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ORIGINAL ARTICLE

THE SOCIODEMOGRAPHICS INFLUENCE IN THE KNOWLEDGE, PERCEPTION, AND BEHAVIOR OF OSTEOPOROSIS IN MALANG: A COMMUNITY-BASED STUDY

Pengaruh Sosiodemografi dengan Tingkat Pengetahuan, Persepsi, dan Perilaku tentang Osteoporosis di Malang: Studi Komunitas

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ABSTRACT

Background: Osteoporosis is a major global health issue that results in disability and high medical expenses. It can significantly impact both individuals and their caregivers, leading to pain, limitations in daily activities, and emotional distress. **Purpose:** This study observed the association of sociodemographic factors in affecting knowledge, perception, and behavior related to osteoporosis in a rural area of Malang, Indonesia. **Methods:** A cross-sectional study was conducted in a rural area of Malang to assess the knowledge, perception, and behavior of adults (≥18 years old) toward osteoporosis. Participants were asked to fill in a validated questionnaire, which was selected randomly using a multistage stratified sampling technique. Collected data were analyzed on SPSS for Windows version 25.0. **Results:** The study included 376 randomly selected participants from various rural areas in Malang. The subjects mostly were within the 51-60 age group (34.0%), with female respondents accounting for 73.4% of the sample. On average, participants scored 1.8 (±2.5) for knowledge, 12.0 (±2.1) for perception, and 12.2 (±2.9) for behavior regarding osteoporosis. Both age and education levels showed associations with knowledge and perception, while only age was significantly linked to behavior concerning osteoporosis. **Conclusions:** Our study revealed a strong association between

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low educational levels, especially among the elderly, and the lack of knowledge, perceptions, and behavior toward osteoporosis.

ABSTRAK

Latar Belakang: *Osteoporosis merupakan salah satu masalah kesehatan global utama yang mengakibatkan kecacatan dan biaya pengobatan yang tinggi. Hal ini dapat berdampak signifikan baik pada individu maupun pengasuhnya,, yang menyebabkan rasa sakit, keterbatasan dalam aktivitas sehari-hari, dan tekanan emosionalyebabkan rasa sakit, keterbatasan fungsional, dan tekanan psikososial.* ***Tujuan:*** *Penelitian ini mengamati hubungan faktor sosiodemografi dalam mempengaruhi pengetahuan, persepsi, dan perilaku terkait osteoporosis di daerah pedesaan Malang, Indonesia.* ***Metode:*** *Penelitian cross-sectional dilakukan di daerah pedesaan Malang untuk menilai pengetahuan, persepsi, dan perilaku orang dewasa (≥18 tahun) tentang osteoporosis. Partisipan dipilih dengan menggunakan metode Teknik multistage stratified sampling, lalu subjek mengisi kuesioner. Data akan dianalisis oleh SPSS untuk Windows versi 25.0.* ***Hasil:*** *Penelitian ini melibatkan 376 partisipan yang dipilih secara acak dari berbagai daerah pedesaan di Malang. Subyek sebagian besar berada pada kelompok usia 51-60 tahun (34,0%) dengan responden perempuan sebanyak 73,4% dari sampel. Rata-rata, peserta mendapat skor 1,8 (±2,5) untuk pengetahuan, 12,0 (±2,1) untuk persepsi, dan 12,2 (±2,9) untuk perilaku mengenai osteoporosis. Usia dan tingkat pendidikan menunjukkan adanya hubungan dengan tingkat pengetahuan dan persepsi, sedangkan hanya usia yang secara signifikan berhubungan dengan perilaku.* ***Simpulan:*** *Penelitian kami menunjukkan adanya hubungan yang kuat antara rendahnya tingkat pendidikan khususnya pada lansia dengan rendahnya tingkat pengetahuan, persepsi dan perilaku terhadap osteoporosis.*

INTRODUCTION

Osteoporosis and fragility fractures are global problems that cause disability with high medical costs. With aging populations increasing in recent years, the number of people affected by osteoporosis is expected to rise substantially (1). Osteoporosis impacts a significant portion of the population, affecting 10% to 30% of women aged 40 and above, as well as up to 10% of men in seven developed countries across the Asia Pacific region. This condition leads to a higher risk of fractures, with 500 to 1000 adults aged 50 and over (2). In a small population in Jakarta, the prevalence of osteoporosis is 20.2% in postmenopausal women (3). Osteoporosis is a silent disease that most patients are often unaware of until they have the first episode of the fractures (4).

Fragility fractures due to osteoporosis impose a significant burden on the individuals, as well as the caregivers and family members. Generally, osteoporosis with fragility fractures can cause back pain, functional, and psychosocial disturbances. These conditions disrupt patients' daily life activities and result in declining their quality of life (5). The World Health Organization (WHO) utilizes disability-adjusted life years (DALYs) to assess the burden of disease. In 2016, fragility fractures were responsible for 2.6 million DALYs, indicating that fractures are the primary contributor to lost DALYs in osteoporosis. (6).

Meanwhile, osteoporosis is a preventable disease and increasing awareness can improve its prevention. In addition, assessing knowledge, perception, and behavior related to osteoporosis in a community is essential for promoting awareness, early detection, prevention, and effective management of the condition (7). It enables targeted interventions and resource allocation to improve the overall health and well-being of the community while reducing the burden of osteoporosis-related complications (8). Knowledge, perception, and

behavior may differ across regions because of sociodemographic factors. However, no study in Indonesia has reported the levels of knowledge, perception, or behavior, and their contributing factors in the community about osteoporosis. Therefore, this study aims to assess the knowledge, perception, or behavior and their association with sociodemographic factors in a small population in Malang, Indonesia.

METHODS

Study Design and Participants

This research is a cross-sectional study that aims to assess the level of knowledge, perception, and behavior of adult individuals toward osteoporosis from a rural area in Malang. Moreover, this study also wanted to evaluate the association between sociodemographic factors with the knowledge, perception, and behavior of osteoporosis. The participants of this study were adults (≥18 years old) and were able to comprehend the Indonesian language. Samples were chosen randomly by a multistage stratified sampling technique which was done in several rural regions in Malang, Indonesia. As for the calculation of the minimum samples, the estimated number of the adult population in Malang was 600,000 individuals. Therefore, based on the confidence interval of 95% and the margin of error was 5%, the minimum samples of this study were 384 individuals. This study was approved by the ethical committee from the Faculty of Medicine Universitas Brawijaya, Malang Indonesia (Ethical approval number: 400/164/K.3/101.7/2023 and approved on July 25th, 2023). All participants signed the informed consent before participation in this study.

Study Tools

The study took place from January to August 2023. We used a specific questionnaire in Indonesian language to assess the level of knowledge, attitude, and perception of the participants. The questionnaire was developed based on the several previous studies and re-evaluated by three experts while translated into the Indonesian versions. The questionnaire included four parts: (1) sociodemographic: including name (alias), age, sex, level of education, occupation, and marital status; (2) knowledge: including eleven specific questions assessing the definition, sign/symptoms, risk factors, prevention, and therapeutic measures with yes/no questions. The correct answer had a score of 1 point while wrong answer got 0 point; (3) perception: composed of five questions about the perception toward osteoporosis with a five-point Likert scale (strongly agree, agree, uncertain, disagree, and strongly disagree). The answer would be scored 0 to 4 according to the right answer; (4) behavior: including six questions that asked about the achievement in doing several behaviors in preventing osteoporosis for the last month. The achievement of the behaviors was asked by the five-point scale (100%, 75%, 50%, 25%, or 0%). The answer would be scored 0 to 4 according to the right answer. Twenty participants were also excluded from this study and conducted a pre-test survey to validate the questionnaire. The internal consistency of the study questionnaire was assessed by calculating the Cronbach's alpha. The values were 0.762 (knowledge section), 0.693 (perception section), and 0.741 (behavior section). The questionnaire was valid for this study as the Pearson α correlation test for each item was >0.25.

Statistical Analysis

Data were summarized using Microsoft Excel 2019 and analyzed by SPSS ver.25 for Windows. The sociodemographic data were presented in frequency and percentages. The numerical scoring system was used in presenting the data on the knowledge, perception, and behavior of the participants. Mean and standard deviation (SD) were used to present the numerical data. The score for the knowledge, perception, and behavior were then categorized into satisfactory or unsatisfactory according to the cut-off from the mean score. The association between the variables were measured using the Chi-square test and followed by the logistic regression model.

RESULTS

Characteristics of Subjects

The characteristics of the subjects are shown in Table 1. The participants of this study were 376 individuals who were randomly chosen from several rural regions in Malang. The mean ages of the subjects were 58.4 ± 11.3 years old. Most subjects were 51 – 60 years old (34.00%). Most respondents were female (73.40%) and widows or widowers (96.80%). According to the education levels, most subjects only finished elementary school (54.80%) while only a few attended the university (6.40% had bachelor's degrees and 0.5% had master's degrees). In addition, according to the employment status, most of the participants did not

work (most of them were housewives), while 43.10% of the others had a job.

Table 1
Characteristics of Subjects

Variable	n	%
Age (years old)		
18 – 30	14	3.70
31 – 40	8	2.10
41 – 50	58	15.40
51 – 60	128	34.00
61 – 70	120	31.90
>70	48	12.80
Sex		
Male	100	2.60
Female	276	73.40
Marriage Status		
Unmarried	4	1.10
Married	8	2.10
Widow/Widower	364	96.80
Educational Level		
Elementary school	206	54.80
Middle school	50	13.30
High school	78	20.70
Bachelor degree	24	6.40
Magister degree	2	0.50
Did not attend school	8	2.10
Did not finish school	8	2.10
Occupational Status		
Unemployed	214	56.90
Employed	162	43.10

Source: Primary data, 2022

Knowledge, Perception, and Behavior of the Respondents Towards Osteoporosis

The distribution of the answer for the knowledge, perception, and behavior section from the respondents toward osteoporosis is shown in Table 2. Based on their answers, most participants (35.10%) understood that osteoporosis can cause bone fracture, and only 1.60% of people had consumed vitamin D supplements as their routine vitamin intake. The description of score for the knowledge, perception, and behavior of the respondents toward osteoporosis is shown in Table 3. The mean knowledge score from the respondents was 1.8 ± 2.5 (from minimum score 0 out of 8). On the other hand, the mean score for perception and behavior were 12.0 ± 2.1 (from minimum score 0 out of 16) and 12.2 ± 2.9 (from minimum score out of 24), respectively. The respondents were categorized into satisfactory and unsatisfactory according to the mean score from each section. Most of the subjects were categorized into the unsatisfactory group, as shown in Table 3.

Association between the Sociodemographic Characteristics with the Knowledge, Perception, and Behavior of the Respondents on Osteoporosis

Tables 4-6 shows the association of the sociodemographic characteristics with the knowledge, perception, and behavior of the participants. In the knowledge section (Table 4), age and education levels were associated with the knowledge of respondents about osteoporosis. The age group between 41 – 50 years old was used as the reference because they represented the median of the population. Thus, subjects who were 51 – 60, 61 – 70, and >70 years old had a significant risk of unsatisfactory knowledge compared to the 41 – 50 years old participants. In addition, compared to the subjects who had only finished elementary school, participants who finished their education in middle school, high school, or had a bachelor's degree demonstrated a lower risk of having unsatisfactory knowledge about osteoporosis. Age and education levels are also associated with the perception of the participants toward osteoporosis, as shown in Table 5. Subjects in the age group 61 – 70 years old had increasing odds of 3.4 times for having the unsatisfactory perception while participants in age group 18 – 30 years old had a lower risk of having unsatisfactory perception compared to the participants from age group 41 – 50 years old. As for the education level, the more education they completed, the less chance of them having unsatisfactory perceptions toward osteoporosis. In the behavior section (Table 6), only age had a significant association with the behavior of the subjects toward osteoporosis. Participants in the age group 61 – 70 and >70 years old had increasing odds of 2.0 and 2.5 times higher for having unsatisfactory behavior compared to the age group 40 – 51 years old, respectively.

Table 2
Distribution of the Answer According to the Questions from Each Section

	Questions	Percentages of Answer (n [%])				
	Knowledge Section	***Correct Answer (n [%])***				
1	Osteoporosis can cause bone to be fragile and easy to fracture	132 (35.10)				
2	Osteoporosis commonly did not have any symptoms	52 (13.80)				
3	Osteoporosis cannot be cured	54 (14.40)				
4	Postmenopausal women have a higher risk to develop osteoporosis	62 (16.50)				
5	Smoking and consuming alcohol cannot increase the risk of osteoporosis	48 (12.80)				
6	Family history with osteoporosis cannot increase the risk of osteoporosis for their children	44 (11.70)				
7	Bone mineral density examination should be performed to early screening of osteoporosis	86 (22.90)				
8	Eating habit did not correlate with the risk of osteoporosis	72 (19.10)				
9	Exercise (such as brisk walking or running) can prevent osteoporosis	54 (14.40)				
10	Steroid (such as prednisone, methylprednisolone, or dexamethasone) could increase the risk of osteoporosis	32 (8.50)				
11	Excess calcium intake can lead to renal stone	30 (8.00)				
		Distribution of Answer (n [%])				
	Perception Section	**Very Agree**	**Agree**	**Uncertain**	**Disagree**	**Very Disagree**
1	I think every individual (young or old individual) can develop osteoporosis	38 (10.10)	88 (23.40)	214 (56.90)	36 (9.60)	0 (0)
2	I think bone mineral density should be performed routinely	6 (1.60)	156 (41.50)	210 (55.90)	4 (1.10)	0 (0)
3	I think enough sun exposure in the morning can prevent osteoporosis	6 (1.60)	166 (44.10)	198 (52.70)	6 (1.60)	0 (0)
4	I think osteoporosis is dangerous and can cause fracture	2 (0.50)	120 (31.90)	250 (66.50)	2 (0.50)	2 (0.50)
5	I think following advice from doctor is important to preserve the bone health	0 (0)	190 (50.50)	184 (48.90)	0 (0)	2 (0.50)
		Distribution of Answer (n [%])				
	Behaviors Section	**100%**	**75%**	**50%**	**25%**	**0%**
1	I consume high calcium diet, such as milk, green vegetables, fish, or meat	30 (8.00)	168 (44.70)	148 (39.40)	26 (6.90)	4 (1.10)
2	I did not consume black coffee, tea, or carbonated drinks more than 3 glasses per day	62 (16.50)	78 (20.70)	112 (29.80)	86 (22.90)	38 (10.10)
3	I got enough exposure from the sunlight at least 10 minutes per day in the morning	26 (6.90)	120 (31.90)	188 (50.00)	40 (10.60)	2 (0.50)
4	I usually have exercise at least 30 minutes on 3 days per week	20 (5.30)	76 (20.20)	192 (51.10)	82 (21.80)	6 (1.60)
5	I am very cautious for anticipating from falling on my daily activities	10 (2.70)	70 (18.60)	288 (76.60)	8 (2.10)	0 (0)
6	I am routinely consuming vitamin D and calcium supplementations	6 (1.60)	12 (3.20)	114 (30.30)	82 (21.80)	162 (43.10)

Source: Primary data, 2022

Table 3
Description of Scores Obtained by The Respondents

Outcome Variables	Maximum Obtainable Scores	Score Received by Respondents		Mean ± SD	Satisfactory n (%)	Unsatisfactory n (%)
		Minimum	Maximum			
Knowledge	11	0	8	1.80 ± 2.50	134 (35.60)	242 (64.40)
Perception	20	6	16	12.00 ± 2.10	172 (45.70)	204 (54.30)
Behavior	24	6	24	12.20 ± 2.90	166 (44.10)	210 (55.90)

Source: Primary data, 2022

Table 4
Association Between the Sociodemographic Characteristics with the Knowledge Levels of Respondents

Characteristic	Answers				*p-value*	OR (95% CI)	p-value
	Satisfactory		Unsatisfactory				
	n	%	n	%			
Age (years old)							
18 – 30	6	4.50	8	3.30	0.003*	1.60 (0.5-5.3)	0.410
31 – 40	2	1.50	6	2.50		3.70 (0.7-19.8)	0.128
41 – 50	32	23.90	26	10.70			
51 – 60	50	37.30	78	32.20		1.90 (1.1-3.6)	0.042*
61 – 70	32	23.90	88	36.40		3.40 (1.8-6.5)	<0.001*
>70	12	9	36	14.90		3.70 (1.6-8.5)	0.002*
Sex							
Male	28	20.90	72	29.80	0.063		
Female	106	79.10	170	70.20		0.60 (0.4-1.1)	0.064
Educational Level							
Elementary school	46	34.30	160	66.10	<0.001*		
Middle school	22	16.40	28	11.60		0.40 (0.2-0.7)	0.002*
High school	48	35.80	30	12.40		0.20 (0.1-0.3)	<0.000*
Bachelor degree	14	10.40	10	4.10		0.20 (0.1-0.5)	<0.000*
Magister degree	0	0	2	0.80		n/a	n/a
Did not attend school	2	1.50	6	2.50		0.90 (0.2-4.4)	0.859
Did not finish school	2	1.50	6	2.50		0.90 (0.2-4.4)	0.859
Marriage Status							
Unmarried	2	1.50	2	0.80	0.685		
Married	2	1.50	6	2.50		3.00 (0.2-37.7)	0.395
Widow/widower	130	97	234	96.70		1.80 (0.3-12.9)	0.559
Employment status							
Unemployed	74	55.20	140	57.90	0.622		
Employed	60	44.80	102	42.10		0.90 (0.6-1.4)	0.622

Source: Primary data, 2022

Table 5
Association Between the Demographic Characteristics with the Perception of Respondents

Characteristic	Answers				*p-value*	OR (95% CI)	p-value
	Satisfactory		Unsatisfactory				
	n	%	n	%			
Age (years old)							
18 – 30	12	7	2	1	<0.001*	0.2 (0.4-0.9)	0.045*
31 – 40	6	3.50	2	1		0.4 (0.1-2.2)	0.299
41 – 50	32	18.60	26	12.70			
51 – 60	66	38.40	62	30.40		1.1 (0.6-2.2)	0.648
61 – 70	38	22.10	82	40.20		2.7 (1.4-5.1)	0.003*
>70	18	10.50	30	14.70		2.1 (0.9-4.5)	0.071
Sex							
Male	38	22.10	62	30.40	0.070		
Female	134	77.90	142	69.60		0.6 (0.4-1.0)	0.071
Educational Level							
Elementary school	64	37.20	142	69.60	<0.001*		
Middle school	24	14	26	12.70		0.5 (0.3-0.9)	0.025*
High school	56	32.60	22	10.80		0.2 (0.1-0.3)	<0.001*
Bachelor degree	20	11.60	4	2		0.1 (0.03-0.3)	<0.001*
Magister degree	0	0	2	1		n/a	n/a
Did not attend school	4	2.30	4	2		0.4 (0.1-1.8)	0.270
Did not finish school	4	2.30	4	2		0.4 (0.1-1.8)	0.270
Marriage Status							
Unmarried	4	2.30	0	0	0.021*	n/a	n/a
Married	6	3.50	2	1		0.3 (0.1-1.3)	0.109
Widow/widower	162	94.20	202	99			
Employment status							
Unemployed	96	55.80	118	57.80	0.692		
Employed	76	44.20	86	42.20		0.9 (0.6-1.4)	0.692

Source: Primary data, 2022

DISCUSSION

Most adults in rural areas only finished their education in elementary schools. According to the data from BPS-Statistics Indonesia and the Indonesian Ministry of Education and Culture's database (9,10), Malang is ranked as the fourth-highest elementary school dropout in East Java. Among individuals aged 15 and above in Malang, the majority hold an elementary school diploma or its equivalent, accounting for 32.80%. This is far below the statistical data of the national average for elementary school education levels in Indonesia, which stands at 97.82%. Knowledge is influenced by several factors, such as intelligence, which refers to a person's capacity for effective and rational action. Education is another critical factor in how information is absorbed. Information significantly impacts how knowledge is retained and adapted. Moreover, the environment serves as a valuable learning resource. Notoatmodjo demonstrated that knowledge could be influenced by various factors, including level of education. An individual with a higher level of education tends to have greater knowledge, while it may be less extensive for those with lower educational levels (11). This statement was consistent with our findings which demonstrated that the subjects with low educational levels were mostly unaware of osteoporosis and its risk factors.

Table 6
Association Between the Demographic Characteristics with the Behavior of Respondents

Characteristic	Answers				*p-value*	OR (95% CI)	p-value
	Satisfactory		Unsatisfactory				
	n	%	n	%			
Age (years old)							
18 – 30	8	4.80	6	2.90	0.049*	0.90 (0.3-3.0)	0.894
31 – 40	2	1.20	6	2.90		3.70 (0.7-19.8)	0.128
41 – 50	32	19.30	26	12.40			
51 – 60	62	37.30	66	31.40		1.30 (0.7-2.4)	0.395
61 – 70	46	27.70	74	35.20		2 (1.0-3.7)	0.035*
>70	16	9.60	32	15.20		2.50 (1.1-5.4)	0.026*
Sex							
Male	36	21.70	64	30.50	0.055		
Female	130	78.30	146	69.50		0.60 (0.4-1.0)	0.056
Educational Level							
Elementary school	84	50.60	122	58.10	0.344		
Middle school	26	15.70	24	11.40		0.60 (0.3-1.2)	0.152
High school	40	24.10	38	18.10		0.70 (0.4-1.1)	0.112
Bachelor degree	10	6	14	6.70		1 (0.4-2.3)	0.933
Magister degree	0	0	2	1		n/a	n/a
Did not attend school	2	1.20	6	2.90		2.10 (0.4-1-.5)	0.381
Did not finish school	4	2.40	4	1.90		0.70 (0.2-2.8)	0.605
Marriage Status							
Unmarried	2	1.20	2	1	0.532		
Married	2	1.20	6	2.90		3 (0.2-37.7)	0.395
Widow/widower	162	97.60	202	96.20		1.20 (0.2-8.9)	0.826
Employment status							
Unemployed	102	61.40	112	53.30	0.115		
Employed	64	38.60	98	46.70		1.40 (0.9-2.1)	0.115

Source: Primary data, 2022

A study conducted in Iran showed that women who have received a higher level of education exhibit significantly better knowledge about osteoporosis compared to their less-educated counterparts, mirroring a similar trend observed among women of reproductive age in Egyptian and Lebanese women (12,13). Nevertheless, two studies conducted in both Poland and Malaysia revealed that older women with lower educational backgrounds have poor knowledge of osteoporosis, while younger participants, including university students, demonstrated a higher level of knowledge about osteoporosis (14,15). The middle-aged and elderly individuals with lower educational levels in China also tend to have poor knowledge of osteoporosis and lack access to information about the condition (16).

Osteoporosis was characterized with a disruption between bone resorption and bone formation (17). Several studies indicated that certain risk factors for osteoporosis, such as diet and lifestyle choices, could be modified (17). A well-rounded nutritional status with adequate dietary protein intake, fruits, and vegetables positively influences bone health. In contrast, a high-calorie diet and excessive alcohol consumption had been linked to lower bone density and higher fracture rates (17). Insufficient intake of calcium, 1,25-

dihydroxyvitamin D, and protein in one's diet could raise the risk of developing osteoporosis (18). Many risk factors could increase the incidence of osteoporosis and were related to health behavior. In this study, we assessed the participant's health behavior based on dietary calcium intake, the importance of physical exercise, avoiding the falling risk, and vitamin D supplementation intake. As the result, most participants, especially the elderly, showed unsatisfactory attitudes toward osteoporosis. They lacked the habit of taking vitamin D supplements, had low calcium intake, consumed high amounts of caffeine, and rarely did physical activities. Meanwhile, physical exercise has the potential to effectively prevent the decrease in bone mineral density among older individuals with osteoporosis (19).

It is crucial to take notes of subjects' dietary habits. High caffeine consumption could potentially impact calcium balance through various mechanisms in the body. Some previous studies have indicated a possible connection between consuming caffeine and a decrease in bone mineral density or an elevated risk of fractures (20). This susceptibility could be due to insufficient calcium intake, a predisposition towards osteoporosis, or older age. Moreover, the lack of vitamin D was related to a loss of bone mass and increased risk of osteoporotic fractures. Vitamin D is essential in regulating the balance of calcium and phosphorus in the body, as well as in the mineralization of the bone structure. Insufficient vitamin D levels could negatively impact bone health and calcium absorption from dietary sources (21).

A recent study in Jordan found that significant risk factors for vitamin D deficiency in the elderly included the lack of physical activity and less exposure to sunlight (22). Moreover, current trends of avoiding sun exposure and reducing the consumption of fish products have led to a high prevalence of vitamin D deficiency among the general population in Japan (22). Despite technological innovation, older women tend to have limited access to trustworthy information sources such as newspapers, magazines, and radio, and are less likely to use the internet for this purpose. It also affected their health behavior related to osteoporosis (23). Furthermore, although the younger subjects had a certain level of awareness, they tended not to apply the preventive behaviors toward osteoporosis. Cultivating a proper mindset toward osteoporosis could be a crucial factor in enhancing health habits to prevent the disease (15).

The global incidence of osteoporosis was found to be 35.30% in elderly women and 12.50% in elderly men. Asia had the highest prevalence of osteoporosis among older individuals, reaching 24.30%. It was projected that one out of every three women over the age of 50 would suffer from fractures associated with osteoporosis (24). Consequently, there is an urgent need to raise awareness among the communities and implement sustainable preventive measures to decrease the burden on the health system. The reliable information delivered by health educators can boost patients' awareness, enhance their confidence in managing their health, and improve the community's overall health. Furthermore, motivation can foster a positive outlook toward osteoporosis, particularly when individuals recognize that risks can be mitigated by minimizing negative behaviors (15).

A basic educational intervention has been proven effective in enhancing osteoporosis awareness in Korea. This approach may offer more advantages by giving knowledge about the risks associated with osteoporotic fractures. Awareness is essential in preventing and treating chronic diseases such as osteoporosis. Each participant was given information about specific risks for osteoporotic fractures, along with guidance on nutritional and lifestyle adjustments to increase bone density (25). Health promotions also can improve individuals' knowledge and attitudes toward osteoporosis. It can also improve some health-related behaviors for bone health, such as sufficient dairy calcium intake, and vitamin D intake (26). Providing not only educational programs, but also training programs, such as physical exercise for the elderly, can foster motivation for healthy behaviors. This, in turn, can reduce the risk of osteoporosis. In addition, providing family counseling in extended educational programs, using audio-visual materials to present key topics, and holding support groups that involve older volunteers who have successfully survived the disease can enhance the outcomes (27).

Research Limitations

Our study is the first of its kind in Indonesia to observe an individual's knowledge, perception, and behavior regarding osteoporosis, as well as identify the various factors that influence it. The findings from this research will serve as the foundation for further interventions so that osteoporosis can be recognized earlier and prevented within the community. On the other hand, our study also has certain limitations. It should be necessary to differentiate between the culture of urban and rural communities, whereas we specifically focused on

rural communities, which may not fully represent the entire population of Malang. In addition, there might be some recall or memory bias where respondents may forget or overestimate the actions taken in their behaviors.

CONCLUSION

This study reveals an association between sociodemographic factors and knowledge, perception, and behavior regarding osteoporosis. Particularly, it highlights a significant relationship with low educational levels, especially among the elderly. Further intervention is needed with a multidisciplinary approach involving both the healthcare sector and government support to tackle this issue.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

M.P, B.S, D.P. designed and the conceptualization of the experiments. M.P. and R.R. performed the experiments and analyzed the data. M.P. and G.A. contributed analysis tools and helped with data interpretation. D.P. provided critical inputs on the study and analysis methodology. M.P. and G.A. wrote the original draft of the paper. B.S. and R.R. reviewed and edited the manuscript. All authors contributed to the manuscript.

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