

Study epidemiology of risk fracture in osteoporosis based on frax score, and osta score, with risk of fall using Ontario score in elderly Indonesia

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Abstract

Background: Osteoporosis is characterized by a low bone mass of bone tissue. If osteoporosis is not treated properly, it will increase the high risk of fracture. The common causes of fracture on osteoporosis condition due to falls. This study aims to find the correlation between the risk of osteoporosis with fall risk (ONTARIO) based on osteoporosis fracture risk (FRAX)

Methods: This study is an analytic study with a cross-sectional method. We collected the sample using random cluster sampling in the six primary health care in Malang on different times service since August–September 2021. Total patient 139, however only 132 patients were included in this study. After collecting data is complete, we analyze using Chi-square tests.

Results: The mean age of participants was 63.9 ± 7.14 . with the age group was dominated by the range of 60–64. It was found that the result of the FRAX SCORE had a low-risk category for major fracture osteoporosis and risk hip fracture. In contrast, from the OSTA score in this study, more than 68 participants (50.8%) were found medium and high-risk scores. Then, in ONTARIO score of the risk fall assessment, and high score in 57 participants (43.2%). If compared between OSTA and ONTARIO, there was a significant relationship between OSTA score and ONTARIO score ($p < 0.000$) with high-risk OSTA have a significant relationship with a high risk of falling and vice versa.

Conclusion: In this study, there was a relationship between the risk of high osteoporosis and the risk of falling.

Keywords

Osteoporosis, OSTA score, FRAX score, ONTARIO score, elderly, fall risk assessment

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Introduction

Osteoporosis is a systemic skeletal disease that is characterized by low bone mass and microarchitecture degeneration of bone tissue, leading to an increase in bone fragility and fracture risk.¹ When osteoporosis is not treated properly, it will increase the high risk of fracture.² Many causes of fractures in osteoporosis occur among the elderly, one of which is fall.³ It was contributed to serious problems in nearly 90% of hip fractures.⁴ A study was reported by US General Surgeon that an estimated 10 million people over 50 years old have osteoporosis, subsequently 1.5 million people leading to fracture each year.⁵ Therefore, osteoporosis will become a serious socio-economic problem in the future.⁶

The World Health Organization (WHO) definition osteoporosis by Bone Mineral Density(BMD)⁷ that is the gold

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standard predictor for risk of fracture osteoporosis and also to determine the initiate ideally for treatment.^{8,9} Therefore, BMD measurements are not widely available in some primary health care, and also the high cost of BMD may limit its broad adoption in some of the populations.¹⁰ More recently, system scoring was recommended for detecting clinical risk factors of fracture osteoporotic such as FRAX SCORE (FS) without BMD^{2,11} FS without BMD not only good predicted for evaluating risk of osteoporotic fracture, but also for identifying post menopause fracture.¹² On the other hand, there was OSTA SCORE (OS) system, that more simple and inexpensive screening tools for elderly needs to find risk of osteoporosis that cause majority fracture in elderly Asia.^{9,11}

Previous studies mention that common causes of fracture on osteoporosis condition due to falls.^{4,13} Past fall or risk of falling is important to notice, in the FS is neither included as an input variable in the FRAX formula¹⁴ Nor OSTA Formula. In addition, Limited studies that elaborate the epidemiological description between the risk of falling on elderly based on the scoring system risk of osteoporotic fractures such as FRAX and OSTA scores. Therefore, this study aims to find the correlation between osteoporosis risk (with OSTA score) with fall risk (using Ontario score) based on osteoporosis fracture risk (using FRAX score without BMD). The authors hope that this research could determine recommendations on policies and standards for primary health care facilities.

Materials and methods

Participants

This study was approved by ethical committee of medical research RSUD Dr. Saiful Anwar with number 400/214/K.3/302/2021 and all of this study were carried out according to the relevant guidelines and regulations. This study is an analytic study with a cross-sectional method. Research variables were observed without any intervention. The subject of this study was all elderly who visited the primary health care when the annual community service is held in August–September 2021. Male and female who came to primary health care, following informed consent, completed a short self-reported questionnaire. The sample was collected by random cluster sampling. We collected sample by using randomly selecting random cluster sampling in the six primary health care in Malang on different times. This method intends to minimize bias and secure samples that can implement the subject of study. We use the *Lemeshow* formula to get the minimum sampling, and we are obtained for a minimum sample of 96 participants.

Criteria inclusion

The main inclusion criteria in this study included patients over 50 years old, both male or female, with no history of malignancy, or who routinely consume steroid drugs. However, the exclusion criteria were patients with a

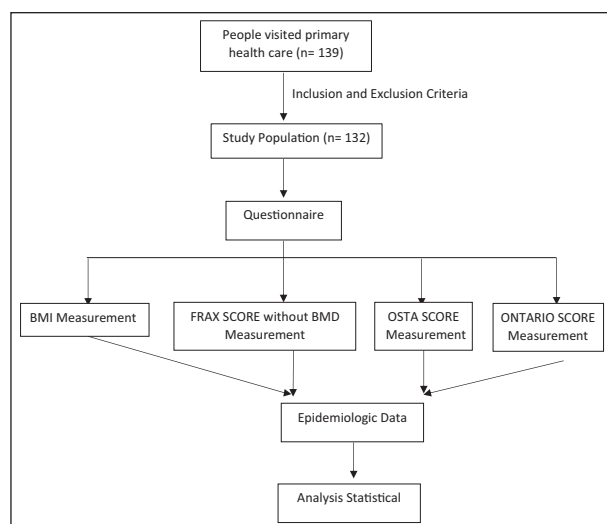


Figure 1. Flowchart of methodological study.

history of fracture 6 months prior study and refuse to give consent for this study. Total patient 139, however only 132 patients were included in this study (Figure 1).

Outcome

All participants who came to primary health care when the annual community service is held on August–September, 2021 were invited, fill in informed consent and complete a self-questionnaire. To identify the risk of fall we use ONTARIO score which are commonly used to asses fall risk on elderly.¹⁵ Demographic data were collected age and sex, weight, and height. BMI measurement was performed immediately when the participant arrived in primary health care. The weight and height measurement were assessed by a medical doctor. However, FRAX, OSTA, and ONTARIO score were filled by participants. Low and high risk of FRAX scores were determined by the recommendation for initiation of treatment at a FRAX score of more than 3% for hip fractures and 20% for major osteoporotic fractures. If below 3% in hip fractures is defined as low risk, and below 20% in major osteoporotic fractures is interpreted as low. However, the OSTA score was stratified into low risk ($OSTA > -1$), medium ($-1 \geq OSTA \geq -4$), and High risk ($OSTA < -4$). Lastly, ONTARIO score indicated patients at a high risk of falling have score of nine or more.

Analysis

After the primary data collection is complete, we analyze the result of the FRAX and OSTA score by two independent assessors who were not involved at the time collecting data. In the end, the data was compiled and analyzed using SPSS version 25.0 with used Chi-square tests to assess the frequency differences. The result of the analysis is shown descriptively using tables.

Table 1. Distribution of variable.

Variable	Category	Sex		Frequency	
		Male	Female		
Gender		54 (40.9)	78 (59.1)	132 (100)	
BMI	Underweight	1 (20.0)	4 (80.0)	5 (100)	
	Normal	33 (45.2)	40 (54.8)	73 (100)	
	Overweight	18 (40.9)	26 (59.1)	44 (100)	
	Obese	2 (20.0)	8 (80.0)	10 (100)	
OSTA SCORE	Low	27 (40.9)	39 (59.1)	66 (100)	
	Medium	7 (53.8)	6 (46.2)	13 (100)	
	High	20 (37.7)	33 (62.3)	53 (100)	
ONTARIO SCORE	Low	34 (45.3)	41 (54.7)	75 (100)	
	High	20 (35.1)	37 (64.9)	57 (100)	
FRAX SCORE WITHOUT BMD	Risk of Major Osteoporotic	Low	54 (40.9)	78 (59.1)	132 (100)
		High	0 (0.0)	0 (0.0)	0 (0.0)
	Risk of Hip Fracture	Low	53 (44.9)	65 (55.1)	118 (100)
		High	1 (0.8)	13 (92.9)	14 (100)

Table 2. Characteristic between Age and FRAX, OSTA, and ONTARIO.

Age range		50–54	55–59	60–64	65–69	70–74	75–79	80–84	Sig
Total		13 (9.8)	26 (19.7)	42 (31.8)	22 (16.7)	13 (9.8)	12 (9.1)	4 (3.0)	0.468
Male/Female		2/11	12/14	19/23	11/11	5/8	4/8	1/3	
Scoring System	Category	50–54	50–59	60–64	65–69	70–74	75–79	80–84	Sig
OSTA SCORE	Low	10 (15.2)	17 (25.8)	24 (36.4)	10 (15.2)	3 (4.5)	1 (1.5)	1 (10.5)	0.003
	Medium	0 (0)	1 (7.7)	7 (53.8)	3 (23.1)	0 (0)	2 (15.4)	0 (0)	
	High	3 (5.7)	8 (15.1)	11 (20.8)	9 (17.0)	10 (18.9)	9 (17.0)	3 (5.7)	
ONTARIO SCORE	Low	8 (10.7)	19 (25.3)	28 (37.3)	12 (16.0)	6 (8.0)	2 (2.7)	0 (0)	0.005
	High	5 (8.8)	7 (12.3)	14 (24.6)	10 (17.5)	7 (12.3)	10 (17.5)	4 (3.0)	
FRAX SCORE	Category								
Risk of Major Osteoporotic	Low	13 (9.8)	26 (19.7)	42 (31.8)	22 (16.7)	13 (9.8)	12 (9.1)	4 (3.0)	-
	High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Risk of Hip Fracture	Low	13 (11)	25 (21.2)	42 (35.6)	21 (17.8)	11 (9.3)	5 (4.2)	1 (0.8)	0.000
	High	0 (0)	1 (7.1)	0 (0)	1 (7.1)	2 (14.3)	7 (50)	3 (21.4)	

Result

In September, 2021 Total participants was 132 participants, there were 54 (40.9%) male and 23 (59.1%) female enrolled in this study. Subject age groups were according to WHO categorization system.¹⁶ The mean age of participants was 63.9 ± 7.14 . with the age group was dominated by the range of 60–64 that are 42 participants (31.8%), Then the lowest age is 50 years old with two participants (1.5%), and highest age was 84 years old with one participant (0.8%) (Table 1).

Furthermore, BMI in this study was dominated by a normal range of more than 50% ($n=73$ participants), and then overweight with 44 (33.3%) participants, obese 10 participants (7.6%), and the rest were underweighted five (3.8%) participants.

In this study, it was found that the result of the FRAX SCORE, majority of 132 participants (100%) had a low-risk category for major fracture osteoporosis. While for the risk of hip fracture, 118 (89.4%) participants were grouped into the low group, and the remaining 14 were in the high group. Hereafter, in this study more than 68 participant (50.8%) were found medium and high-risk score. Lastly, ONTARIO Score in this study majority low Score with 75 participants (56.8%), and high score in 57 participants (43.2%) (Table 2).

Our study compared between range age with variable of research, we found that FRAX Score for major osteoporotic was dominated by age range group 60–64 with 42 participants (31.8%) with low risk of fracture major osteoporotic. Then, the same output is also obtained for risk of hip fracture, mostly participants have low category of hip fracture with dominated with age range group 60–64 with

Table 3. Ontario scores descriptive.

		ONTARIO		Total	Sig
		Low	High		
OSTA	Low	50 (75.8)	16 (24.2)	66 (100)	0.000
	Medium	10 (76.9)	3 (23.1)	13 (100)	
	High	15 (28.3)	38 (71.7)	53 (100)	
FRAX					
Risk of Major Osteoporotic	Low	75 (56.8)	57 (43.2)	132 (100)	-
	High	0 (0.0)	0 (0.0)	0 (0.0)	
Risk of Hip Fracture	Low	72 (61.0)	46 (39.0)	118 (100)	0.005
	High	3 (21.4)	11 (78.6)	14 (100)	

42 participants (36.4%). (Table 3) In the other hand of this condition, this study compared this result with OSTA score to ensure that the result of this study to achieve proper outcome. From OSTA score, we found that the low-risk OSTA score was mostly in the age range of 60–64 years with 24 participants (36.4%) while the high risk trended to be equally distributed on aged over 54 years old with eight participants (15.1%) in the age range 55–59, 11 participants (20.8%) in the age range 60–64 years, and so on. This result is significant at the $p=0.05$ level. Hereafter, in ONTARIO score of the risk fall assessment, the low-risk ONTARIO score was mostly dominated by the age range of 60–64 years with 28 participants (37.3%), while the high-risk ONTARIO score was also found to be at most 60–64 years old with 14 participants (24.6%).

In our study, there is significant correlation between OSTA score and ONTARIO score ($p: 0.000$). Sample participants that include study who have high OSTA score in 38 participant (71.7%) also have high fall risk based on ONTARIO Score and Vice versa.

Discussion

This study aims to determine the relationship between the risk of osteoporosis and the risk of falling in elderly age which will lead to an increase in the risk of osteoporotic fractures and also to describe epidemiology to provide an epidemiological description of the risk of osteoporosis in Malang.

Osteoporotic fractures are the primary and most significant consequence of osteoporosis, and the increasing morbidity and death have imposed a huge healthcare burden on people. By the year 2050, it is predicted that fractures caused by osteoporosis would treble and medical costs will spike, while the frequency of osteoporosis in men will also rise.¹⁷ Fracture because of osteoporosis made a great impact, not only for medical field, but also in socioeconomic area.¹³ For this reason, early detection of osteoporosis and risk factors for falls is needed to minimize fractures in elderly patients who are at high risk of causing osteoporotic fractures. For long term novel it can reduce fracture rates in Indonesia and also reduce cost cause osteoporotic fracture.

From our study, 132 participants (100%) which dominated in range age 60–64 years old (42 participants or 31.8%) reported have low risk of Major Osteoporotic using FRAX Score, however, 72 participants (61%) reported have low risk of Hip Fracture and 3 participants (21.4%). This finding probably because of the threshold of FRAX Score was set too high in relation to the FRAX score recommendations. Study by Chandran et al., 2020 he said when threshold set up to $>15\%$ for asses major osteoporotic fracture probability (MOFP) has sensitivity score 30%, and also when threshold set up $>3\%$ for asses hip fracture probability (HFP) have sensitivity score 45% especially in woman of 65 years old. In addition, he also states that in 50–64-year-old Singapore women, the cut-off level (MOFP > 3.7 and HFP $> 0.6\%$) cannot be utilized as a screening threshold, as it would miss a high proportion of women with BMD in the osteoporosis range. Therefore this cut off cannot be used as a screening methods.¹⁸

In contrast, from OSTA score in this study more than 68 participant (50.8%) were found medium and high-risk score. This result probably because of character of OSTA Score that have high sensitivity for finding risk of osteoporosis. Study by Koh et al.¹⁰ that using cutoff -1 yielded specificity 45% and sensitivity 91%, In line with research by Koh et al., study by Muslim et al. 2012 mentioned that sensitivity and specificity of OSTA score was 87.5% and 95.8%, respectively, especially in post menopause woman.¹⁹ This result might be consideration for population with high osteoporosis risk often have sign and symptom that make them difficult to walk which makes them prone to fall. Based on this result and due to the morbid effects of this risk of osteoporosis, it is important to provide prevention of fall in older adults.

In our study, it was found that there was a significant relationship between OSTA score ($p < 0.000$) and FRAX score ($p < 0.005$) with a high risk of falling, so it can be concluded that, patients with high OSTA will experience a high risk of falling, and vice versa. For this reason, intervention is needed so that patients with a high risk of falling and having a high risk of osteoporosis do not sustain fractures cause osteoporosis.

The prevention of the disease and related fractures is considered crucial for the elderly population's health and his quality of life,⁷ Therefore, risk fall assessment noteworthy to notice. In this study, there are 53 participants have high risk OSTA score then, 38 participant (71.7%). shows high risk of osteoporosis and also have high fall risk based on ONTARIO Score. This condition should be a concern for health care providers. Because, if this condition is ignored, then when this patient low-impact falls, the possibility of sustain a fracture will be even greater. A systematic review was conducted by Morrison et al., 2013 that reporting epidemiology of low impact fall which resulting fracture osteoporosis concluded that there are two major factors result an osteoporotic fracture, low bone mass and a fall. His study also found if rate fall higher in women than man in East Asian Population.¹³ Therefore, All older person, especially women with osteoporosis should receive fall prevention advice, which should include exercise, particularly strength and balance training, medication reduction or elimination, and environmental adjustments.²⁰ In this case, we choose ONTARIO scoring system for asses risk of fall in elderly population.

A few studies were found in the literature on the question of correlation between risk fall with scoring system (ONTARIO Score) and risk of fracture system such as FRAX and ONTARIO score. The ONTARIO score osteoporosis strategy is composed of five primary components: health promotion; bone mineral density testing, accessibility, and quality; post fracture care; professional education; and research and evaluation.²¹ In ONTARIO osteoporosis strategy, there is relationship between the incidence of hip and wrist fractures has decreased in recent years as a result of increased bone density testing and antiresorptive medication treatment.²¹

There are several interactions causes of fracture according to the Ontario Health Technology Assessment Series. However, in this study, the authors wanted to link the correlation of OSTA scores with osteoporosis. There are intrinsic and extrinsic factors. The intrinsic factor consisted of psychosocial and demographic risks, medical risk factors, activity and dependence medications. Then, for extrinsic factor consist of tripping hazards, balance and slipping hazards, and vision hazards²² There are several points that we can apply by himself on a daily activity, but there are also that can be used as input for policies in primary health facilities.

There are methods that can prevent using intervention risk of fall in elderly age also. For intrinsic control, there are exercise treatments, vision assessment, vitamin D and calcium supplements, gait-stabilizing devices, hip protectors, From study meta-analysis by Emery et.al, he state that exercise a statistically significant beneficial effect on the risk of falls.²³ In line with study before, ONTARIO recommendations stated the effects of long-term exercise treatments on risk of fall-related injury found that focused exercise programs moderately reduce the incidence of fall-related accidents.²²

In the other hand, extrinsic factor also can to take control using to prevent of fall using control Outdoor gait-stabilizing devices for mobile elderly may help prevent falls and fall-related injuries during the winter. Then, psychotropic education withdrawal under medication also may be an effective method of preventing falls.²² In addition, in elderly women, a combination of vitamin D and calcium supplements can help lower the risk of falling by more than 40%.

There are a lot of limitations to be considered. In this study, we obtain small participants and the short period of study. Hence, it is difficult to make any precise suggestions, and also, we did not perform DXA bone densitometer for confirmation risk of osteoporosis condition. Therefore, a further study with more focus on comparing the sensitivity and specificity of OSTA confirmed by FRAX using DXA bone densitometer (BMD), after that the future study can continue to find the relationship more clearly between risk fall and risk osteoporotic fracture.

Conclusion

Early detection of osteoporosis is very important to reduce the number of osteoporotic fractures due to falls. In this study, there was a relationship between the risk of high osteoporosis and the risk of falling. Thus, it is necessary to be noted especially for the elderly with a high risk of osteoporosis which will cause fractures if they fall.

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Contribution

Edi Mustamsir: Conception and design, or analysis and interpretation of data

Istan Irmansyah Irsan: Conception and design, or analysis and interpretation of data

Thomas E.J.C. Huwae: Drafting the article and revising it critically for important intellectual content

Anhika Yudistira: Agreement to be accountable for all aspects of the work

Ananto Satya Pradana: Final approval of the version to be published

Muhammad Alwy Sugiarto: Drafting the article

Rahmad: Conception and design

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics approval

This study was approved by ethical committee of medical research RSUD dr. Saiful Anwar with number 400/214/K.3/302/2021

Patient consent for publication

Informed consent was obtained from all participants for publication of their data.

Informed consent

This study was approved by ethical committee of medical research and all participant consent was obtained for publication.

Significance for public health

Osteoporosis is a systemic skeletal disease that is characterized by low bone mass and microarchitecture degeneration of bone tissue, leading to an increase in bone fragility and fracture risk. When osteoporosis is not treated properly, it will increase the high risk of fracture. US General Surgeon that an estimated 10 million people over 50 years old have osteoporosis, subsequently 1.5 million people leading to fracture each year and will become a serious socio-economic problem in the future. Therefore, this study is important to implemented for reduce the incidence of osteoporotic fractures by preventing falls. In this study, the importance of education regarding the early detection of osteoporosis and also the risk of falling is very important to note.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article

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