



## Osteoporosis and Risk Factors among Postmenopausal Women in Integrated Health Post for Elderly

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### Abstract

**Objectives:** The availability of prevalence data for osteoporosis in Indonesia is limited due to the constrained access to BMD measurements, especially in rural areas. Integrated Health Post for the Elderly (Posyandu Lansia) is one of the Indonesian government's programs to monitor and provide health care for the elderly, including postmenopausal women. This study aimed to determine the prevalence of osteoporosis and related risk factors in postmenopausal women. **Methods:** Respondents were 249 postmenopausal women from 440 people who attended the Posyandu Lansia from 9 villages in Sidoarjo. Quantitative ultrasound was used for calcaneal BMD measurement; other data were collected via questionnaires and enumerated by trained villagers. **Results:** Our study revealed that the prevalence of osteoporosis postmenopausal women was 73.5%. The osteoporosis risk factors of age, BMI, weight, and menopause duration were associated with T-scores both individually ( $p < 0.05$ ) or simultaneously ( $p < 0.001$ ), while menopause age and exercise did not. **Conclusions:** Groups possessing high-risk factors associated with a high prevalence of osteoporosis are postmenopausal women age  $\geq 65$  years, BMI  $< 20$  kg/m<sup>2</sup>, weight  $< 58$  kg and duration of menopause  $> 6$  years. Regardless of the groupings, the prevalence of osteoporosis was very high in postmenopausal women. Dietary and exercise adjustments as well as pharmacotherapy may be required to improve their bone health.

**Keywords:** Osteoporosis; Postmenopause; QUS; Risk factors.

### Introduction

Osteoporosis increases bone fragility and the risk of fractures due to decreased bone mass and microarchitectural abnormalities [1, 2]. Low bone mineral density (BMD) and fracture are clinical features and complications in osteoporosis. The low BMD can be used to determine postmenopausal osteoporosis. Postmenopausal status in women is one of the risk factors other than advanced age and low body weight or body mass index (BMI). The risk factors for osteoporosis or fractures in postmenopausal

women are age  $\geq 65$  yo, bodyweight  $< 57.6$  kg, BMI  $< 20$  kg/m<sup>2</sup> and early menopause  $< 40$  yo [1, 3, 5]. The lifelong regular exercise is a lifestyle modification to prevent bone loss and fracture [3, 5]. Recommended exercise to maintain bone health is regular weight-bearing (e.g., walking 3-4 days per week for 30-40 minutes plus back and posture exercises for several minutes) [3, 6]. Along with the increasing aging population and longer life span, osteoporosis is becoming a global epidemic, including in Indonesia [7].

In Indonesia osteoporosis is prevalent for the elderly, especially women whose risk is four times greater than men. The incidence of osteoporosis (T score  $\leq -2.5$ ) in Indonesian in 2006 was 22.5%, 32% and 53% for women with age ranged 50-80, 60-80, and 70-80 yo, respectively [8,9]. T-score, measured quantitatively by using ultrasound, declined slowly until approximately 45 years of age, then declined rapidly to reach a mean T-score of  $< -2.5$  at about 71–75 years of age [10]. Indonesia women at the age of 46-85 years have the lowest T-score among seven Asian countries. The study, however, used participants primarily from urban areas and inferred that more than half of these women could be at risk of having osteoporosis and fractures after the age of 70.

In contrast with the study, the prevalence and incidence of hip and vertebral fractures reported was the lowest (9%) in women in Indonesia and the highest (24%) in Japan [10,11]. The incidence was 119 per 100,000 per year, hip fractures in 2010 were 38,618, of which 75% were women and from hospital registry data at aged  $> 40$  years were 30,666, of which 60% were women. International Osteoporosis Foundation reported that osteoporotic fractures in a lifetime are experienced 1 in 3 women over 50 yo [12, 13]. T score  $\leq -2.5$  of BMD is used to diagnose osteoporosis in postmenopausal women.

The complete criteria for classifying osteoporosis according to the World Health Organization is normal  $\geq -1.0$ , low bone mass (osteopenia)  $-1.0 -2.5$ , osteoporosis  $\leq -2.5$  [2, 3, 14]. The osteoporosis diagnosis is established using DXA techniques as WHO gold standard measured in axial bone (i.e. the lumbar spine, femoral neck) [3,4,15]. DXA instruments access is very limited in Indonesia. The number of Indonesian people is 263.991.380 in World Bank Data in 2017 with 51% of the population live in the cities. DXA devices are only available in some urban areas, the big cities, and in total is only 65, making accessibility of these devices  $< 1$  per million population (or 0.1). Such low access to DXA is similar within Vietnam but in contrast with South Korea which has 24 devices per million people [12, 16, 17].

Quantitative ultrasound (QUS) is one of the techniques available for indirect bone fragility measurement. QUS usually used to measure heel or calcaneus peripheral bone density helps to identify patients with low

bone density. Compared to DXA, QUS is easier to handle as it is portable and provides calculated T-scores, useful to identify individuals at risk of osteoporosis in rural areas, such as Sidoarjo. Employing QUS, this study aimed to determine the prevalence and some risk factors related to osteoporosis in rural areas, in particular among elderly visiting the Integrated Health Posts for Elderly (so-called Posyandu Lansia) in Sidoarjo. Posyandu Lansia is a special extension of the Community Health Center (Puskesmas), the first-level health service facility. Sidoarjo is a rural city with most of its area located in the suburb of Surabaya which is the second main city in Indonesia. Majority of the residents are farmer, businessmen or service provider for Surabaya.

In general, like many other rural areas in Indonesia, most of the residents lack of exercise and not consuming dairy products, thus susceptible to osteoporosis. Our study focused on postmenopausal women,  $\sim 60\%$  of patients catered by Posyandu Lansia. Information on the osteoporosis prevalence and related risk factors (especially high-risk groups) will help the Posyandu Lansia to provide appropriate services and promotes preventive health program to improve the quality of life of the elderly [18, 20].

## Materials and Methods

### Study Design and Participants

This study has a cross-sectional and population-based design. The population of this study was the elderly from nine villages in Sidoarjo who visited nine Posyandu Lansia. The total number of Posyandu Lansia visitors was 440 of both genders. The study inclusion criteria were the age of at least 36 yo, postmenopausal women, complete medical record and willing to become respondents and underwent QUS examination. Postmenopausal women are defined as women who did not have any menstruation for at least 12 consecutive months. The number of postmenopausal women who were eligible and willing to participate was 249 people. All pertinent documents were kept confidential.

### Bone Mineral Density Measurement and Questionnaire

The cadres at the Posyandu Lansia were trained to measure height and weight by

Puskesmas health workers. Trained cadres measured height, weight, bone mineral density, and input the data into Card for Health (Kartu Menuju Sehat, KMS). The bone density was measured using quantitative ultrasound (Osteosys, SONOST 3000, Germany) on calcaneus bone of left heel for approximately 5 minutes. The bone density value used was the T-score shown on the QUS machine. QUS validity was evaluated by comparing bone density measurement with DXA of 85 respondents. DXA was accessible in Surabaya, the neighboring city. The questionnaire was adapted from the standard Foundation for Medical Practice Education 2006, handed to and filled by participants for information about age, last menstruation time and exercise history.

The Health Research Ethics Committee of Faculty of Medicine, Brawijaya University approved the study protocols (No. 247/EC/KEPK/S3/06/2016). Informed consent, both verbal and signed a written form, from participants were documented and kept by the researcher (SLU). All pertinent documents were kept anonymous and confidential.

### Statistical Analysis

The dependent variable is the T-score. Independent variables were age, BMI, weight, menopause age and duration, and exercise. "The classification criteria used for age, BMI, weight and menopause age associated with osteoporosis or fracture risk" were as previously described [3, 5]. Menopausal duration was classified into early (1-6 years) or late postmenopause (> 6 years) [21]. Such classification was used to compare the prevalence of osteoporosis and the degree of risks between two groups. Osteoporosis states were classified based on T-score value, i.e. osteoporosis =  $\leq -2.5$ , osteopenia = between  $-1.0$  and  $-2.5$  and normal  $\geq -1.0$ . The exercise was classified as "Yes" if all exercises were performed regularly at and as scheduled by Posyandu Lansia and/or other exercises for a minimum of 30 minutes/day five days weekly, or "No" if only did daily activities at home. Exercises included morning walk, Posyandu Lansia physical training, gardening, cycling, jogging or any combination of them. Data were analyzed statistically using SPSS version 22. The statistical analysis used was t-test, continued with Pearson correlation (the

direction and strength of the relationship) and linear regression (variable influence strength) both at an individual (simple) and simultaneous (multiple) variables. The results were considered significant if  $p < 0.05$ .

### Results

This study included 249 postmenopausal women, aged 44-95 years with a mean age of 62.5 yo (standard deviation of 8.4 years). The age, height, weight, BMI, menarche and menopause duration of the study population are represented in Table 1. Thirty-six percent of participants were in late elderly (65 yo or more), 1.1% had their menopause at an early age (<40 yo), and 71% had a menopausal duration of 6 years or more (Table 2).

To evaluate the agreement between QUS and DXA, osteoporosis status of 85 respondents diagnosed based on T-score measured by QUS was compared to that of DXA. The following value were obtained, i.e. sensitivity = 57%, specificity = 63%, positive prediction value (PPV) = 73% and negative prediction value (NPV) = 46%. For the subsequent study, QUS was employed to determine the prevalence and risk factors for osteoporosis. The total prevalence of osteoporosis in the study population was ~ 75% (183 of 249).

The osteoporosis prevalence in groups of age, BMI, menopause age and duration were shown in Table 2, Figure 1 and Figure 2. Statistical analyses showed that age ( $r = -0.257$ ), BMI ( $r = 0.207$ ), weight ( $r = 0.269$ ) and menopause duration ( $r = -0.265$ ) were associated with T-scores ( $p < 0.05$ ), while the age of menopause and exercise did not. Simple regression analysis showed that T-score was influenced by weight (7.3%), menopause duration (7%), age (6.6%), and BMI (4.3%). The increasing age and menopause duration decreased T-score 0.021 and 0.023 points, respectively. The increasing weight and BMI increased T-score 0.032 and 0.017 points, respectively. Multiple regression analysis showed that only weight was related to the T scores ( $p$ -value = 0.027), however, age; BMI; weight; and menopause duration simultaneously resulted in 11.7% ( $R^2$  value = 0.117) effects on T-score ( $p = 0.000$ ). Groups possessing risk factors associated with high prevalence of osteoporosis were postmenopausal women age  $\geq 65$  years, BMI  $< 20$  kg/m<sup>2</sup>, weight  $< 58$  kg and duration of menopause  $> 6$  years.

**Table 1: Demographic data of postmenopausal women in nine Posyandu Lansia**

Variable	n	Mean (SD)	Minimal	Maximal
Age (year)	249	62.458 (8.3767)	44	95
T-score (g/cm <sup>2</sup> )	249	-2.8313 (0.67608)	-4.4	-0.6
Height (cm)	234	151.141 (6.1680)	128	170
Weight (kg)	234	54.720 (10.6620)	26	107
BMI (kg/m <sup>2</sup> )	234	23.9478 (4.4890)	13	48
Menopause duration (years)	178	11.6 (7.632)	1	38
Menopause age (yo)	178	49.42 (4.448)	38	63

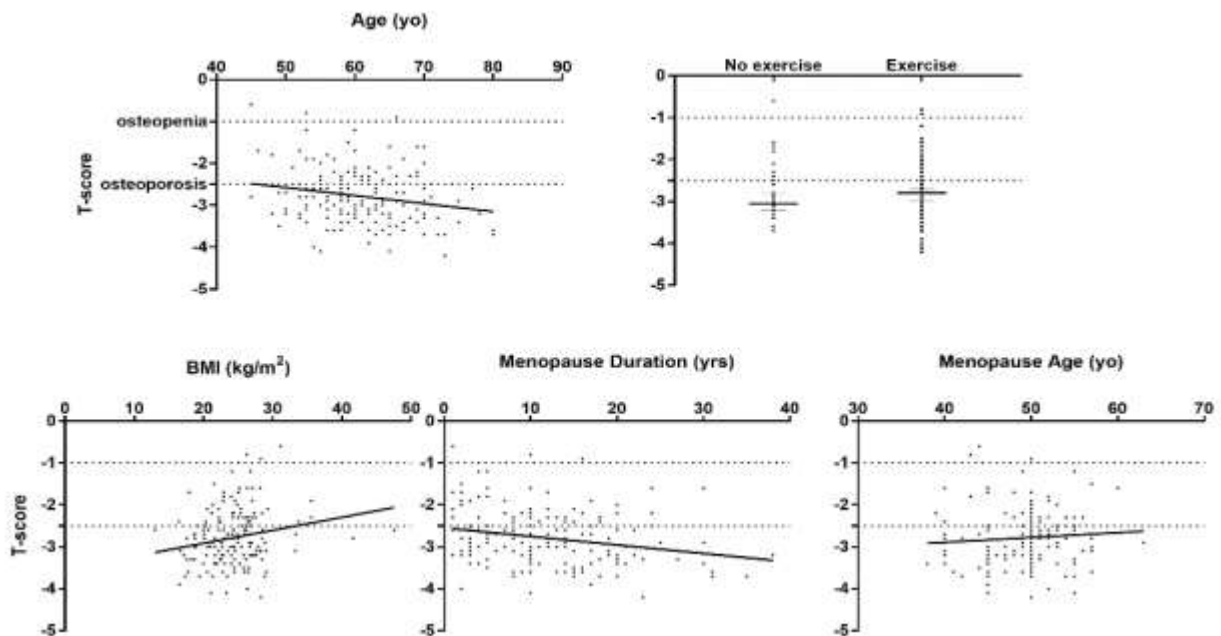
**Table 2: Prevalence of osteoporosis and risk factors in postmenopausal women**

Variable	Percent (n)	Prevalence Osteoporosis (n/N %)	t test	r	R <sup>2</sup>	b
<b>Age (yo) **</b>			0.021	-0.257	0.066	-0.021
36-64	63.9 (159)	45				
≥ 65	36.1 (90)	28.5				
<b>BMI (kg/m<sup>2</sup>) *</b>			0.008	0.207	0.043	0.032
< 20	15.8 (37)	13.7				
≥ 20	84.2 (197)	59.4				
<b>Weight (kg) **</b>			0.000	0.269	0.073	0.017
< 58	64.5 (151)	50.4				
≥ 58	35.5 (83)	22.6				
<b>Menopause duration (yrs) *</b>			0.003	-0.265	0.070	-0.023
Early Postmenopause (1-6)	28.1 (50)	18.5				
Late Postmenopause (> 6)	71.9 (128)	52.8				
<b>Menopause Age (yo)</b>			0.944			
Early Menopause (36-39)	1.1 (2)	0.6				
Normal Menopause (≥ 40)	98.9 (176)	70.8				
<b>Exercise (n = 235)</b>			0.929			
Yes	71.1 (167)	52.3				
No	28.9 (68)	20.9				

\*p < 0.05 and \*\* p < 0.001

r = correlation coefficient

R<sup>2</sup> = determination coefficient; b = regression coefficient in simple regression analysis



**Figure 1: The effects of risk factors on T- score value. The T-score of majority of postmenopausal women falls within osteopenia and osteoporosis categories. Age and menopause duration correlate negatively, whereas BMI and onset age of menopause correlate positively with the T-score (p<0.005). There is no difference on T-score between exercise and no exercise groups of postmenopausal women**

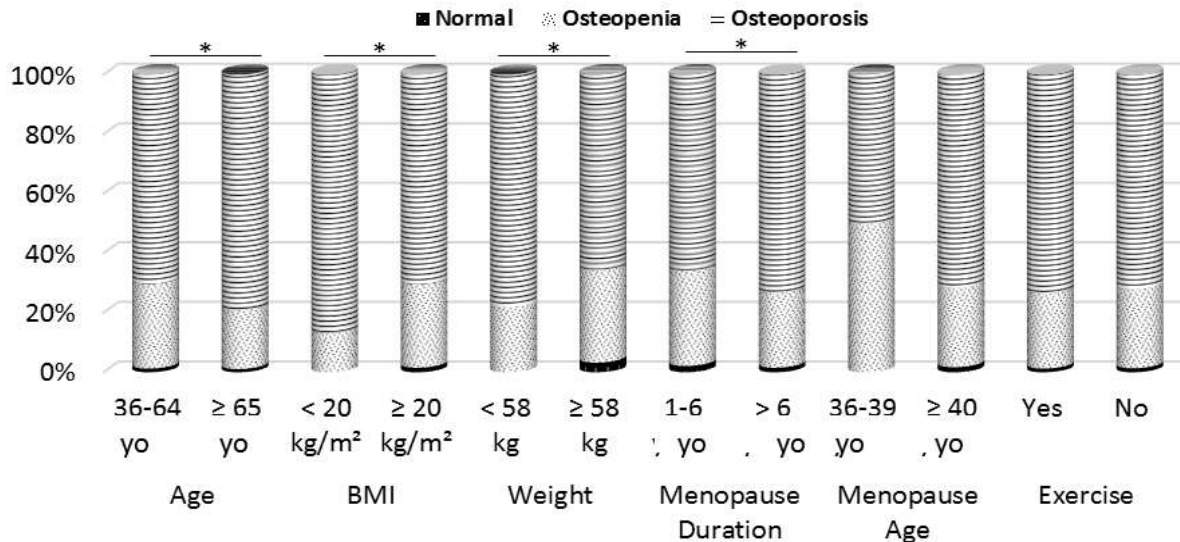


Figure 2: The prevalence of osteoporosis in postmenopausal women at Posyandu Lansia. In all groups based on age, weight, BMI, menopausal onset of age and duration, and exercise, osteoporosis is prevalent in more than 50% of population

## Discussion

This study showed that the postmenopausal women with osteoporosis were ~ 75%, higher than that of data from the elderly in Posyandu Lansia, Sidoarjo in 2016 and more recent study in 2017, i.e. 59.5% [22] and 43.8%, respectively [26]. Such difference may be due to the BMD measurement (DEXA vs QUS) and sampling of the population. Our results also showed that the number of postmenopausal women with osteoporosis was higher in group age  $\geq 65$  years, BMI  $< 20$  kg/m<sup>2</sup>, weight  $< 58$  kg and duration of menopause  $> 6$  years. Those results were consistent with assessment for risk fracture and osteoporosis in postmenopausal women, i.e. age  $\geq 65$  years, low body weight  $< 57.6$  kg [3]. The Odds Ratio for osteoporosis will increase by 8% for each addition of age range, which is 60-64 years, 65-69 years and 70-75 years [23].

The years since menopause is a risk factor for osteoporosis in China [24]. In our study, only a small fraction of participants menopause at early menopause age (36-39 years), although others reported that early menopause, at  $< 45$  yo [4] or  $< 40$  yo [25] contributes to osteoporosis and fracture. Our study also showed that mean of T-score  $< -2.5$  was detected in participants at earlier age i.e 46-55 yo, much younger than other studies in Indonesia (2006-2009) which reported in the range of 71-75 yo [10]. Identification of the risk of fractures is usually carried out together with BMD, patients' characteristics and the history of previous fragility hip, distal forearm, and vertebral fractures [27].

Data obtained from women in Austria who come for BMD measurement with aged  $\geq 40$  yo showed that with a mean age of respondents 56.1 yo, 66.8% of patients suffered from vertebral fractures. The authors claimed that there is a correlation between age, height, weight, and BMI with each category of BMD values, i.e. normal, osteopenia and osteoporosis. Canadian Multicentre Osteoporosis Study also demonstrated that BMI, weight, and height were correlated with BMD in premenopausal women [28]. In group with BMI 20 kg/m<sup>2</sup> risk ratio of hip fracture increased 2-fold compared to a BMI of 25 kg/m<sup>2</sup> [5]. Interestingly, in our study none of the participants including those who were categorised as osteoporosis, postmenopausal women age  $\geq 65$  years, BMI  $< 20$  kg/m<sup>2</sup>, weight  $< 58$  kg and duration of menopause  $> 6$  years, has ever experienced bone fracture.

One of the explanations is the participants in our study were enjoying the relatively sedentary lifestyle and never encounters such weather and environment necessitating extreme physical activities like in Austria or Canada. Our study showed also that exercise did not affect T-score, which probably due to inadequacy of the exercise program implemented by the Posyandu Lansia. Other studies mostly showed that a combination of regular exercise 3-5 times a week and a balanced diet will maintain adult bone health [5,29]. For exercise, weight-bearing with low intensity may be suitable for the elderly [30]. A meta-analysis study shows that exercise from 4-36 months will increase calcaneus T-score in all age ranges including elderly

women [31] The types of exercise that can be applied for postmenopausal women are aquatic and weight bearing for 6 months [32], and brisk walking 20-50 minutes every day for 12 months with progressive progression in the first 3 months [33]. In China, USA, and Korea, osteoporosis in postmenopausal women was 9.65-25.7% with a mean age of 59.7 years, with risk factors age, menopause duration, BMI < 18.5 kg/m<sup>2</sup> and absence from weight-bearing or low exercise 20 min/day [34, 37]. Other studies in Bali, Indonesia showed the prevalence of 24.52% osteoporosis in postmenopausal women with DXA [38], which may be related to the physical active lifestyle of Balinese.

Studies from India reported that women aged 40-60 years showed a positive correlation between age, time from menopause, sun exposure and BMD [39, 41]. In our studied population, no significant differences observed between groups with exercise or not. In both groups, osteoporosis was prevalent. The majority of participants who did the prescribed exercise, performed during the early morning after morning prayer and finished soon after dawn. Thus, the exercise may not only inadequate in term of load, but also the chosen time, i.e. very little sun exposure. Prevention must be done to reduce the occurrence of osteoporotic fractures. It has been known that exercise, in appropriate dose, serves as a mechanical signal which triggers anabolic processes beneficial for bones and muscles and regulate skeletal homeostasis.

Exercise also produces a significant increase in estrogen through the ratio of 2-hydroxyestrone to 16 $\alpha$ -hydroxy estrone in healthy premenopausal women [42,43]. The current exercise and diet adopted by Posyandu Lansia and/or applied by the participants apparently did not improve osteoporosis. Groups with some risk factors for osteoporosis may receive intensive and comprehensive programs to prevent osteoporosis and fractures. This will mainly target postmenopausal women whose numbers are more than half of the elderly in the Posyandu Lansia. First is by adopting a healthy lifestyle including exercise and exposure to sunlight such as gymnastics, relaxing walks to improve fitness [19,24]. Physical and mental-emotional health could be assessed, recorded and monitored by Posyandu Lansia, and collaborating with the

Indonesian Osteoporosis Society (PEROSI). PEROSI may then update its Guidelines for Management of Osteoporosis and the Indonesian Healthy Bone Foundation (PERWATUSI). Based on local needs, supplementary nutrition could also be offered. Other measures like fracture risk screening (FRAX), counseling on prevention of osteoporosis and osteoporotic fracture, appropriate exercise activities to prevent osteoporosis or osteoporotic fractures. Also time for exercise, not only after the morning prayer before dawn but also after sunrise. Indonesia is a tropical country with abundant sun exposure. Sun exposure provides the primary source of vitamin D as a vital component of bone health [5].

## Conclusions

More than half of the postmenopausal women who visit Posyandu Lansia suffered osteoporosis. Age, BMI, weight and menopause duration were significantly associated with T-scores both individually and simultaneously. Menopause age and exercise did not significantly correlate with T-score. The groups with a greater prevalence of osteoporosis may require a comprehensive program to prevent the worsening of osteoporosis and fractures such as exercise and nutrition at the right amount and time. The provision of drug therapy, such as biphosphonate, may need to implemented to improve their bone health.

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## Conflict of Interest

The authors have no conflict of interest to declare.

## Ethical Approval

The protocols in the present study were reviewed and approved by the Health Research Ethics Committee of Faculty of Medicine, Brawijaya University, Malang-Indonesia (No. 247/EC/KEPK/S3/06/2016).

## Authors' Contributions

Conceptualization: SLU, MH, DL, LEF, Data curation: SLU, Formal analysis: SLU, DL, Funding acquisition: SLU, KI, Writing-



original draft: SLU, Writing-review and editing: SLU, MH, DL, LEF, KI.

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