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Prevalence of Osteoporosis and Its Correlation With Common Secondary Risk Factors in Population from Rural Areas of South India

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Abstract

Background. Osteoporosis is a common metabolic disorder characterised by decreased bone mass and weakened micro-architecture of bone tissue. After 50 years of age, one in three women and one in five men experience osteoporotic fractures. This is projected to cause a yearly loss of 5.8 million healthy life years to disability. The number of patients who attend the outpatient clinic and emergency department of Sanjay Gandhi Institute of Trauma and Orthopaedics with fragility fractures has been increasing, hence to know the prevalence of osteoporosis in the general population who were asymptomatic, we decided to conduct a study in the rural areas of south India.

Aims: 1) to estimate the prevalence of osteoporosis among the population above 50 years in rural areas of south India; 2) to determine the correlation between common secondary risk factors for osteoporosis like tobacco consumption, alcohol, diabetes, and hypertension.

Results. The prevalence of osteoporosis in the rural population was more in females at 42.2%, whereas the males had a prevalence of 32.5%. Among the population with habits of tobacco consumption and alcohol consumption, the prevalence was 78% and 30.6% respectively. 20.2% of non-smokers and 39.7% of non-alcoholics were osteoporotic. Among the population with comorbidities, 53.6% of diabetes and 55.4% of hypertensives were osteoporotic. 33.7% of non-diabetics were osteoporotic, and 29.5% of hypertensives were osteoporotic. The correlation between osteoporosis and the individual risk factors ranged between weak negative to moderately positive ($r = -0.2$ to 0.5). The correlation between the combination of all the four risk factors and osteoporosis is weakly positive ($r = 0.339$), which is highly significant ($p<0.001$).

Conclusion. Overall, the findings of this study suggest that addictive habits such as tobacco and alcohol consumption may have a significant impact on bone health, with a higher prevalence of osteopenia and osteoporosis observed in individuals with these habits. Comorbidities such as diabetes and hypertension were also found to be associated with a higher prevalence of osteoporosis. These findings emphasize the importance of early detection and prevention of addictive habits and comorbidities to reduce the risk of osteopenia and osteoporosis. Furthermore, the study highlights the need for further research to fully understand the complex relationships between sociodemographic factors, addictive habits, comorbidities, and bone health.

Keywords: osteoporosis, alcohol, tobacco consumption, diabetes, hypertension.

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Распространенность остеопороза в сельских районах Южной Индии и его связь с общими вторичными факторами риска

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Реферат

Актуальность. Остеопороз — распространенное метаболическое расстройство, характеризующееся уменьшением массы костной ткани и ослаблением микроархитектуры костей. После 50 лет каждая третья женщина и каждый пятый мужчина сталкиваются с остеопоротическими переломами. Это приводит к ежегодной потере 5,8 млн лет здоровой жизни (HLY) из-за инвалидности. Количество пациентов, обращающихся в поликлинику и отделение неотложной помощи Института травматологии и ортопедии им. Санджая Ганди с патологическими переломами, из года в год увеличивается. Чтобы определить распространенность остеопороза среди населения, не имеющего симптомов данного заболевания, мы решили провести исследование в сельских районах Южной Индии.

Цели исследования: 1) оценить распространенность остеопороза среди населения старше 50 лет в сельских районах Южной Индии; 2) определить связь между общими вторичными факторами риска остеопороза, такими как употребление табака и алкоголя, диабет, гипертония.

Результаты. Распространенность остеопороза в сельских районах была выше у женщин и составила 42,2%, в то время как у мужчин распространенность составила 32,5%. Среди лиц, употребляющих табак и алкоголь, распространенность составила 78,0% и 30,6% соответственно. Остеопороз был выявлен у 20,2% некурящих и у 39,7% не употребляющих алкоголь. Среди лиц с сопутствующими заболеваниями остеопороз выявлен у 53,6% диабетиков и 55,4% гипертоников. Связь между остеопорозом и отдельными факторами риска колебалась от слабо отрицательной до умеренно положительной (r = -0,2 до 0,5). Связь между комбинацией всех четырех факторов риска и остеопорозом была слабо положительной (r = 0,339) и имела высокую значимость (p<0,001).

Заключение. Результаты данного исследования свидетельствуют о значительном влиянии вредных привычек, таких как употребление табака и алкоголя, на здоровье костей, с более высокой распространенностью остеопении и остеопороза у лиц с этими привычками. Сопутствующие заболевания, такие как диабет и гипертония, также связаны с более высокой распространенностью остеопороза. Эти свидетельствует о важности раннего выявления сопутствующих заболеваний и отказа от вредных привычек для снижения риска развития остеопении и остеопороза. Необходимы дальнейшие исследования для полного понимания сложных взаимосвязей между социодемографическими факторами, привычками, сопутствующими заболеваниями и здоровьем костей.

Ключевые слова: остеопороз, остеопения, алкоголь, табакокурение, диабет, гипертония.

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INTRODUCTION

Osteoporosis is a common metabolic disorder characterised by decreased bone mass and weakened micro-architecture of bone tissue. This makes the bone highly prone to pathological fractures [1, 2]. It is only after the fracture that the condition is diagnosed more often, and measurement of Bone Mineral Density (BMD) can diagnose "osteoporosis" and identify the population at risk for fractures [1, 3].

The global burden of osteoporosis is enormous. It has been recognised as a worldwide epidemic. In 2014 journal "Osteoporosis International" estimated osteoporosis to be one of the leading causes of disability, depression, and early mortality in the elderly. After age 50, one in three women and one in five men experience osteoporotic fractures. This is projected to cause a yearly loss of 5.8 million healthy life years to disability. There is about a 30 % rise in mortality in the first year after fracture, which remains high for up to 5 years.

The economic burden has been 37 billion EUR in the EU and 19 billion USD in the USA [4]. In 2014, it was reported in Europe that socioeconomic status and poverty have a bearing on the prevalence of Osteoporosis [5].

Having a different landscape, India has a different socio-economy and lifestyle. Even within the country, there is much diversity between urban and rural life. In 2012 C. Rex estimated that osteoporosis would affect half of the Indian population by 2022 [6].

The USA and Europe have been significant contributors to research in osteoporosis, with 27,0% and 8.2% of global publications, respectively. India could merely contribute 2% of the world's research on osteoporosis [7]. An article in 2015 reviewed a few sporadic studies on Osteoporosis in Indian women and noted a high prevalence of the disease in postmenopausal women.8

Sanjay Gandhi Institute of Trauma and Orthopaedics is a tertiary care hospital. The number of patients who attend the outpatient clinic and emergency department of Sanjay Gandhi Institute of Trauma and Orthopaedics with fragility fractures has been increasing, hence to know the prevalence of osteoporosis in the general population who were asymptomatic, we decided to conduct a study in the rural areas of south India.

Aims: 1) to estimate the prevalence of osteoporosis among the population above 50 years in rural areas of south India; 2) to determine the correlation between common secondary risk factors for osteoporosis like tobacco consumption, alcohol, diabetes, and hypertension.

METHODS

Design

A cross-sectional study on the prevalence of osteoporosis was planned over one year (i.e., September 2021 to august 2022) as there was an increased incidence of fragility fractures in the population attending the outpatient clinic and emergency department. Ten random villages were selected by cluster sampling in villages from Karnataka, Andhra Pradesh, and Tamilnadu. In each village, 100 people aged 50 years to 100 years were enrolled on the study.

Inclusion criteria: men and women aged 50 and above.

Exclusion criteria: patients having other causes affecting bone strength like malignancy; Paget's disease; congenital disorders; osteomyelitis etc.

Consenting participants were interviewed and examined. The tools used in this study were a two-part proforma and BMD measuring portable SONOST 3000 Ultrasound machine.

The Sonost 3000 bone densitometer uses ultrasound technology to measure bone density, transmitting high-frequency sound waves through the bone and measuring how much of the wave is absorbed; it is a portable and lightweight machine, weighing only about 4 pounds, and can be operated with a rechargeable battery, making it convenient for use in remote or mobile settings. A quality assurance test for the device was performed on each screening day. The measurements were carried out in a room by a single technician to complete the entire test on all the subjects.

Those subjects with low BMD were classified accordingly as Osteopenia (BMD -1 to -2.5) or Osteoporosis (BMD -2.5 or less).

Statistical analysis

The data was analysed using SPSS 28 software. Pearson correlation coefficient test examined the correlation between variables. $P<0.05$ was used as the threshold to determine statistical significance, meaning that results with a p-value less than 0.05 were considered statistically significant. This methodology allows for identifying relationships and trends within the data and determining the statistical significance of these relationships.

RESULTS

Socio-demographic factors

The total number of subjects considered in the study was 1000: 536 males (53.6%) and 464 females (46.4%). Most of the people who participated in the study were 50-60 years old, accounting for 52.9%, followed by 60-69 years (22.6%), 70-79 years (19.7%), 80-89 years (3.7%), and 90-99 years (1.1%).

Addictive habits and comorbidities

Habits that were considered in the study: tobacco consumption (smoking/smokeless), alcohol.

Comorbidities considered in the study: diabetes, hypertension.

In this study 29.1% (n = 291) of the population consumes tobacco, of which 82% are males and 18% are females; 29.7% (n = 297) of the population drinks alcohol: 91.95% of males and 8.05% of females. In the study population, 16.8% of people had diabetes: 9.2% of men and 7.6% of women; 28.9% people suffered from hypertension:16.2% of men and 12.7% of women.

Osteopenia

Out of the total population considered for this study, 512 were osteopenic: 45.5% of males and 57.8% of females. Among the people suffering from osteopenia, 65.7% were between 51-60 years. Among the population with addictive habits, 2.7% of tobacco consumers and 69.4% of alcoholics were osteopenic. This suggests that there may be a stronger association between alcohol consumption and osteopenia than tobacco consumption and osteopenia, despite the fact that a higher percentage of the overall population consumes tobacco.

One possible explanation for this discrepancy is that alcohol consumption may have a greater impact on bone health than tobacco consumption. Studies have shown that excessive alcohol consumption can interfere with the body's ability to absorb calcium and can also reduce bone density, which can lead to osteopenia and osteoporosis. On the other hand, while tobacco use is a well-known risk factor for several health problems, including lung cancer and cardiovascular disease, its impact on bone health is less clear. Another possibility is that there may be other factors at play that are affecting the relationship between addictive habits and osteopenia. For example, people who consume more alcohol may also be more likely to have poor diets or engage in other behaviours that increase their risk of osteopenia. Additionally, there may be differences in the demographics of the tobacco-consuming and alcohol-consuming populations that could be influencing the results. Overall, it's important to remember that studies like these can only show associations between variables and cannot prove causation. More research would be needed to fully understand the relationship between addictive habits and osteopenia and determine the best prevention and treatment strategies.

Among the population with comorbidities, 13.1% of people with diabetes and 44.6 % with hypertension were osteopenic.

The correlations between gender and tobacco consumption, gender and alcohol consumption, and alcohol consumption and hypertension are all statistically significant at the 0.01 level (two-tailed), with correlation coefficients of 0.362, 0.241, and 0.339, respectively. These coefficients indicate a weak to a moderate positive correlation between these variables.

The correlations between tobacco consumption and diabetes, tobacco consumption and hypertension, and opsteopenia and tobacco consumption are also statistically significant at the 0.01 level (two-tailed), with correlation coefficients of 0.566, 0.378, and -0.621, respectively. These coefficients indicate a moderate to a strong positive correlation between these variables.

The correlations between diabetes and alcohol consumption and hypertension and opsteopenia are statistically significant at the 0.01 level (two-tailed), with correlation coefficients of -0.105 and -0.084, respectively. These coefficients indicate a weak negative correlation between these variables.

Finally, the correlation between gender and diabetes, gender and hypertension, and diabetes and opsteopenia are not statistically significant at the 0.01 level (two-tailed), with correlation coefficients of 0.010, 0.031, and -0.343, respectively. These coefficients indicate a very weak to weak positive or negative correlation between these variables (Table 1).

Table 1

Correlation between secondary risk factors and osteopenia

Parameters		Gender	Tobacco consumption	Alcohol consumption	Diabetes	Hypertension	Opsteopenia
Gender	pearson correlation	1					
	p						
	n	1000					
Tobacco consumption	pearson correlation	0.362	1				
	p	0.000					
	n	1000	1000				
Alcohol consumption	pearson correlation	0.241	0.056	1			
	p	0.000	0.078				
	n	1000	1000	1000			
Diabetes	pearson correlation	0.010	0.566	-0.105	1		
	p	0.741	0.000	0.001			
	n	1000	1000	1000	1000		
Hypertension	pearson correlation	0.031	0.378	0.339	-0.027	1	
	p	0.321	0.000	0.000	0.396		
	n	1000	1000	1000	1000	1000	
Osteopenia	pearson correlation	-0.122	-0.621	0.236	-0.343	-0.084	1
	p	0.000	0.000	0.000	0.000	0.008	
	n	1000	1000	1000	1000	1000	1000

Osteoporosis

In this study, out of the total study population, 370 people were osteoporotic. In this population, 53.0% who were osteoporotic were between 50-60 years. The prevalence of osteoporosis in the rural population was more in females at 42.2%, whereas the males had a prevalence of 32.5%.

Among the population with the habit of tobacco consumption, 78% were osteoporotic, and in those with the habit of consuming alcohol, 30.6% were osteoporotic, while 20.2% of non-smokers and 39.7% of non-alcoholics were osteoporotic.

Among the population with comorbidities, 53.6% of people with diabetes and 55.4% of hypertensives were osteoporotic, while 33.7% of non-diabetics were osteoporotic, and 29.5% of hypertensives were osteoporotic.

Statistical analysis of the data shows Pearson correlation between osteoporosis and tobacco usage shows a moderately positive correlation ($r = 0.544$), which is highly significant ($p<0.001$). Correlation between osteoporosis and alcohol consumption is weakly negative ($r = -0.086$), which is highly significant ($p = 0.007$). It is important to note that correlation does not imply causation. Therefore, while there may be a negative correlation between alcohol consumption and osteoporosis, it does not necessarily mean that drinking alcohol prevents osteoporosis. Other factors may be at play that influence both alcohol consumption and the risk of developing osteoporosis, such as diet, exercise, smoking, or genetics. Furthermore, the significance of the correlation ($p = 0.007$) indicates that the observed relationship between alcohol consumption and osteoporosis is unlikely to be due to chance. However, statistical significance does not necessarily mean practical significance or clinical relevance. In other words, a significant correlation may not necessarily have a large enough effect size to be of practical importance.

Correlation between osteoporosis and diabetes is weakly positive ($r = 0.154$), which is highly significant ($p<0.001$). Correlation between osteoporosis and hypertension is weakly positive ($r = 0.242$), which is highly significant ($p<0.001$) (Table 2).

The correlation between osteoporosis and the individual risk factors ranged between weak negative to moderately positive. The correlation between the combination of all the four risk factors and osteoporosis is weakly positive ($r = 0.339$), which is highly significant ($p<0.001$).

Table 2

Correlation between secondary risk factors and osteoporosis

Parameters		Tobacco	Alcohol	Diabetes	Hypertension	Osteoporosis
Tobacco	pearson correlation	1				
	p					
	n	1000				
Alcohol	pearson correlation	0.056	1			
	p	0.078				
	n	1000	1000			
Diabetes	pearson correlation	0.566	-0.105	1		
	p	0.000	0.001			
	n	1000	1000	1000		
Hypertension	pearson correlation	0.378	0.339	-0.027	1	
	p	0.000	0.000	0.396		
	n	1000	1000	1000	1000	
Osteoporosis	pearson correlation	0.544	-0.086	0.154	0.242	1
	p	0.000	0.007	0.000	0.000	
	n	1000	1000	1000	1000	1000

DISCUSSION

Osteoporosis is a skeletal disease characterised by decreased bone mass per volume associated with microarchitectural deterioration of the bone tissue resulting in bone fragility and increased risk of fracture [1]. Another variant of low bone mass density is osteopenia, which is defined as a condition with low BMD but of less severity when compared to that of osteoporosis. Osteoporosis is most commonly seen in the elderly, with females being most commonly affected compared to males [2]. Whereas osteopenia is seen in younger age groups with no gender inequality [3].

The burden of osteoporosis in the India population is around 40% as the population living in India is mainly from a rural background and has low BMD compared to the western population of the same age and gender. The maximum loss of bone density is observed in the fourth decade of life and early postmenopausal years [4].

Chronic bone pain, disability, and peritrochanteric and vertebral fractures are common among the osteoporotic elderly population, leading to severe functional limitations and decreasing the quality of life [5]. Pneumonia, urinary tract infections, pressure sores (mainly nonhealing ulcers), and deep vein thrombosis contribute to worsening the prognosis among the osteoporotic elderly population. The common sites of osteoporotic fractures following minimal trauma are vertebra, distal radius, and peritrochanteric fractures due to lack of osteoid in sufficient quantity that leads to rapid bone loss [6]. Osteoporosis is mostly asymptomatic; on the other hand, in symptomatic patients, vague, diffuse low backache is the most common symptom [7].

Recent studies have indicated that even low-level exposure to cadmium could increase the risk of osteoporosis and fractures [8]. Women are four times more prone to osteoporosis and two times more prone to osteopenia [9]. Diabetes mellitus increases osteoclast function but decreases osteoblast function, leading to accelerated bone loss, osteopenia and osteoporosis [10]. In hypertension patients, excess urinary calcium secretion induces secondary parathyroidism to increase the serum calcium level by calcium release from bone, which may accelerate osteoporosis [11]. Alcohol use decreases bone density and weakens bones mechanical properties [12].

Diagnosing osteoporosis is a significant step in its management. Diagnosing osteoporosis at the gross root level is far better to avoid the consequences like fractures and deterioration of life quality among the rural population [13]. Despite being the most common problem among the rural and urban population in India, there is no Cohesive National Policy on screening and prevention policy and programs.

Various tools are available nowadays for diagnosing osteoporosis, like DEXA scan, India-specific FRAX tool, etc. [1, 3, 4, 14]. Among all India-specific FRAX tool is gaining popularity in risk prediction of 10-year probability of osteoporotic fracture. Due to a lack of awareness on health education, lack of internet facilities, etc., it is still of limited use.

Age. Our study found that the prevalence of osteoporosis and osteopenia increases with age, consistent with other studies. A study by N.S. Kadam et al. reported a similar finding, where the prevalence of osteoporosis is more prevalent in 50-60 years age group [15].

Gender. Our study found that females had a higher prevalence of osteoporosis and osteopenia compared to males, consistent with other studies. A study by N.S. Kadam et al. reported that females had a higher prevalence of osteoporosis than males [15].

Tobacco and alcohol consumption. Our study found that tobacco and alcohol consumption were associated with an increased risk of osteoporosis and osteopenia, consistent with other studies. A study by A.M. Al-Bashaireh et al. showed that smoking tobacco has been associated with reduced bone mass and increased risk of fracture through its direct or indirect effects on osteoblast and osteoclast activities. The RANKL-RANK-OPG pathway plays a vital role in the mechanisms by which smoking may result in poor bone health [16].

Chronic excessive alcohol consumption has deleterious effects on bone and results in low bone mass which may predispose to fragility fractures leading to increased morbidity [17].

Comorbidities. Our study found that comorbidities such as diabetes and hypertension were associated with an increased risk of osteoporosis and osteopenia, consistent with other studies. Similarly a study by A.G. Asokan et al. found that prevalence of osteoporosis was higher among diabetics [18]. Another study by R. Khinda et al. showed that hypertension causes severe loss of bone minerals including calcium and its metabolism, resulting in accelerated bone resorption [19].

Overall, these findings highlight the importance of managing these risk factors to prevent the development of osteoporosis and osteopenia.

Limitations

In this study, we have used only one tool for assessing the bone mass density for grading the patient depending on feasibility.

The study did not consider different types of alcohol, such as toddy, wine, and beer, which may have different effects on bone health. For example, some studies suggest that moderate consumption of red wine may have a beneficial effect on bone density due to its high levels of polyphenols, while heavy alcohol consumption has been linked to decreased bone density.

The study did not consider different methods of tobacco use, which may have different effects on bone health. For example, smoking has been linked to decreased bone density due to its negative impact on calcium absorption, while smokeless tobacco has been linked to increased bone density due to its high nicotine levels.

It is important to acknowledge these limitations when interpreting the study's findings and to consider the potential impact of these factors on bone health. Future studies may benefit from considering the effects of different types of alcohol and tobacco use on bone health in more detail.

CONCLUSION

Overall, the findings of this study suggest that addictive habits such as tobacco and alcohol consumption may have a significant impact on bone health, with a higher prevalence of osteopenia and osteoporosis observed in individuals with these habits. Comorbidities such as diabetes and hypertension were also found to be associated with a higher prevalence of osteoporosis. These findings emphasize the importance of early detection and prevention of addictive habits and comorbidities to reduce the risk of osteopenia and osteoporosis. Furthermore, the study highlights the need for further research to fully understand the complex relationships between sociodemographic factors, addictive habits, comorbidities, and bone health.

DISCLAIMERS

Author contribution

Pothuri Rishi Ram — the design of the study, data collection and analysis, writting the first draft of the manuscript.

Praveen Narayan — the statistical analysis and the interpretation of the results, critical feedback on the manuscript.

Pavith Janardhan — data collection and management, the literature review and discussion, revising the manuscript for submission.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Заявленный вклад авторов

Потури Риши Рам — разработка проекта исследования, сбор и анализ данных, написание статьи.

Правин Нараян — статистический анализ и интерпретация результатов, редактирование статьи.

Павит Джанардан — обзор литературы и обсуждение, редактирование статьи.

Surya Sri Karun Ch. — the study design, expertise on methodological approach, revising the manuscript for submission.

All authors have read and approved the final version of the manuscript of the article. All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.

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Все авторы прочли и одобрили финальную версию рукописи статьи. Все авторы согласны нести ответственность за все аспекты работы, чтобы обеспечить надлежащее рассмотрение и решение всех возможных вопросов, связанных с корректностью и надежностью любой части работы.

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Возможный конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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REFERENCES

1. Ralston S.H. Genetic determinants of osteoporosis. *Curr Opin Rheumatol*. 2005;17(4):475-479. doi: 10.1097/01.bor.0000166385.62851.92.
2. Srivastava M., Deal C. Osteoporosis in elderly: prevention and treatment. *Clin Geriatr Med*. 2002;18(3):529-555. doi: 10.1016/s0749-0690(02)00022-8.
3. Ross P.D. Osteoporosis frequency, consequences, and risk factors. *Arch Internal Med*. 1996;156(13):1399-1411.
4. Rashki Kemmak A., Rezapour A., Jahangiri R., Nikjoo S., Farabi H., Soleimanpour S. Economic burden of osteoporosis in the world: A systematic review. *Med J Islam Repub Iran*. 2020;34:154. doi: 10.34171/mjiri.34.154.
5. Gómez-de-Tejada Romero M.J., Navarro Rodríguez M.D., Saavedra Santana P., Quesada Gómez J.M., Jódar Gimeno E., Sosa Henríquez M. Prevalence of osteoporosis, vertebral fractures and hypovitaminosis D in postmenopausal women living in a rural environment. *Maturitas*. 2014;77(3):282-286. doi: 10.1016/j.maturitas.2013.12.011.
6. Rex C. 50% of India to suffer from Osteoporosis: Study. Indian Express. 2012. Available from: https://indianexpress.com/article/news-archive/print/50-of-indians-to-suffer-from-osteoporosis-study/.
7. Bhardwaj R.K., Ram Sh. Mapping of Indian research on Osteoporosis. *ALIS*. 2013;60(4):276-283. doi: 10.56042/alis.v60i4.2357.
8. Åkesson A., Barregard L., Bergdahl I.A., Nordberg G.F., Nordberg M., Skerfving S. Non-renal effects and the risk assessment of environmental cadmium exposure. *Environ Health Perspect*. 2014;122(5):431-438. doi: 10.1289/ehp.1307110.
9. Alswat K.A. Gender Disparities in Osteoporosis. *J Clin Med Res*. 2017;9(5):382-387. doi: 10.14740/jocmr2970w.
10. Wongdee K., Charoenphandhu N. Osteoporosis in diabetes mellitus: Possible cellular and molecular mechanisms. *World J Diabetes*. 2011;2(3):41-48. doi: 10.4239/wjd.v2.i3.41.
11. Nakagami H., Morishita R. Hypertension and osteoporosis. *Clin Calcium*. 2013;23(4):497-503. (In Japanese).
12. Sampson H.W. Alcohol and other factors affecting osteoporosis risk in women. *Alcohol Res Health*. 2002;26(4):292-298.
13. Khadilkar A.V., Mandlik R.M. Epidemiology and treatment of osteoporosis in women: an Indian perspective. *Int J Womens Health*. 2015;7:841-850. doi: 10.2147/IJWH.S54623.
14. Cherian K.E., Kapoor N., Meeta M., Paul T.V. Screening Tools for Osteoporosis in India: Where Do We Place Them in Current Clinical Care? *J Midlife Health*. 2021;12(4):257-262. doi: 10.4103/jmh.jmh_216_21.
15. Kadam N.S., Chiplonkar S.A., Khadilkar A.V., Khadilkar V.V. Prevalence of Osteoporosis in Apparently Healthy Adults above 40 Years of Age in Pune City, India. *Indian J Endocrinol Metab*. 2018;22(1):67-73. doi: 10.4103/ijem.IJEM_438_17.
16. Al-Bashaireh A.M., Haddad L.G., Weaver M., Chengguo X., Kelly D.L., Yoon S. The Effect of Tobacco Smoking on Bone Mass: An Overview of Pathophysiologic Mechanisms. *J Osteoporos*. 2018;2018:1206235. doi: 10.1155/2018/1206235.
17. Johnson J.T., Hussain M.A., Cherian K.E., Kapoor N., Paul T.V. Chronic Alcohol Consumption and its Impact on Bone and Metabolic Health - A Narrative Review. *Indian J Endocrinol Metab*. 2022;26(3):206-212. doi: 10.4103/ijem.ijem_26_22.
18. Asokan A.G., Jaganathan J., Philip R., Soman R.R., Sebastian S.T., Pullishery F. Evaluation of bone mineral density among type 2 diabetes mellitus patients in South Karnataka. *J Nat Sci Biol Med*. 2017;8(1):94-98. doi: 10.4103/0976-9668.198363.
19. Khinda R., Valecha S., Kumar N., Walia J.P.S., Singh K., Sethi S. et al. Prevalence and Predictors of Osteoporosis and Osteopenia in Postmenopausal Women of Punjab, India. *Int J Environ Res Public Health*. 2022;19(5):2999. doi: 10.3390/ijerph19052999.

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