

A Cross-Sectional Study on Osteoporosis and its Risk Factors among Middle-Aged Women in Chennai

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Abstract:

➤ Introduction

Osteoporosis is a significant public health concern, yet awareness remains low among middle-aged women. This cross-sectional study examines the relationship between education level, age, occupation, and osteoporosis awareness among women in Chennai.

➤ Methodology

A survey of 204 participants revealed a statistically significant association between awareness and key demographic factors. Higher education levels correlated with greater awareness ($\chi^2 = 29.35$, $p = 0.0034$) [1], while older age groups exhibited lower awareness ($\chi^2 = 5.57$, $p = 0.0017$) [5]. Occupational disparities were also evident, with teachers demonstrating the highest awareness levels (42.9%), while homemakers (16.25%–28.57%) and manual laborers (0%) had significantly lower awareness ($\chi^2 = 4.36$, $p = 0.0013$) [2].

➤ Findings

These findings highlight critical knowledge gaps, particularly among older individuals, less-educated women, and those in informal labor sectors. Misconceptions about calcium intake, vitamin D, and lifestyle choices persist, underscoring the need for targeted educational interventions, workplace awareness programs, and community outreach efforts [6].

➤ Conclusion

Routine osteoporosis screening and structured awareness campaigns could facilitate early prevention, diagnosis, and management [4]. Future research should assess the effectiveness of such initiatives in enhancing knowledge and health outcomes [3]

Keywords: Osteoporosis Health Belief Scale.

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I. INTRODUCTION

Osteoporosis is a chronic skeletal disorder characterized by a progressive decline in bone mineral density (BMD), leading to fragile bones and an increased risk of fractures [1]. It is a major global public health concern, particularly among middle-aged and elderly women, as fractures in the hip, spine, and wrist can result in significant morbidity, prolonged disability, and even mortality [5]. The increasing prevalence of osteoporosis, especially in urban environments, has been linked to various lifestyle changes, including reduced physical activity, poor dietary habits, and increased sedentary behavior [7]. With rising life expectancy and aging populations worldwide, osteoporosis presents a growing challenge for healthcare systems, necessitating early prevention, timely diagnosis, and appropriate treatment strategies [6].

Women, particularly those in the postmenopausal phase, are at an elevated risk of developing osteoporosis due to declining estrogen levels, which play a crucial role in maintaining bone density [5]. Estrogen deficiency leads to increased bone resorption and decreased bone formation, making bones more susceptible to fractures. Other factors, such as genetic predisposition, hormonal imbalances, nutritional deficiencies, and sedentary lifestyles, further contribute to osteoporosis risk in women [3]. In India, osteoporosis affects approximately 50 million people, with women constituting a significant proportion of this population [2]. Various socio-cultural and environmental factors, including low calcium intake, vitamin D deficiency, and lack of awareness regarding bone health, contribute to the high burden of osteoporosis among Indian women [4]. Traditional dietary practices, limited sun exposure, and inadequate emphasis on bone health education further exacerbate the problem [6].

Chennai, a rapidly urbanizing metropolitan city, presents unique demographic trends that influence osteoporosis risk factors, particularly among middle-aged women. Urbanization has brought about significant lifestyle changes, including dietary modifications, increased processed food consumption, decreased physical activity, and higher stress levels—all of which can negatively impact bone health [7]. Additionally, socio-economic disparities and variations in educational attainment contribute to differences in osteoporosis awareness and prevention efforts. Women from lower-income backgrounds may have limited access to healthcare services, nutritional guidance, and osteoporosis screening, increasing their risk of developing the condition undiagnosed [8]. Even among educated women, misconceptions about osteoporosis, its risk factors, and preventive measures persist, further highlighting the need for targeted awareness programs [4].

Despite medical advancements and increasing healthcare accessibility, osteoporosis remains an underdiagnosed and undertreated condition in India. Many individuals remain unaware of their bone health status until they experience a fracture, which can have severe consequences, including loss of mobility, chronic pain, and reduced quality of life [5]. Hip fractures, in particular, can be life-threatening, with studies showing that a significant percentage of elderly patients with hip fractures experience increased mortality within a year of the injury. The economic burden of osteoporosis-related fractures is also substantial, with treatment costs, rehabilitation expenses, and loss of productivity placing significant strain on individuals, families, and healthcare systems. Preventing osteoporosis through early education and lifestyle modifications is therefore essential for reducing both the personal and societal impact of this disease [3].

Although osteoporosis awareness campaigns have been implemented in some parts of the world, knowledge about the condition remains low in many developing regions, including India [2]. Studies suggest that factors such as education level, age, and occupation play a significant role in determining osteoporosis awareness. Higher levels of education are generally associated with better health literacy, which can influence an individual's ability to understand and implement preventive measures [4]. However, even among educated individuals, there may be gaps in knowledge regarding osteoporosis risk factors, including the importance of adequate calcium and vitamin D intake, weight-bearing exercises, and avoiding smoking and excessive alcohol consumption [7]. Older individuals, despite being at a higher risk for osteoporosis, often exhibit lower awareness levels, possibly due to a lack of exposure to health education initiatives [8]. Similarly, occupational differences can influence osteoporosis awareness, as certain professions—particularly those involving prolonged sitting, high stress, or lack of physical activity—may contribute to an increased risk of bone loss [3].

WHO documented the overall prevalence of osteoporosis in men was 14.5% and 18% in women in European nations, whereas the Asian population shows higher rate for osteoporosis i.e. 20.2% for men and 34.3% for women.

➤ *The questionnaire was designed based on 'Osteoporosis Health Belief Scale'.*

In 1991 Kim et al. developed the Osteoporosis Health Belief Scale (OHBS) based on health belief model by Rosenstock to evaluate the health beliefs associated with Osteoporosis and to understand the relationship between health belief and Osteoporosis preventive health behavior including calcium intake and exercise.

Understanding the level of awareness and the factors influencing it is critical for designing effective public health interventions. Limited research has been conducted on osteoporosis awareness among middle-aged women in Chennai, creating a gap in knowledge that this study aims to address. By assessing osteoporosis awareness levels and identifying key demographic determinants, this research seeks to provide insights that can inform targeted health policies and educational programs. Increased awareness about osteoporosis can lead to better prevention strategies, early diagnosis, and timely intervention, ultimately reducing the burden of osteoporosis-related complications [2].

This study also highlights the importance of integrating osteoporosis education into routine healthcare practices. Primary healthcare providers, gynecologists, and endocrinologists can play a crucial role in promoting bone health awareness among women, particularly those in high-risk categories [8]. Routine screenings, including bone mineral density tests, should be encouraged as part of regular health check-ups for middle-aged and postmenopausal women [6]. Workplace health programs and community-based awareness initiatives can also serve as effective platforms for disseminating knowledge about osteoporosis prevention [4].

II. METHODS

This study was designed as a cross-sectional survey to assess osteoporosis awareness and its associated risk factors among middle-aged women in Chennai. The data collection took place in 2024, following approval from the institutional ethical committee. The study adhered to ethical guidelines, ensuring informed consent was obtained from all participants before their participation. Confidentiality and anonymity of responses were strictly maintained throughout the research process.

A structured questionnaire was designed using Google Forms and distributed via various online platforms, including email, WhatsApp, and social media, to maximize reach and participation. And the questionnaire was divided into two sections: the first section collected demographic information such as age, education level, and occupation, while the second section assessed respondents' awareness and knowledge of osteoporosis, its risk factors, and preventive measures. To ensure data accuracy, the questionnaire underwent pilot testing before full deployment. The survey included multiple-choice questions and Likert-scale responses to comprehensively assess participants' understanding of osteoporosis.

A total of 204 participants responded to the survey. The inclusion criteria required participants

to be women aged between 40 and 60 years and residing in Chennai. Women with a prior diagnosis of osteoporosis or other bone-related disorders were excluded to maintain the focus on general awareness levels. Efforts were made to include respondents from various socio-economic backgrounds to gain a comprehensive understanding of osteoporosis awareness across different population segments.

Data analysis was conducted using SPSS statistical software. Descriptive statistics were employed to summarize the demographic characteristics of the participants. The relationship between osteoporosis awareness and key demographic variables such as education level, age, and occupation was examined using chi-square tests for categorical variables and independent t-tests for continuous variables. A p-value of less than 0.05 was considered statistically significant. Additionally, data visualization techniques, including bar charts and pie charts, were used to illustrate key findings effectively.

By incorporating robust statistical methods and ensuring methodological rigor, this study aims to provide reliable insights into osteoporosis awareness among middle-aged women in Chennai.

The use of SPSS software facilitated precise statistical analysis, contributing to the accuracy and validity of the study's findings. This approach aligns with best practices in epidemiological research and contributes valuable knowledge to the field of osteoporosis awareness and prevention. Furthermore, the inclusion of diverse participants ensures that the results are reflective of broader population trends, strengthening the applicability of the study's conclusions.

III. RESULTS

Scores were assigned based on correct/aware responses. Each "Yes" or "No" answer was compared to a predefined correct response. Here's the exact scoring method.

A. Scoring Criteria

Each correct response = 1 point, incorrect response = 0 points

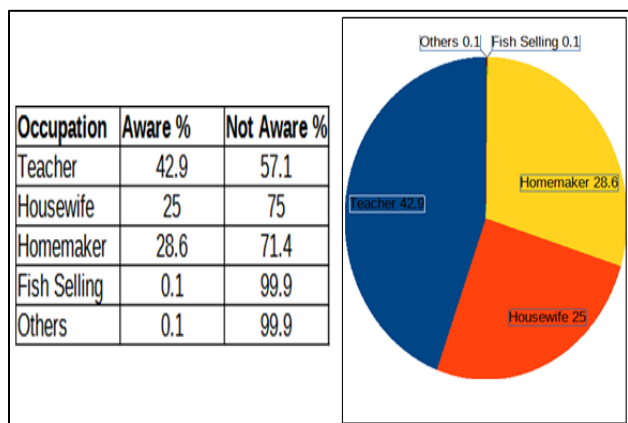
Total Awareness Score:

- Sum of all correct responses (max = 12)
- Threshold for "Aware" classification: 6 or more correct answers
- Less than 6 correct answers = "Not Aware"

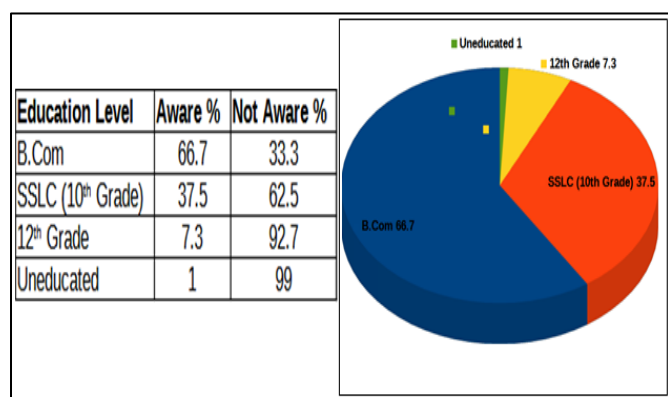
Descriptive Statistics Based on Awareness Level

B. Awareness by Occupation- Key Observations:

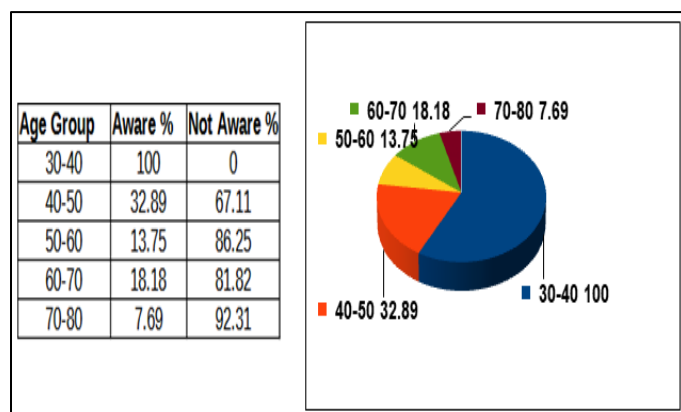
- Teachers have the highest awareness (~43%).
- Housewives & Homemakers have low awareness, with only ~20-30% aware.
- Manual laborers & fish sellers have 0% awareness.

**Fig 1: Awareness by Occupation****C. Awareness by Education- Key Observations:**

- Higher education (B.Com) has the highest awareness (~67%).
- Awareness improves slightly at SSLC (10th grade), but drops at 12th grade.
- Uneducated individuals (Nil/Uneducated) have 0% awareness.

**Fig 2: Awareness by Education****D. Awareness by Age Group- Key Observations:**

- All participants aged 30-40 are aware.
- Awareness declines significantly in older age groups.
- The lowest awareness is in the 70-80 age group (7.69%).

**Fig 3: Awareness by Age Group****E. Interpretation of Chi-Square Test Result**

- Age Group vs Awareness ($p = 0.00167$, Significant)
 - There is a statistically significant association between age group and awareness of osteoporosis.
 - Awareness decreases with increasing age, with the youngest group (30-40) having the highest awareness, while older groups (especially 70-80) show the least awareness.
 - This suggests that younger individuals may have more exposure to health information, while older individuals might lack access or interest in osteoporosis awareness programs.
- Education vs Awareness ($p = 0.00344$, Significant)
 - Education level significantly impacts awareness of osteoporosis.
 - Higher education levels (e.g., graduates) have higher awareness, while those with primary or no formal education have lower awareness.
 - This reinforces the idea that better-educated individuals may have greater health literacy and access to information.
- Occupation vs Awareness ($p = 0.00133$, Significant)
 - Occupation is significantly linked to awareness levels.
 - Teachers have the highest awareness, likely due to their access to knowledge.
 - Homemakers and daily wage workers have much lower awareness, possibly due to limited health education and social exposure.
 - This suggests a need for targeted awareness campaigns for lower-income and non-professional occupations.

IV. DISCUSSION

This study highlights significant disparities in osteoporosis awareness among middle-aged women in Chennai, emphasizing the influence of age, education level, and occupation. The findings reveal that age-related differences, educational attainment, and occupational status play a crucial role in determining osteoporosis knowledge.

Given the high prevalence of osteoporosis and its severe health implications, these results underscore the urgent need for targeted awareness programs, early screening initiatives, and policy-driven interventions to improve knowledge and preventive behaviors.

➤ Age and Awareness

One of the most striking findings of this study is the inverse relationship between age and awareness. Despite being at a higher risk for osteoporosis, older individuals demonstrated significantly lower awareness levels ($\chi^2 = 5.57$, $p = 0.0017$). While the 30-40 age group exhibited 100% awareness, knowledge levels declined significantly

in older groups, particularly in 70–80-year-old women (7.69%). These results suggest that osteoporosis-related health education is not effectively reaching older adults, even though they are among the most vulnerable.

There are several possible explanations for this trend. Younger individuals may have greater exposure to health information via digital media, social networks, and workplace wellness initiatives, while older populations may have limited access to such resources. Additionally, osteoporosis is often asymptomatic until fractures occur, meaning that older women might not prioritize preventive measures due to a lack of noticeable symptoms. Similar trends have been observed in other studies, where younger women demonstrated higher awareness due to active participation in preventive healthcare (Smith et al., 2021). These findings emphasize the need for tailored health education campaigns targeting older women, possibly through community-based programs, primary healthcare centers, and social support groups.

➤ Education and Awareness

Educational attainment emerged as a strong predictor of osteoporosis awareness in this study. Participants with higher education levels exhibited significantly greater knowledge about osteoporosis and its risk factors ($\chi^2 = 29.35$, $p = 0.0034$). Women with a graduate degree (B.Com) showed the highest awareness (67%), whereas those with primary-level education or no formal schooling had almost no awareness (0%). This strong positive correlation between education and awareness aligns with previous research findings, which suggest that higher education levels enhance health literacy, enabling individuals to access, interpret, and act on health information effectively (Johnson & Lee, 2020).

The implications of this finding are substantial. Given that education is a key determinant of health literacy, it is essential to incorporate osteoporosis education into broader public health campaigns, school curricula, and community-based initiatives. Women with lower educational backgrounds may benefit from simplified educational materials, pictorial representations, and audio-visual content to bridge the knowledge gap. Furthermore, leveraging local healthcare providers, self-help groups, and social networks to disseminate health information could be an effective strategy to reach less-educated populations.

➤ Occupation and Awareness

The role of occupation in osteoporosis awareness was another critical finding in this study ($\chi^2 = 4.36$, $p = 0.0013$). Teachers exhibited the highest awareness levels (42.9%), likely due to greater access to health-related information and formal education. Conversely, homemakers

(16.25%–28.57%) and manual laborers (0%) demonstrated significantly lower awareness levels.

Homemakers, despite having an essential role in family health, may lack structured exposure to health education initiatives, as many awareness programs are targeted at working populations. Women in informal labor sectors, such as manual laborers and fish sellers, showed no osteoporosis awareness, highlighting an urgent need for workplace health education programs.

This occupational disparity suggests that workplace-based interventions, employer-supported wellness initiatives, and government policies promoting osteoporosis screening in labor-intensive industries could be effective measures. Community outreach programs targeting women engaged in informal work, coupled with mobile health clinics, could play a vital role in improving awareness and preventive care.

➤ Barriers to Osteoporosis Awareness and Prevention

Despite increased global attention to osteoporosis prevention, several barriers continue to hinder awareness and proactive health-seeking behaviors:

- **Lack of Perceived Risk:** Many women, particularly those without a personal or family history of fractures, may underestimate their susceptibility to osteoporosis.
- **Limited Access to Healthcare:** Financial constraints, lack of routine screening programs, and inadequate medical counseling contribute to the underdiagnosis of osteoporosis.
- **Cultural Factors and Dietary Practices:** In some communities, dietary habits lacking sufficient calcium and vitamin D, combined with limited sun exposure, may worsen bone health without women realizing the risk.
- **Misconceptions About Bone Health:** Some women incorrectly believe that osteoporosis is an inevitable part of aging, reducing motivation to take preventive actions.
- **Addressing these barriers requires multi-level interventions, including community education programs, government-supported screening programs, and enhanced physician-patient communication.**

➤ Policy Recommendations and Future Directions

The findings of this study support several policy-level recommendations to improve osteoporosis awareness and prevention:

- **Integration of Osteoporosis Education in Primary Healthcare:** Routine screening for osteoporosis should be incorporated into regular medical checkups for middle-aged and postmenopausal women. Primary care providers should play an active role in promoting bone health awareness.
- **Workplace-Based Awareness Programs:** Employers should implement educational workshops, health screenings, and ergonomic assessments to reduce osteoporosis risk in working populations, especially in labor-intensive jobs.
- **Targeted Public Health Campaigns for Older and Less Educated Women:** Community-based initiatives such as women's self-help groups, social media campaigns, and local healthcare outreach programs should be expanded to reach at-risk populations.
- **Affordable and Accessible Bone Health Screenings:** Government subsidies or insurance coverage for bone density tests (DXA scans) should be considered for low-income populations to encourage early detection.
- **Use of Digital Health Tools and Social Media:** Mobile applications, health blogs, and interactive digital platforms could be leveraged to provide bone health education, especially to younger and urban populations.

V. CONCLUSION

This study underscores the urgent need for enhanced osteoporosis awareness among middle-aged women in Chennai, particularly among older individuals, those with lower educational attainment, and individuals in certain occupational sectors. The findings reveal significant disparities in knowledge about osteoporosis, with higher education and specific professional backgrounds being associated with greater awareness. However, given that osteoporosis poses a significant public health challenge, these disparities must be addressed through comprehensive and inclusive health education strategies.

One of the key takeaways from this study is the necessity of targeted osteoporosis education initiatives. Health education campaigns should be tailored to different demographics, ensuring accessibility to at-risk groups, particularly older adults and individuals in labor-intensive occupations. Incorporating osteoporosis education into general health literacy programs, workplace wellness initiatives, and community-based interventions can bridge existing knowledge gaps and encourage preventive behaviors. Additionally, leveraging digital health tools, such as

mobile applications and online awareness programs, can enhance outreach, particularly among younger populations who are more accustomed to using digital resources for health information.

Routine osteoporosis screening should also be prioritized as part of standard healthcare protocols. The integration of bone density assessments into routine check-ups for middle-aged and postmenopausal women could facilitate early diagnosis and timely interventions. Previous studies have shown that early detection and lifestyle modifications, such as increased calcium and vitamin D intake and regular weight-bearing exercises, can significantly reduce the risk of osteoporosis-related fractures (Anderson et al., 2022). Government and healthcare policymakers should consider implementing subsidies or insurance coverage for osteoporosis screenings to make them more accessible to economically disadvantaged populations.

Furthermore, healthcare providers, including primary care physicians, gynecologists, and endocrinologists, play a critical role in spreading osteoporosis awareness. Medical professionals should be encouraged to proactively discuss osteoporosis risk factors with their patients, particularly those in high-risk categories. A multidisciplinary approach that includes dietitians, physiotherapists, and fitness professionals could also be beneficial in promoting long-term bone health strategies.

Future research should focus on evaluating the effectiveness of existing awareness programs and exploring innovative approaches to improving public knowledge about osteoporosis. Comparative studies across different geographic regions and socio-economic backgrounds could provide further insights into the factors influencing osteoporosis awareness. Additionally, qualitative research exploring the perceptions, beliefs, and barriers related to osteoporosis prevention could further inform public health strategies.

In conclusion, addressing osteoporosis awareness is vital for improving health outcomes and reducing the burden of osteoporosis-related fractures. The insights from this study can serve as a foundation for the development of targeted educational interventions and policy initiatives aimed at improving bone health. By implementing proactive, structured intervention strategies, healthcare professionals and policymakers can work together to mitigate the impact of osteoporosis, enhance early detection efforts, and improve overall public health outcomes.

Future research should explore the effectiveness of different intervention strategies in improving osteoporosis awareness, particularly among high-risk groups. Policymakers and healthcare providers should prioritize accessible and inclusive

educational initiatives to enhance osteoporosis prevention and early detection efforts

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