

## ORIGINAL RESEARCH

# Exploring the Incidence of Osteoporosis in Smokers: An Institutional-Based Investigation

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### ABSTRACT

**Background:** Osteoporosis presents itself as a multifaceted and diverse disorder. Smoking is widely acknowledged for its role in contributing to numerous health issues, among them osteoporosis and bone fractures. Consequently, this study was initiated to evaluate the prevalence of osteoporosis in individuals who smoke. **Methods:** The study encompassed 250 individuals who had a smoking history of at least 10 cigarettes per day over the past five years. Additionally, 250 non-smoking individuals were included as normal controls. Comprehensive demographic and clinical information for all participants was collected, including detailed medical and personal histories. Thorough clinical and oral examinations were conducted on all subjects, and the occurrence of osteoporosis was documented. **Results:** The overall incidence of osteoporosis was found to be 31.6 percent among smokers and 4.2 percent among non-smokers. Significantly higher rates of osteoporosis were observed in smokers compared to non-smokers. Among smokers with osteoporosis, 50.63 percent were in the age group of more than 45 years, and 34.81 percent were in the age group of 30 to 45 years. In the non-smokers group, 47.62 percent of individuals with osteoporosis were in the age group of more than 45 years, while 38.09 percent were in the age group of 30 to 45 years. Among both smokers and non-smokers with osteoporosis, 66.46 percent and 61.91 percent, respectively, were females. **Conclusion:** Smoking represents a substantial and well-established risk factor for the onset and progression of osteoporosis, a condition characterized by diminished bone density and increased susceptibility to fractures. The detrimental effects of smoking on bone health are attributed to several factors. Firstly, smoking has been linked to alterations in hormonal levels, particularly a decrease in estrogen in both men and women, which plays a crucial role in maintaining bone density. Additionally, smoking is known to interfere with the absorption of calcium, an essential mineral for bone strength, further compromising skeletal integrity. Moreover, the harmful constituents of tobacco smoke adversely affect bone-forming cells, impeding their ability to generate and maintain healthy bone tissue. The cumulative impact of these mechanisms underscores the significance of smoking as a risk factor in the development of osteoporosis. Recognizing and addressing this association is crucial for promoting bone health and preventing the adverse consequences of osteoporosis in individuals who smoke.

**Keywords:** Osteoporosis, Smokers.

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### INTRODUCTION

Osteoporosis stands as a complex and heterogeneous disorder, encompassing a spectrum of disruptions in the intricate process of bone remodeling<sup>1</sup>. This intricate imbalance ultimately results in a decline in bone mineral density (BMD), compromising the microarchitectural integrity of bones and elevating the risk of fractures, thereby posing substantial challenges to both economic and public health domains. Osteoporotic fractures, in particular, contribute significantly to increased morbidity and mortality, underscoring the imperative to delve into the factors influencing bone health. Amid the myriad contributors

to osteoporosis, smoking emerges as a significant and independent risk factor for the attenuation of BMD. The adverse effects of smoking on bone health extend beyond the well-documented impact of active smoking, as recent evidence sheds light on the detrimental consequences of passive smoking. Even individuals exposed to secondhand smoke are susceptible to a decline in BMD, further highlighting the pervasive influence of tobacco on skeletal integrity. Recognizing the intricate interplay between smoking and osteoporosis becomes paramount for devising comprehensive strategies to mitigate the health implications associated with compromised

bone health<sup>2,3</sup>. This broader perspective underscores the need for public health initiatives aimed at discouraging smoking and promoting awareness of the multifaceted consequences of tobacco use, thereby fostering skeletal well-being and reducing the societal burden imposed by osteoporosis-related fractures. The detrimental impact of smoking on health is widely acknowledged, encompassing a range of issues, among which osteoporosis and bone fractures are notable concerns. Within the intricate concoction of over 4000 compounds found in tobacco smoke, there is a notable gap in our understanding of which specific components play pivotal roles in underlying mechanisms. However, emerging evidence suggests that cadmium, a constituent of tobacco smoke, could be a key player in this regard. Smokers are significantly exposed to cadmium through tobacco consumption, presenting a major source of this toxic metal in their systems. In contrast, non-smokers primarily encounter cadmium through dietary intake or occupational exposure<sup>4</sup>. Cadmium has long been implicated as a potential risk factor for osteoporosis and fractures, particularly when exposure levels are elevated. The association between cadmium and bone health has prompted a closer examination of the intricate relationship between smoking, cadmium exposure, and the increased vulnerability to skeletal issues. This acknowledgment of cadmium as a potential culprit emphasizes the multifaceted nature of the impact of smoking on bone health. It underscores the importance of not only recognizing the broad health risks associated with smoking but also delving into the specific elements within tobacco smoke, such as cadmium, that contribute to the complex web of health problems, particularly those related to osteoporosis and fractures. This nuanced understanding is vital for developing targeted interventions and public health initiatives aimed at mitigating the adverse effects of smoking on bone health.

Thus, the impetus behind this study was to comprehensively investigate and analyze the prevalence of osteoporosis within the population of smokers<sup>5</sup>. By undertaking a thorough examination, the research aimed to shed light on the extent to which smoking contributes to the incidence of osteoporosis, adding depth to our understanding of the intricate relationship between tobacco use and bone health. Through meticulous data collection and analysis, this study sought to provide valuable insights into the prevalence and potential implications of osteoporosis among smokers, contributing to the broader body of knowledge aimed at informing public health initiatives and preventive measures in this context.

## MATERIALS AND METHODS

The research was meticulously executed within the confines of the Department of Orthopedics, with the primary objective of conducting a thorough examination into the incidence of osteoporosis among

individuals who engage in smoking. A cohort comprising 250 smokers, each with a consistent history of consuming a minimum of 10 cigarettes daily for at least five consecutive years, was carefully selected for inclusion in the study. In parallel, an equal number of 250 individuals who were non-smokers, serving as normal controls, were judiciously enlisted for the purpose of establishing comparative insights. The methodological approach adopted was comprehensive, ensuring a holistic understanding of the study participants. Detailed demographic and clinical data were meticulously collected for each individual, providing a comprehensive foundation for the subsequent analysis. The recording of detailed medical and personal histories added a nuanced layer to the investigation, facilitating a deeper exploration of potential contributing factors to osteoporosis in the context of smoking. A thorough clinical and oral examination further enriched the dataset, capturing relevant nuances in bone health that may be influenced by smoking habits. The central outcome measure, the incidence of osteoporosis, was a focal point of the study. Rigorous efforts were made to precisely record and document this parameter, providing a quantitative basis for the subsequent analyses. The results, after thorough scrutiny and validation, were systematically documented in a Microsoft Excel sheet, ensuring organized and meticulous data management.

To unravel the statistical significance of the findings, a robust analysis was conducted using the sophisticated tools provided by the SPSS software. The Chi-square test and the student t-test were judiciously employed to evaluate the level of significance, ensuring a statistically sound foundation for drawing meaningful conclusions from the amassed data. In essence, this methodological rigor, from participant selection to data collection and statistical analysis, underscores the study's commitment to delivering insights that contribute substantively to our understanding of the relationship between smoking and osteoporosis. The meticulous execution of this study serves not only to expand the current body of knowledge but also to inform potential interventions and public health initiatives in addressing the impact of smoking on bone health.

## RESULTS

In the realm of our present research, a meticulous examination unfolded, involving the in-depth analysis of 250 individuals with a smoking history, each consuming a minimum of 10 cigarettes daily for a duration spanning at least five years. Concurrently, a carefully selected control group of 250 non-smokers was included to establish a comparative foundation. The mean age of participants in the smokers' group was identified at 48.6 years, while their non-smoking counterparts in the control group had a mean age of 49.1 years. The overarching discovery brought to light a profound distinction in the prevalence of

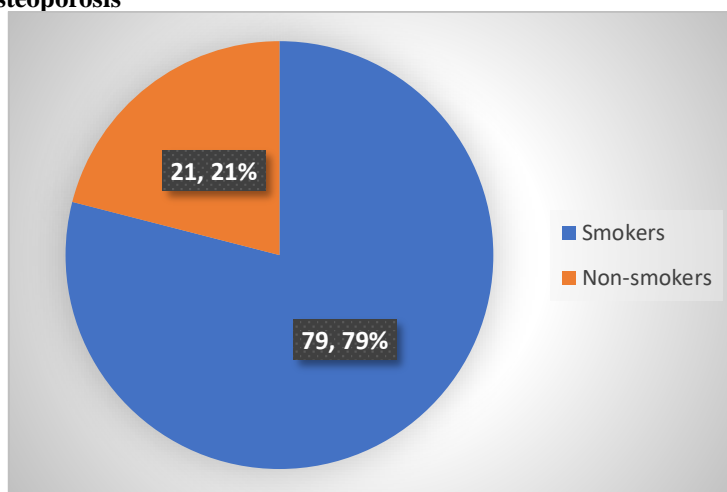
osteoporosis between these two cohorts. Among smokers, the overall incidence of osteoporosis stood conspicuously higher at 31.6 percent, in stark contrast to the notably lower incidence of 4.2 percent observed among non-smokers. This glaring difference underscored a compelling association between smoking and a heightened susceptibility to osteoporosis. Further exploration into age-specific trends within each group illuminated nuanced patterns. In the smokers' group, more than half (50.63 percent) of those diagnosed with osteoporosis belonged to the age bracket exceeding 45 years, while 34.81 percent fell within the 30 to 45 years age range. Conversely, in the non-smokers' group, 47.62 percent of individuals with osteoporosis were aged over 45 years, with 38.09 percent falling within the 30 to 45 years age range. This detailed breakdown by age provided valuable insights into the varying vulnerabilities to osteoporosis within distinct age

categories among both smokers and non-smokers. A gender-specific lens was applied to further enrich the findings, revealing that in the smokers' group, a significant majority (66.46 percent) of those diagnosed with osteoporosis were females. Similarly, among non-smokers, 61.91 percent of individuals with osteoporosis were females. This gender-specific dimension accentuated a potential role of gender in the complex interplay between smoking and osteoporosis. In essence, this research not only accentuated the overall heightened risk of osteoporosis among smokers but also illuminated age and gender as influential variables in the manifestation of this association. The intricate analysis contributes nuanced insights into the multifaceted relationship between smoking habits and osteoporosis, laying the groundwork for further investigations and targeted interventions in the realm of bone health.

**Table 1: Incidence of osteoporosis**

Osteoporosis	Smokers	Non-smokers
Number of patients	79	21
p- value	0.001 (Significant)	

**Fig1: Incidence of osteoporosis**



**Table 2: Age and gender wise distribution of patients with presence of osteoporosis**

Parameter		Smokers		Non-smokes	
		Number	Percentage	Number	Percentage
Age group (years)	Less than 30	23	14.56	2	14.29
	30 to 45	55	34.81	4	38.09
	More than 45	80	50.63	5	47.62
Gender	Males	21	33.54	4	38.09
	Females	51	66.46	7	61.91

**DISCUSSION**

The intricate pathophysiologic mechanisms that contribute to osteoporosis in individuals who smoke remain a domain yet to be fully elucidated. Cigarette smoking is posited to induce alterations in bone metabolism through various intricate pathways<sup>6</sup>. These alterations may occur indirectly, impacting calcitropic hormone metabolism and leading to

disruptions in the production, metabolism, and binding of estradiol. Furthermore, cigarette smoking may also influence adrenal cortical hormone metabolism, presenting a complex interplay of factors. Additionally, direct effects on osteogenesis are implicated, encompassing changes in the RANK–RANKL–OPG system—a crucial regulator of bone remodeling—alongside alterations in collagen

metabolism and bone angiogenesis. The intricate interplay of these factors underscores the multifaceted nature of the impact of cigarette smoking on bone health. Therefore, recognizing the gaps in our understanding of these complex mechanisms, the present study was initiated with the objective of assessing the incidence of osteoporosis among smokers. By delving into the prevalence of osteoporosis within this specific demographic, the research seeks to shed light on the intricate biological processes at play and contribute valuable insights toward a more comprehensive understanding of how smoking influences bone health.

The initiation of the present study was motivated by the need to comprehensively examine the incidence of osteoporosis among individuals who smoke. In the research, a detailed analysis involved 250 smokers, each with a history of consuming a minimum of 10 cigarettes per day for at least the past 5 years. Simultaneously, a control group of 250 non-smokers was meticulously enrolled for comparative purposes. The mean age of patients in the smokers' group was identified at 48.6 years, while in the control group, it was 49.1 years. The investigation yielded a striking contrast in the overall incidence of osteoporosis between smokers and non-smokers. Among smokers, the prevalence of osteoporosis was notably higher, registering at 31.6 percent, in sharp contrast to the significantly lower incidence of 4.2 percent among non-smokers<sup>7</sup>. This stark difference underscored the substantial association between smoking and an elevated risk of osteoporosis. In a parallel vein, insights from Daniell HW's data search were incorporated, revealing a noteworthy observation. The search identified seventeen females with severe idiopathic presenile osteoporosis, of which eight subjects were considered. Intriguingly, only one of them was a nonsmoker, one smoked less than 20 cigarettes daily, while six had a history of smoking 20 or more cigarettes daily for an extended period. This finding suggested a potential link between smoking and the induction of premature sex hormone deficiency. Notably, this observation was further supported by the discernment that menopause tended to occur several years earlier in smokers compared to nonsmokers. These collective findings underscore the multifaceted nature of the relationship between smoking and osteoporosis, suggesting intricate mechanisms that go beyond direct bone metabolism alterations. The study not only contributes to the body of knowledge on this subject but also prompts further exploration into the potential impact of smoking on hormonal dynamics, shedding light on a broader spectrum of health implications associated with tobacco use. The body of evidence from prior epidemiological studies and animal experiments strongly supports and provides plausible mechanistic explanations for the induction of osteoporosis by cadmium exposure. The intricate biological mechanisms underlying the toxicity of cadmium on

bone have been the subject of rigorous investigation, giving rise to several proposed models. Notably, the link between cadmium-induced osteoporosis and kidney dysfunction has been observed in epidemiological studies involving a Chinese population. However, it's noteworthy that adverse effects of cadmium on bone have been identified in populations where no apparent signs of impaired kidney function were present, suggesting a direct impact of cadmium on bone health.

Animal experiments have contributed significantly to our understanding of the multifaceted ways in which cadmium disrupts bone metabolism. Cadmium has been shown to exert both direct effects on bone formation and resorption and indirect effects by disturbing calcium and vitamin D metabolism. In a related study conducted by Ghadimi et al<sup>8</sup>, the influence of smoking on bone health in elderly male smokers was investigated. Their findings concluded a significant association between low bone mass and bone fractures in elderly male smokers. This underscores the complex interplay of factors contributing to bone health, where smoking, as a source of cadmium exposure, can play a discernible role in the manifestation of osteoporosis and related fractures.

Collectively, these studies contribute to a growing body of knowledge, emphasizing the multifactorial nature of osteoporosis induction by cadmium exposure. The intricate interplay between cadmium, bone metabolism, and associated risk factors such as smoking underscores the need for comprehensive approaches to understanding and addressing the impact of environmental exposures on bone health. The findings from the present study underscore a noteworthy association between smoking and a heightened incidence of osteoporosis compared to non-smokers. Within the smoker's group, the prevalence of osteoporosis was particularly pronounced among individuals aged over 45 years, constituting 50.63 percent of the affected population, while 34.81 percent fell within the 30 to 45 years age range. Similarly, in the non-smokers' group, 47.62 percent of those with osteoporosis were aged over 45 years, with 38.09 percent falling within the 30 to 45 years age bracket. This age-specific breakdown highlights the differential vulnerability to osteoporosis among distinct age groups in both smokers and non-smokers.

Furthermore, gender-based analysis revealed that in both the smokers and non-smokers groups, a substantial majority of individuals diagnosed with osteoporosis were females, constituting 66.46 percent and 61.91 percent, respectively<sup>9</sup>. This underscores the potential impact of gender on the relationship between smoking and osteoporosis. Insights into the effects of smoking on female health were provided by the observation that menopause occurs up to 4 years earlier in female smokers compared to nonsmokers, indicating a potential association with premenopausal

ovarian dysfunction. This phenomenon, however, was not observed in secondhand smokers. Additionally, female smokers exhibited lower levels of 25-OH vitamin D3 and decreased calcium absorption, further implicating smoking in disruptions to hormonal and nutritional factors that contribute to bone health. Previous studies examining the relationship between smoking characteristics in men and bone health have yielded nuanced findings. Classifying men based on smoking characteristics revealed a decrease in bone mass with the number of smoking years and pack years. The number of cigarettes smoked per day, however, yielded inconsistent results, with studies reporting both positive and negative associations. Notably, smokers consuming 20 or more cigarettes per day consistently demonstrated significantly lower bone mineral density (BMD) compared to never smokers.

These collective findings highlight the multifaceted impact of smoking on bone health, emphasizing age, gender, and specific smoking characteristics as influential factors in the complex relationship between smoking and osteoporosis. The study provides valuable insights into the varied dimensions of this association, contributing to a more comprehensive understanding of the effects of smoking on skeletal health.

## CONCLUSION

Based on the results obtained in the present study, the authors have conclusively determined that smoking constitutes a significant risk factor for the development of osteoporosis. The findings consistently highlight a higher incidence of osteoporosis among smokers compared to non-smokers, emphasizing the substantial impact of

smoking on bone health. These conclusions align with the broader body of research and support the established understanding that tobacco use poses a notable risk to skeletal integrity, contributing to the manifestation of osteoporosis.

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