BMI was associated with higher risk of humerus fracture and lower risk of hip fracture while there was no association between BMI and wrist and ankle fractures[10]. In the present study, groups with first time low-energy and high-energy fractures were compared with respect to BMI values and it was found that BMI values of the low-energy fracture group were statistically significantly lower compared with those of the high-energy fracture group. The protective effect of increased BMI on low-energy wrist fracture should be noted. In contrast, increased BMI results in an increase in risk of high-energy wrist fracture. Despite the protective effect of BMI on wrist, adverse factors increasing osteonecrosis in obesity such as increase in cytokine and upregulation of nuclear factor kappa B ligand receptor activator dependent on it, decrease in adiponectin and decrease in serum 25-hydroxy vitamin level should not be ignored[17].

Conclusion

The primary measure which can be taken against the increased risk of fractures in postmenopausal period is the determination of risk factors. The risk of low-energy wrist fracture in postmenopausal women with low BMI and the risk of high-energy wrist fracture in postmenopausal women with high BMI are higher. Therefore, postmenopausal women with low BMI should be closely followedwith BMD measurements.

Statement of Ethics

This study was approved by the local Ethic Committee (OMU/ KAEK no:2020/526), and signed informed consent was obtained from the participants. The study was conducted ethically in accordance with the Declaration of Helsinki.

Conflict of interest

Authors declare that they have no financial interests or personal conflicts that may affect the study in this article.

Authors' contributions

Conceptualization: L.K, A.D Data curation: L.K Formal analysis: L.K, A.D Investigation: L.K Methodology: L.K, A.D Validation: L.K, A.D Visualization: L.K Roles/Writing - original draft: L.K, A.D Writing - review & editing: L.K, A.D

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