

Effect of an Integrated Education and Exercise Program on Osteoporosis Knowledge in a Medical Rehabilitation Setting: A One-Group Pre-Posttest Study

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Abstract:

Osteoporosis remains an important public health concern because inadequate awareness of its risk factors and preventive strategies may delay the adoption of protective health behaviors. Educational interventions combined with practical exercises may strengthen knowledge about osteoporosis and support preventive awareness. This study evaluated changes in osteoporosis-related knowledge following a structured education and preventive exercise program delivered in a medical rehabilitation setting. A quantitative one-group pre-test–post-test design was conducted with 20 patients and their accompanying individuals at the Medical Rehabilitation Unit of R.T. Notopuro Regional General Hospital, Sidoarjo, Indonesia. Participants were recruited using purposive sampling. Osteoporosis-related knowledge was assessed using a structured seven-item questionnaire administered before and immediately after the intervention. The program included education on osteoporosis, its risk factors, preventive measures, and low-impact exercises to target muscle strength, balance, and flexibility. Descriptive statistics and a paired-samples t-test were used for analysis. The mean proportion of correct responses increased from 38.33% on the pre-test to 80.83% on the post-test. Participant-level analysis showed a mean increase in score of 2.55 points (SD = 1.47; SE = 0.33; 95% CI: 1.86–3.24), with a statistically significant difference between assessments ($t(19) = 7.77$, $p < 0.001$). The integrated osteoporosis education and exercise program was associated with a substantial short-term improvement in participants' knowledge of osteoporosis. Further controlled studies with larger sample sizes and longer follow-up periods are required to assess knowledge retention and behavioral outcomes.

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INTRODUCTION

Osteoporosis represents an important global public health challenge because deterioration in bone strength increases susceptibility to fragility fractures and their associated physical, social, and economic consequences. The condition becomes increasingly relevant as populations age, and the number of individuals exposed to age-related skeletal deterioration continues to grow (Wang & Seibel, 2023). Osteoporotic fractures can contribute to pain, functional impairment, reduced mobility, loss of independence, and deterioration in quality of life. Hip and vertebral fractures are particularly concerning because they may require prolonged rehabilitation and can substantially restrict daily functioning (Zhang et al., 2022). The clinical burden of osteoporosis extends beyond individuals to families and healthcare systems, increasing the need for treatment, rehabilitation, long-term care, and assistance with activities of daily living (Moayyeri et al., 2023).

Insufficient knowledge of osteoporosis remains a significant barrier to effective prevention, as the condition may develop without obvious clinical manifestations in its early stages. Individuals may therefore underestimate their susceptibility until bone loss has progressed or a fracture has occurred (Ahmed et al., 2023). Limited understanding of osteoporosis can also lead to misconceptions about who is at risk, which factors contribute to bone deterioration, and which preventive measures should be adopted. Awareness of the importance of osteoporosis does not necessarily indicate adequate knowledge of specific risk factors or the adoption of effective preventive behaviors (Taghvaei et al., 2022). Health literacy concerning bone health is consequently essential for supporting timely recognition of risk and informed participation in preventive activities (Tsai et al., 2024).

Osteoporosis prevention is particularly relevant because several determinants of bone health and fracture risk are modifiable through appropriate lifestyle practices. Adequate nutrition, sufficient intake of nutrients important for bone metabolism, regular physical activity, maintenance of muscular strength, improvement of balance, avoidance of harmful lifestyle behaviors, and reduction of fall risk represent important elements of preventive care (Rizzoli & Chevalley, 2024). Physical exercise is particularly relevant because appropriate movement can support musculoskeletal function and contribute to strength, balance, flexibility, and functional independence (Hsu et al., 2024). Preventive recommendations may have limited practical value when individuals receive information without sufficient understanding of how to incorporate them into daily activities (Xiong et al., 2025).

Health education has therefore become an important strategy for improving osteoporosis-related knowledge and strengthening individual capacity to participate in preventive behaviors (Darawad et al., 2022). Educational interventions can explain the characteristics of osteoporosis, identify populations at increased risk, clarify modifiable and non-modifiable risk factors, and introduce practical strategies for maintaining bone health. Programs that incorporate practical activities offer additional value because participants can directly observe and practice behaviors introduced during educational sessions. Exercise demonstrations can transform theoretical information into a practical preventive activity, particularly when movements are simple, low-impact, and adaptable to varying levels of physical capacity (Anupama et al., 2023). The integration of knowledge-based education with practical exercises may provide a more comprehensive preventive approach than information delivery alone (Jamil et al., 2024).

A practical evidence gap remains regarding the implementation of brief, integrated osteoporosis education and exercise activities in routine medical rehabilitation settings. Many preventive programs emphasize knowledge acquisition as the principal outcome, while opportunities to combine disease education with direct experience of preventive exercise may receive less attention in routine healthcare activities (Ierulli et al., 2025). Medical rehabilitation units provide a relevant setting because patients frequently encounter concerns related to mobility, physical function, musculoskeletal health, and maintenance of independence. Individuals accompanying patients also constitute an important audience for preventive health education, as they may influence health decisions, provide social support, and disseminate health information within families and communities (Mouchaers et al., 2023).

The present study addresses this practical gap by integrating structured osteoporosis education with a low-impact preventive exercise session for patients and accompanying individuals attending a medical rehabilitation unit. The program covered fundamental knowledge of osteoporosis, populations at increased risk, relevant risk factors, preventive strategies, and awareness of osteoporosis-specific exercise (Belgacem et al., 2022). Direct participation in low-impact movements targeting muscular strength, balance, and flexibility complemented the educational content (Bragonzoni et al., 2023). Immediate pre- and post-program assessments provided an opportunity to examine whether exposure to this combined educational approach was

associated with measurable changes in osteoporosis-related knowledge in a real-world hospital setting.

This study aimed to evaluate changes in participants' osteoporosis-related knowledge following a structured education and preventive exercise program delivered in the Medical Rehabilitation Unit of R.T. Notopuro Regional General Hospital. Assessment of pre-intervention and post-intervention knowledge was intended to determine the direction and magnitude of change associated with participation in the program. Evidence from this evaluation may inform the development of feasible osteoporosis prevention activities that can be incorporated into rehabilitation and other healthcare services. Strengthening preventive knowledge within accessible clinical settings is particularly important because earlier awareness and engagement in protective behaviors may support long-term bone health before clinically significant complications occur (Chan et al., 2022).

METHOD

Design

This study employed a quantitative one-group pre-test–post-test design to assess changes in participants' osteoporosis-related knowledge following an educational intervention. Participants completed the same structured questionnaire immediately before and after the osteoporosis prevention program, allowing within-participant comparison of knowledge scores across the two assessment points. The design was used to quantify the magnitude and direction of change in osteoporosis-related knowledge following the intervention without a parallel control group. The findings were therefore interpreted as changes associated with participation in the educational program rather than as definitive evidence of a causal effect.

Setting and Time

The study was conducted in the Medical Rehabilitation Unit of R.T. Notopuro Regional General Hospital, Sidoarjo, East Java, Indonesia, in June 2025. Participants attended an osteoporosis prevention education activity delivered within the hospital setting.

Population, Sample, and Sampling

The study population consisted of patients and individuals accompanying patients who were present at the Medical Rehabilitation Unit of R.T. Notopuro Regional General Hospital, Sidoarjo, during the osteoporosis prevention activity. A total of 20 participants were enrolled in the study. Participants were recruited through purposive sampling, in which individuals were selected from the target population for their presence in the study setting and relevance to the objectives of the osteoporosis prevention program. This sampling approach was used to obtain participants who could appropriately receive the educational intervention and complete both the pre-test and post-test assessments. The final sample comprised 20 participants who participated in the osteoporosis prevention education activity and were included in the evaluation.

Intervention

The intervention consisted of an educational session and a practical exercise program focusing on osteoporosis prevention. The educational component addressed the definition of osteoporosis, possible clinical manifestations, risk factors, and preventive strategies. Practical recommendations for reducing the risk of osteoporosis were also presented.

Osteoporosis was explained to participants as a condition characterized by reduced bone density and an increased risk of fracture. The educational material also emphasized the clinically silent nature of osteoporosis during its early stages, which can result in affected individuals remaining unaware of the condition until a fracture occurs.

A practical osteoporosis prevention exercise session was subsequently conducted. The exercise program included low-impact physical movements intended to strengthen muscles, improve balance, and enhance flexibility. The movements were selected to facilitate participation, including participation by individuals with physical limitations.

Instrument and Measurement Properties

Participants' knowledge of osteoporosis was assessed using a structured seven-item questionnaire administered before and after the educational intervention. The questionnaire was designed to capture key domains relevant to osteoporosis prevention, including the definition and basic understanding of osteoporosis, populations at increased risk, recognized risk factors, preventive measures, frequency of physical activity or exercise, prior awareness of osteoporosis-specific exercise, and perceptions regarding the importance of osteoporosis prevention. The instrument provided a brief assessment of participants' baseline knowledge and prevention-related awareness while allowing changes following the intervention to be evaluated using the same set of items.

The pre-test was administered electronically through Google Forms immediately before the educational session. Participants completed the identical questionnaire after the osteoporosis education and exercise program as a post-test. Administering the same items at both assessment points ensured consistent item content and facilitated direct comparison between pre- and post-intervention responses. Knowledge-based items were evaluated by the proportion of correct responses, with higher post-test scores indicating greater osteoporosis-related knowledge following the educational activity. The questionnaire also contained items addressing physical activity and awareness of osteoporosis exercise, which represented prevention-related behavioral or awareness domains rather than purely factual knowledge.

Data Collection Procedure

Data collection was conducted sequentially during the osteoporosis prevention program at the Medical Rehabilitation Unit of R.T. Notopuro Regional General Hospital. Participants first received information about the study procedures. They completed a 7-item pre-test electronically via Google Forms to assess baseline knowledge of osteoporosis, including its definition, potential symptoms, risk factors, and preventive measures. The educational session was delivered immediately following completion of the baseline assessment and covered the definition and characteristics of osteoporosis, possible clinical manifestations, major risk factors, and recommended preventive strategies. Practical guidance on reducing the risk of osteoporosis was incorporated into the educational material to facilitate participants' understanding and adoption of preventive behaviors. Participants subsequently took part in a structured osteoporosis prevention exercise session consisting primarily of low-impact movements designed to strengthen muscles, improve balance, and enhance flexibility. The same questionnaire was administered as a post-test following completion of the educational and exercise sessions to evaluate changes in osteoporosis-related knowledge between the pre-intervention and post-intervention assessments.

Data Analysis

Data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were used to summarize participants' responses at the pre-test and post-test assessments, with categorical responses presented as frequencies and percentages of correct answers. Item-level changes were calculated as percentage-point differences to describe the magnitude of improvement across the assessed osteoporosis-related knowledge domains. Overall changes in knowledge scores between the pre-test and post-test assessments were examined using a paired-samples t-test, as both measurements were obtained from the same participants. The results of the paired analysis were reported as the mean paired difference, standard deviation (SD), standard error (SE), t-statistic, degrees of freedom (df), 95% confidence interval (CI), and two-tailed p-value. Statistical significance was established at $p < 0.05$. This analytical approach enabled evaluation of both the descriptive pattern of knowledge improvement and the statistical significance of changes following the osteoporosis prevention intervention.

Ethical Declaration

This study received formal ethical approval from the Ethics Committee of the Public Health Program, Universitas STRADA Indonesia. All research procedures were designed and carried out in strict compliance with the ethical principles articulated in the Declaration of Helsinki, as well as relevant national and institutional regulations governing research involving human participants. Written informed consent was obtained from every participant prior to data collection, ensuring full disclosure of the study's purpose, methodology, anticipated benefits, potential risks, and the voluntary nature of participation, including the unreserved right to withdraw at any stage without penalty. Participant confidentiality was rigorously preserved throughout all phases of the research, and all collected data were anonymized and securely stored to prevent unauthorized access or identification.

RESULT

Participant Demographic Characteristics

The demographic characteristics of the 20 activity participants showed that most were older adults: 9 (45.0%) aged ≥ 60 years, 7 (35.0%) aged 50–59 years, and 4 (20.0%) aged 40–49 years. Female participants predominated, accounting for 14 (70.0%), while male participants accounted for 6 (30.0%). Regarding educational level, most participants had a senior high school education (7 participants; 35.0%), followed by elementary school (5 participants; 25.0%), junior high school (4 participants; 20.0%), and diploma/bachelor's degree (4 participants; 20.0%). In terms of occupation, homemakers were the largest group (8 participants; 40.0%), followed by retired individuals (6 participants; 30.0%), private employees (3 participants; 15.0%), entrepreneurs (2 participants; 10.0%), and civil servants (1 participant; 5.0%). By participant category, most were rehabilitation patients (12; 60.0%), while 8 (40.0%) were accompanying family members or caregivers. These characteristics indicate that the osteoporosis prevention education and exercise program primarily involved older adults and individuals closely connected to rehabilitation services, representing an appropriate target population for increasing awareness and preventive knowledge regarding osteoporosis.

Table 1. Demographic Characteristics of Activity Participants

Demographic Variable	Category	n (%)
Age (years)	40–49 years	4 (20.0)
	50–59 years	7 (35.0)
	≥60 years	9 (45.0)
Sex	Male	6 (30.0)
	Female	14 (70.0)
Educational Level	Elementary school	5 (25.0)
	Junior high school	4 (20.0)
	Senior high school	7 (35.0)
	Diploma/bachelor's degree	4 (20.0)
Occupation	Retired	6 (30.0)
	Housewife	8 (40.0)
	Private employee	3 (15.0)
	Entrepreneur	2 (10.0)
	Civil servant	1 (5.0)
Participant Category	Rehabilitation patients	12 (60.0)
	Accompanying family members/caregivers	8 (40.0)

Pre-Test and Post-Test Calculations for Extension Activities

The pre-test and post-test results demonstrate a clear improvement in participants' knowledge following the osteoporosis education activity. The mean percentage of correct responses increased from 38.33% on the pre-test to 80.83% on the post-test, representing an average improvement of 42.50 percentage points. This pattern is consistent with the questionnaire domains, which were designed to assess participants' understanding of osteoporosis, populations at increased risk, relevant risk factors, and preventive measures. Question 1, which assessed basic understanding of osteoporosis, increased from 50% to 100%, indicating that all participants were able to identify the appropriate concept after receiving education. Question 2, concerning groups at higher risk of osteoporosis, increased from 40% to 85%, corresponding to a 45-percentage-point improvement. Question 3, which addressed osteoporosis risk factors, showed a similarly substantial increase from 20% to 70%. These findings indicate that the educational session was particularly useful in strengthening participants' understanding of the fundamental concepts and risk profile of osteoporosis.

Improvement was also evident in participants' knowledge of preventive strategies. Question 4, which addressed measures to reduce osteoporosis risk, increased from 30% at pre-test to 70% at post-test, representing a 40-percentage-point improvement. This result corresponds directly with the educational content delivered during the intervention, which included information on osteoporosis prevention and practical recommendations for reducing risk. The intervention also incorporated osteoporosis prevention exercises designed to strengthen muscles, improve balance, and enhance flexibility through low-impact movements. Question 6, which assessed participants' awareness of osteoporosis exercises, showed one of the largest improvements, rising from 10% before the intervention to 60% afterward. The 50-percentage-point increase suggests that osteoporosis-specific exercise was relatively unfamiliar to participants before the program, while direct exposure to the exercise session substantially increased their awareness of this preventive approach.

Question 7 produced a different pattern from the other questionnaire items. The percentage of favorable responses was already relatively high at baseline, increasing from 80% at pre-test to 100% at post-test, with a smaller improvement of 20 percentage points. The high initial score suggests that most participants already recognized the importance of acquiring knowledge about osteoporosis prevention before attending the educational program. The post-test result indicates that this awareness became universal after the intervention. Question 5, which assessed the frequency of

participants' physical activity or exercise, is not included in the pre-test–post-test comparison table presented. Its omission is methodologically understandable if the item was treated as a behavioral characteristic rather than a knowledge item with a single correct answer. However, this rationale should be explicitly stated in the manuscript. Overall, the item-level results suggest that the largest educational gains occurred in areas with the lowest baseline knowledge, particularly osteoporosis risk factors and osteoporosis-specific exercise. In contrast, smaller gains occurred in areas where participants already demonstrated relatively high baseline awareness.

Table 2. Results of Pre-Test and Post-Test Calculations for Extension Activities

Question	Pre-test (%)	Post-test (%)	Difference
1	50	100	50
2	40	85	45
3	20	70	50
4	30	70	40
6	10	60	50
7	80	100	20
Mean	38.33	80.83	42.50

The paired-samples t-test demonstrated a statistically significant improvement in post-test scores compared with pre-test scores. The mean paired difference was 2.55 points (SD = 1.47), with a standard error of 0.33. The 95% confidence interval for the mean difference ranged from 1.86 to 3.24, indicating that the true average improvement was consistently greater than zero. This pattern supports a meaningful increase in participants' osteoporosis-related knowledge following the educational intervention.

Table 3. Paired Samples Test for Pre-test and Post-test Scores

Comparison	Mean Difference	SD	SE Mean	95% CI of the Difference	t	df	p
Post-test – pre-test	2.55	1.47	0.33	1.86–3.24	7.77	19	<.001

The inferential analysis confirmed that the observed improvement was statistically significant, $t(19) = 7.77$, $p < 0.001$. The degrees of freedom indicate that the analysis was based on 20 paired observations from participants who completed both the pre-test and post-test assessments. The very small p-value provides strong evidence that the post-test scores were higher than the pre-test scores beyond what would be expected from random variation alone. These findings indicate that the osteoporosis prevention education program was associated with a substantial improvement in participants' knowledge after the intervention.

DISCUSSION

The present study demonstrated a substantial improvement in osteoporosis-related knowledge following a combined education and preventive exercise program among patients and individuals accompanying patients in a medical rehabilitation setting. The descriptive findings showed that the mean proportion of correct responses increased from 38.33% on the pre-test to 80.83% on the post-test, representing an average improvement of 42.50 percentage points across the knowledge items included in the analysis. The participant-level paired-samples analysis provided additional statistical evidence of improvement, with a mean increase of 2.55 points and a 95% confidence interval ranging from 1.86 to 3.24 points. The observed difference was statistically significant, $t(19) = 7.77$, $p < 0.001$. These findings indicate that exposure to the osteoporosis prevention program was associated with

substantially higher knowledge immediately after the intervention. The magnitude and consistency of the improvement across multiple questionnaire domains suggest that a relatively brief, structured educational activity can address important gaps in osteoporosis awareness within a hospital-based population (McWilliam Ross & Gilder, 2023).

The pronounced improvement in basic knowledge of osteoporosis is consistent with previous research demonstrating that targeted health education can increase public understanding of chronic diseases that are frequently underrecognized before clinical complications occur. Osteoporosis presents a particular educational challenge because reduced bone density may progress without obvious symptoms until a fragility fracture develops. Limited symptom recognition can contribute to low perceived susceptibility, delayed preventive behavior, and insufficient engagement with bone-health screening (Elgzar et al., 2023). The increase in correct responses to the item assessing basic understanding of osteoporosis from 50% to 100% suggests that the educational content successfully clarified the fundamental nature of the condition. Similar educational approaches reported in osteoporosis prevention research have shown that structured, disease-specific education can substantially improve participants' knowledge and understanding of osteoporosis (Şahin et al., 2024).

Knowledge concerning populations at increased risk also improved markedly after the intervention, indicating that participants developed a broader understanding of osteoporosis susceptibility. The proportion of correct responses increased from 40% to 85% for the item addressing groups at higher risk, representing a 45-percentage-point improvement. This finding is clinically relevant because osteoporosis is commonly perceived as a condition affecting primarily older women, despite the presence of multiple demographic, clinical, nutritional, and lifestyle-related determinants of bone health (Wang et al., 2024). Previous osteoporosis-awareness studies have identified important gaps and misconceptions regarding sex, menopause, smoking, physical inactivity, nutritional factors, and other determinants of osteoporosis risk (Alhourri et al., 2022). Improved recognition of susceptible groups may enhance individual risk appraisal and encourage earlier engagement with preventive strategies. The remaining proportion of incorrect responses after the intervention also indicates that risk communication may require further reinforcement, particularly when participants are expected to distinguish between common stereotypes and scientifically established risk profiles.

The substantial increase in knowledge of osteoporosis risk factors provides further evidence that the program addressed an important baseline knowledge gap. Correct responses to the risk-factor item increased from 20% before the intervention to 70% after the intervention, corresponding to a 50-percentage-point improvement. Previous studies of osteoporosis awareness have frequently reported inadequate recognition of modifiable risk factors, including insufficient calcium and vitamin D intake, low levels of weight-bearing physical activity, smoking, excessive alcohol consumption, and lifestyle patterns that compromise bone health (Xue et al., 2025). Recognition of modifiable determinants is particularly important because preventive education becomes more actionable when participants understand which behaviors can be changed. The present findings suggest that the intervention improved participants' capacity to identify relevant risks, although 30% of responses remained incorrect after the program. This residual knowledge gap supports continued reinforcement through clear educational materials and individualized health-professional counseling to strengthen understanding and retention of more complex osteoporosis-related information (Ziyar et al., 2025).

Knowledge of osteoporosis prevention also improved following the educational activity, reinforcing the importance of translating disease awareness into practical preventive recommendations. Correct responses regarding preventive measures increased from 30% on the

pre-test to 70% on the post-test, representing a 40-percentage-point improvement. Scientific evidence on osteoporosis prevention consistently emphasizes adequate nutrition, sufficient intake of calcium and vitamin D, appropriate physical activity, maintenance of muscle strength, avoidance of smoking, moderation of alcohol consumption, and reduction of fall risk (Singer et al., 2023). Health education programs may be more effective at strengthening preventive intentions and behaviors when recommendations are translated into practical actions related to nutrition and physical activity rather than presented solely as abstract information (Jeihooni et al., 2022). The educational program in the present study incorporated practical recommendations alongside information about osteoporosis, which may have facilitated the observed improvement. The post-test percentage also suggests that a single educational exposure may not be sufficient to achieve a complete understanding of multifactorial prevention strategies.

The improvement in awareness of osteoporosis-specific exercise is among the most clinically meaningful findings, as baseline familiarity with this preventive approach was particularly low. Awareness increased from 10% before the intervention to 60% after participants received education and participated in low-impact exercises, producing a 50-percentage-point improvement. Exercise is an important component of osteoporosis prevention because appropriate physical activity contributes to musculoskeletal function, muscle strength, postural control, balance, and reduction of fall-related fracture risk (Bae et al., 2023). Previous intervention research also indicates that supervised exercise delivery may provide greater benefit than predominantly unsupervised approaches when participants are expected to perform osteoporosis-related physical activities correctly and consistently (Hoffmann et al., 2022). Direct participation in low-impact movements may have transformed an unfamiliar concept into an observable and reproducible preventive behavior. The persistence of 40% unfavorable responses after the session suggests that exercise education may benefit from repeated demonstrations, written exercise guidance, supervised follow-up, or individualized adaptations based on participants' functional capacity.

The comparatively small improvement in the perceived importance of osteoporosis prevention reflects a ceiling effect due to relatively high baseline awareness. Favorable responses increased from 80% at pre-test to 100% at post-test, corresponding to a 20-percentage-point improvement. High initial awareness indicates that most participants already considered osteoporosis prevention important, even though their detailed knowledge of disease mechanisms, risk factors, and preventive actions was considerably more limited. This discrepancy between general awareness and specific knowledge has also been reported in osteoporosis research, where individuals may be aware of the condition yet exhibit significant deficiencies in detailed disease-related knowledge (Ding et al., 2025). The finding emphasizes the distinction between perceived importance and functional health literacy. Effective osteoporosis prevention programs should therefore move beyond increasing general awareness and focus on providing specific knowledge and practical skills, including self-efficacy, planning, and commitment to preventive actions, that can support informed preventive behavior (Askarian et al., 2026).

The statistically significant paired-samples result strengthens the descriptive evidence by demonstrating that improvement occurred systematically at the participant level rather than only through changes in aggregated item percentages. The mean increase of 2.55 points, accompanied by a relatively narrow 95% confidence interval of 1.86 to 3.24, indicates a consistent positive shift in knowledge scores within the study sample. Previous educational intervention studies have similarly demonstrated significant short-term improvements in osteoporosis knowledge after structured counseling, educational media, group teaching, or other structured educational activities (Hauser et al., 2026; Peksoy-Kaya et al., 2024). Statistical significance should nevertheless be interpreted within the context of the study design. The absence of a control group prevents separating the

intervention effect from potential testing effects, attention effects, or other influences that may occur between the two assessments. The findings therefore support an association between participation in the program and increased knowledge rather than definitive evidence that the intervention alone caused the observed change.

The findings have practical implications for osteoporosis prevention within rehabilitation services and other outpatient healthcare settings. Medical rehabilitation units provide an appropriate environment for preventive education because patients and accompanying family members may already be engaged with issues related to mobility, musculoskeletal function, disability prevention, or healthy aging. Integrating concise osteoporosis education with practical, low-impact exercise may offer a feasible approach to expanding preventive services without requiring complex technology or extensive resources (Ziebart et al., 2025). Educational content could prioritize domains with the lowest baseline performance, particularly risk factors, preventive strategies, and osteoporosis-specific exercise. Future programs could incorporate repeated sessions, printed or digital educational materials, exercise demonstrations, reminder systems, and follow-up assessments to determine whether improvements in knowledge are retained and translated into sustained preventive behaviors (Newman et al., 2025).

Several methodological limitations should be considered when interpreting these findings. The study included only 20 participants recruited purposively from a single hospital-based setting, which limits statistical precision and restricts generalizability to broader populations. The one-group pre-test–post-test design lacked a comparison group, leaving the study vulnerable to testing effects and other threats to internal validity (Bierer et al., 2025). The post-test was administered immediately after the intervention, meaning that the findings primarily reflect short-term knowledge acquisition rather than long-term retention. The seven-item questionnaire provided a brief assessment, although comprehensive evidence regarding its psychometric validity and reliability was not established in the available study documentation. The importance of using formally validated osteoporosis-knowledge instruments is demonstrated by recent psychometric research evaluating internal consistency, test–retest reliability, item difficulty, discrimination, and other measurement properties (Chellamuthu et al., 2025). Administration of identical questions at pre-test and post-test may also have increased participants' familiarity with the items. Question 5 assessed physical activity frequency and was not included in the item-level correct-response comparison because it represented a behavioral characteristic rather than a conventional knowledge item. The intervention combined health education with practical exercise, preventing the determination of the independent contribution of each component. Future research should employ larger samples, validated measurement instruments, comparison groups, longer follow-up periods, and behavioral or clinical outcomes to determine whether improved knowledge leads to sustained physical activity, healthier bone-related behaviors, reduced fall risk, or other meaningful osteoporosis-prevention outcomes.

CONCLUSION

The osteoporosis prevention education program was associated with a meaningful improvement in participants' knowledge of osteoporosis, including its fundamental characteristics, risk factors, preventive strategies, and the role of osteoporosis-specific exercise. The findings support the potential value of integrating structured health education with practical exercise demonstrations in medical rehabilitation services as an accessible strategy to strengthen osteoporosis-related health literacy and preventive awareness. The interpretation of these findings should remain cautious because the study involved a small purposively selected sample from a single setting, lacked a control group, and assessed outcomes immediately after the intervention.

Future studies should evaluate the intervention in larger, more diverse populations, using validated measurement instruments, comparison groups, and longer follow-up periods to determine whether improvements in knowledge are sustained and translated into preventive behaviors and clinically relevant outcomes.

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CONFLICT OF INTEREST

None.

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