



## Research Article

### Risk factors for knee osteoarthritis among rural women: a cross-sectional study

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#### ABSTRACT

Knee osteoarthritis (OA) is a progressive degenerative joint disorder commonly affecting elderly and postmenopausal women, particularly in rural populations where factors such as low physical activity and socioeconomic challenges are prevalent. This cross-sectional study aimed to identify risk factors associated with knee OA among rural women. The study was conducted at a tertiary-care hospital and included 50 female patients aged above 40 years diagnosed with knee OA, selected through purposive sampling. Data on demographic characteristics, medical history, and lifestyle factors were collected using a structured sheet. Anthropometric measurements, including body mass index (BMI) and waist-hip ratio (WHR), were calculated, and information on menopausal status, comorbidities, and tobacco use was recorded. The results showed that 82% of participants were postmenopausal, 48% had a BMI above 25 kg/m<sup>2</sup>, and many had higher WHR values. Additionally, 46% had hypertension, 52% had diabetes, and 48% reported tobacco chewing. These factors were associated with an increased risk and prevalence of knee OA. In conclusion, postmenopausal status, elevated BMI, higher WHR, and comorbidities such as diabetes and hypertension are key risk factors for knee osteoarthritis among rural women.

**Keywords:** Risk factors, Rural women, Obesity, Menopause, Co-morbidities.

#### INTRODUCTION

Osteoarthritis (OA) is a chronic, progressive degenerative disorder of synovial joints and represents one of the leading causes of pain, disability, and functional limitation among middle-aged and elderly populations worldwide [1, 2]. Although OA predominantly affects older individuals, younger adults may also develop the condition following joint injury or prolonged mechanical overuse [3]. Pathologically, OA is characterised by progressive degeneration of articular cartilage accompanied by inflammatory changes within the synovial cavity, leading to structural and functional joint deterioration [4].

The knee joint is the most commonly affected site, followed by the hip, hands, feet, and spine, largely due to its weight-bearing function and exposure to repetitive mechanical stress over time [5]. The prevalence of knee OA increases with advancing age and is consistently reported to be higher among women than men, particularly after menopause [6]. Globally, osteoarthritis ranks among the leading causes of disability and significantly contributes to restricted mobility, loss of independence, and reduced quality of life among older adults [7]. Nearly one-third of adults older than 60

years' experience symptomatic knee OA, emphasising its growing public health burden [8].

Based on aetiology, OA is classified as primary or secondary. Primary knee OA is mainly attributed to cumulative mechanical loading and age-related joint degeneration, whereas secondary OA arises from identifiable factors such as previous trauma, joint infection, or inflammatory disorders that alter joint congruity and cartilage metabolism [9]. Earlier concepts described OA as a simple "wear-and-tear" condition; however, advances in molecular biology have established OA as a complex disease involving inflammatory, metabolic, and biomechanical mechanisms.

The pathogenesis of OA involves an interplay between genetic susceptibility, abnormal mechanical stress, and altered cellular responses of articular chondrocytes. These changes lead to dysregulated gene expression, cartilage matrix breakdown, subchondral bone remodelling, and osteophyte formation, ultimately accelerating disease progression [10]. Clinically, OA follows a slowly progressive course with intermittent exacerbations of pain and

stiffness. Pain-induced reduction in physical activity further contributes to muscle weakness, joint instability, and worsening functional decline [11].

Several non-modifiable and modifiable risk factors have been identified in the development of knee OA. Increasing age and female sex are among the strongest predictors, with postmenopausal women showing higher susceptibility, likely due to estrogen deficiency and loss of its protective anti-inflammatory effects [12]. Obesity and elevated body mass index (BMI) are well-established modifiable risk factors that increase mechanical loading on the knee joint while also promoting systemic inflammation through adipokine release [13]. In addition, increased waist-hip ratio reflects central obesity, which may further exacerbate metabolic and biomechanical stress on the joint.

Metabolic comorbidities such as hypertension and diabetes mellitus have also been increasingly recognised as contributors to knee OA. Hypertension may impair subchondral bone perfusion, while diabetes accelerates cartilage degeneration through advanced glycation end-product accumulation, independent of body weight [14]. Reduced physical activity, common among individuals with chronic pain, contributes to muscle atrophy and poor joint stabilisation, thereby increasing OA risk. Lifestyle factors such as tobacco use may further worsen joint health by inducing oxidative stress and impairing cartilage repair mechanisms.

Rural women represent a particularly vulnerable population due to combined exposure to occupational knee loading, limited healthcare access, delayed diagnosis, and a high prevalence of metabolic and lifestyle-related risk factors. Despite this, data on the specific risk profile of knee osteoarthritis among rural women remain limited.

Therefore, this study is needed due to the high burden of knee osteoarthritis among rural women, who are exposed to multiple biological, occupational, and lifestyle-related risk factors. Limited healthcare access and delayed diagnosis further contribute to disease progression. Identifying modifiable risk factors is essential for early intervention and the development of targeted, cost-effective preventive strategies in rural settings.

Overall, this study aims to identify risk factors for knee osteoarthritis among rural women to aid early detection and prevention.

## **MATERIAL AND METHOD**

### **Study design and setting**

This cross-sectional study was conducted at a tertiary-care hospital in Maharashtra, India, to identify risk factors associated with knee osteoarthritis among rural women. The hospital caters to patients from rural areas and receives both direct visits and referrals from orthopaedic and other healthcare services.

### **Study population and eligibility criteria**

The study included female patients aged  $\geq 40$  years who were clinically diagnosed with knee osteoarthritis and belonged to

rural areas. Participants were selected using purposive sampling, and informed consent was obtained prior to inclusion. Patients with a history of recent knee trauma or fractures, inflammatory joint diseases such as rheumatoid arthritis, previous knee surgery or joint replacement, congenital or neurological disorders affecting joint function, and those unwilling or unable to provide reliable information were excluded.

### **Data collection and classification**

Data were collected using a structured data collection sheet. Demographic details such as age, occupation, and residence, along with clinical history including duration of symptoms, were recorded. Lifestyle factors such as physical activity levels and tobacco consumption were obtained through patient interviews. Anthropometric measurements including height, weight, waist, and hip circumferences were recorded to calculate body mass index (BMI) and waist-hip ratio (WHR). Menopausal status and comorbidities such as diabetes mellitus and hypertension were documented based on patient history and medical records. The collected data were systematically analysed to determine the association between these variables and knee osteoarthritis among rural women.

### **Procedure**

The present study was conducted after obtaining approval from the Institutional Ethical Committee. All participants were informed about the purpose, procedures, and potential implications of the study. Written informed consent was obtained from each participant before their inclusion in the study.

All subjects were initially screened to determine their eligibility according to the predefined inclusion and exclusion criteria. During the screening process, demographic details such as name, age, sex, menopausal status, and occupation were recorded. Participants who fulfilled the inclusion criteria were enrolled in the study.

A detailed medical history was obtained from each participant to identify any comorbid conditions such as hypertension, diabetes mellitus, or other musculoskeletal disorders that might influence the outcome.

Subsequently, anthropometric measurements, including height, weight, and waist-hip ratio (WHR), were recorded using standardised procedures and calibrated instruments. Body Mass Index (BMI) was calculated using the formula:

$$\text{BMI} = \text{WEIGHT(Kg)} \div \text{HEIGHT(m)}^2$$

To measure the waist-hip ratio, patients stood with their arms crossed on the contralateral shoulders. The WHO recommended measuring the hip circumference across the broadest part of the buttocks with the tape parallel to the floor, and the waist circumference at the midline between the lower margin of the last palpable ribs and the top of the iliac crest. The waist-hip ratio (WHR) was calculated by dividing the waist circumference (WC) by

the hip circumference (HC), using the same measurement units for each (WC/HC).

Information regarding menopausal status, physical activity levels, and tobacco consumption was also collected through structured interviews.

All data were systematically recorded in a predesigned data collection sheet. The collected data were then entered into a computer database for statistical analysis to determine the prevalence of risk factors for knee osteoarthritis among the study participants.

#### Statistical analysis

All collected data are entered into Microsoft Excel for analysis. Descriptive statistics are used to summarise demographic, anthropometric, clinical, and lifestyle variables. Continuous variables such as age, height, weight, body mass index (BMI), and waist-hip ratio (WHR) are calculated using standard formulas and expressed as mean values and percentages where appropriate. BMI is calculated as weight (kg) divided by height squared ( $m^2$ ), and WHR is calculated as waist circumference divided by hip circumference.

Categorical variables, including menopausal status, presence of hypertension and diabetes mellitus and tobacco consumption, are analysed as frequencies and percentages. The prevalence of each risk factor is determined by dividing the number of participants exhibiting the risk factor by the total sample size and multiplying by 100. The results are presented in tables and graphical formats to describe the distribution of risk factors among women with knee osteoarthritis [3,4].

The study was conducted on 50 women who were diagnosed with knee OA using ACR criteria. Among the 50 participants, the 82% were postmenopausal, and 48% had BMI above  $25kg/m^2$ , higher waist-hip ratios. 46% patients had hypertension, and 52% diabetes and 48% had a habit of tobacco chewing. These factors were found to be associated with increased risk and prevalence of knee OA.

#### BMI

The percentage distribution of Body Mass Index (BMI) among women with knee osteoarthritis (OA). The majority of participants (48%) had a normal BMI (18.5–24.9), followed by 34% who were overweight (25–29.9) and 14% who were obese ( $\geq 30$ ). Only 4% of participants were underweight ( $\leq 18.5$ ).

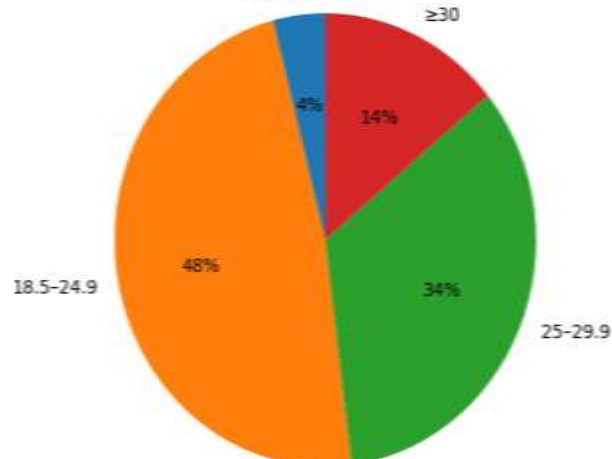
#### Waist hip ratio

The percentage distribution of Waist-to-Hip Ratio (WHR) among women with knee osteoarthritis (OA). The majority of participants (54%) had a high WHR ( $\geq 0.86$ ), indicating central obesity. 34% of participants had a moderate WHR (0.81–0.85), while only 12% had a normal WHR ( $\leq 0.8$ ).

**Table 1:** Distribution of BMI among women

BMI	$\leq 18.5$	18.5-24.9	25-29.9	$30 \leq$
No. of people = (n)	2	24	17	7
%	4	48	34	14

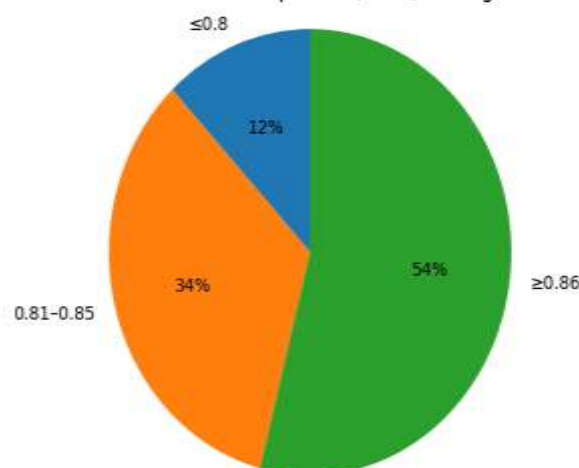
**Graph 1:** Distribution of BMI among women  
Distribution of Body Mass Index (BMI) among Women



**Table 2:** Distribution of WHR among women

WHR	$\leq 0.8$	0.81-0.85	$0.86 \leq$
No of people = (n)	6	17	27
%	12	34	54

**Graph 2:** Distribution of WHR among women  
Distribution of Waist-Hip Ratio (WHR) among Women



#### hypertension

**Table 3:** Hypertension in each age group

Age (years)	Hypertension = Yes (n)	Yes (%)	Hypertension = No (n)	No (%)	Total (n)
40–49	7	50.0	7	50.0	14
50–59	4	44.4	5	55.6	9
60–69	3	33.3	6	66.7	9
70–79	7	50.0	7	50.0	14
$\geq 80$	2	50.0	2	50.0	4
Total	23	46.0	27	54.0	50

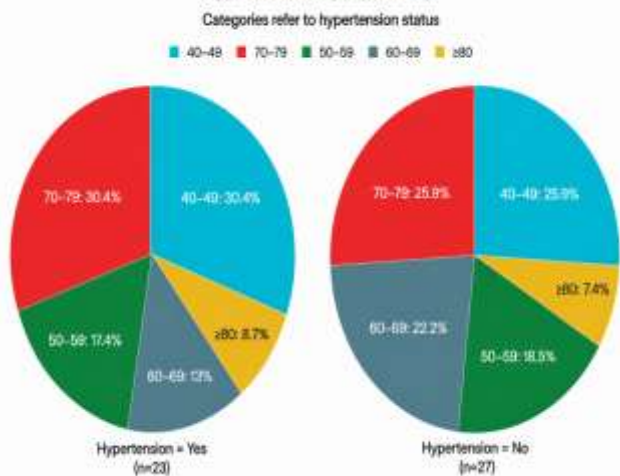
The percentage distribution of hypertension among different age groups of women with knee osteoarthritis (OA). The highest prevalence of hypertension (50%) was observed in the age groups 40–49 years, 70–79 years, and  $\geq 80$  years, followed by 44.4% in the 50–59 years group. The lowest prevalence (33.3%) was seen in the 60–69 years group. Overall, 46% of the study participants were hypertensive. The findings indicate that hypertension is common among women with knee OA, particularly in middle-aged and elderly groups.

#### Diabetes mellitus

The percentage distribution of diabetes mellitus among different age groups of women with knee osteoarthritis (OA). The highest prevalence of diabetes mellitus was observed in the 50–59 years group (66.6%), followed by the 40–49 years group (60%). The

60–69 years group showed a prevalence of 44.4%, while the 70–79 years group had the lowest prevalence (35.4%). In the oldest age group (>80 years), half of the participants (50%) had diabetes. Overall, 52% of participants were diabetic, while 48% were non-diabetic.

**Graph 3: Hypertension in each age group**  
Hypertension by Age Group

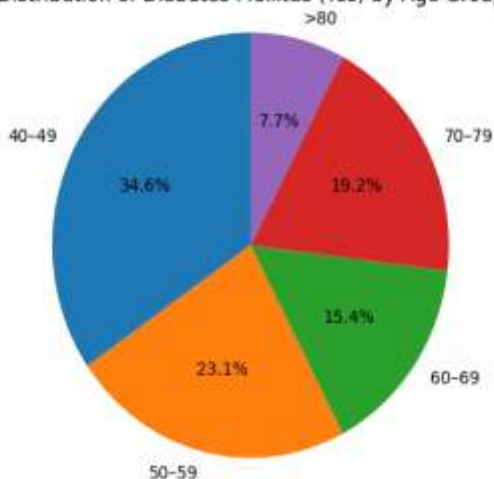


**Table 4: Diabetes mellitus in each group**

Age (Years)	Diabetes mellitus =Yes (n)	Yes (%)	Diabetes mellitus =No (n)	No (%)	Total(n)
40-49	9	60	5	33.3	15
50-59	6	66.6	3	33.3	9
60-69	4	44.4	5	55.5	9
70-79	5	35.4	9	64.2	14
>80	2	50	2	50	4
Total	26	52	24	48	50

**Graph 4: Diabetes mellitus in each group**

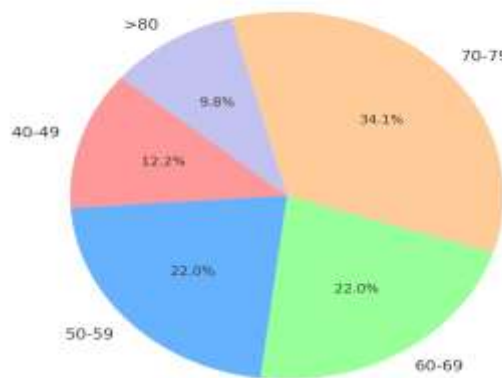
Distribution of Diabetes Mellitus (Yes) by Age Group



**menopausal status**

The distribution of menopausal status among different age groups of women with knee osteoarthritis (OA). Among participants aged 40–49 years, 9 women (18%) were premenopausal, and 5 women (10%) were postmenopausal. All participants in age groups 50–59, 60–69, 70–79, and >80 years were postmenopausal, with the highest proportion in the 70–79 years group (28%). Overall, 41 participants (82%) were postmenopausal, and 9 participants (18%) were premenopausal. These findings indicate that the majority of women with knee OA are postmenopausal.

**Graph 6: Postmenopausal status in each group**  
Post-Menopausal Status Distribution by Age Group

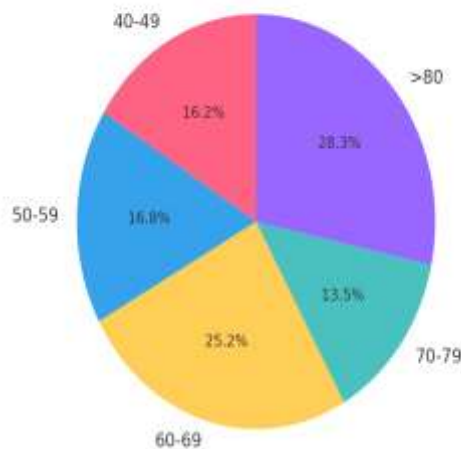


**Tobacco consumption**

The distribution of tobacco consumption among different age groups of women with knee osteoarthritis (OA). The prevalence of tobacco use varied across age groups, with the highest proportion observed in the >80 years group (75%) and the 60–69 years group (66.7%). The 50–59 years group had 44.4%, the 40–49 years group had 42.9%, and the 70–79 years group had the lowest proportion (35.7%). Overall, 24 participants (48%) reported consuming tobacco, while 26 participants (52%) did not. The higher prevalence of tobacco use in older age groups increases the risk of knee OA.

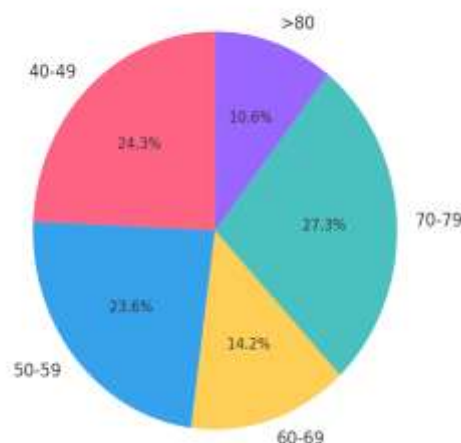
**Chart 7: Tobacco Consumption = Yes**

Age-wise Distribution - Tobacco Consumption = Yes



**Chart 8: Tobacco Consumption = No**

Age-wise Distribution - Tobacco Consumption = No



**Table 5:** Menopausal status in each group

Age (Years)	Premenopausal Status = (n)	Post Menopausal Status = (n)	Premenopausal Status (%)	Post Menopausal Status (%)	Total (n)
40-49	9	5	18	10	14
50-59	0	9	0	18	9
60-69	0	9	0	18	9
70-79	0	14	0	28	14
>80	0	4	0	8	4
Total	9	41	18	82	50

**Table 6:** Tobacco consumption in each group

Age (Years)	Tobacco Consumption =Yes (n)	Yes (%)	Tobacco Consumption =No (n)	No (%)	Total(n)
40-49	6	42.9	8	57.1	14
50-59	4	44.4	5	55.6	9
60-69	6	66.7	3	33.3	9
70-79	5	35.7	9	64.3	14
>80	3	75	1	25	4
Total	24	48	26	52	50

## DISCUSSION

The present cross-sectional study aimed to identify the risk factors associated with knee osteoarthritis (OA) among rural women above 40 years of age. The findings indicated that the majority of participants were postmenopausal (82%), with 52% exhibiting a body mass index (BMI) above 25 kg/m<sup>2</sup>, indicating overweight or obesity. Furthermore, 46% of participants reported hypertension, 52% had diabetes mellitus, 66% demonstrated low levels of physical activity, and 46% reported the habit of tobacco chewing. These findings suggest that both metabolic and lifestyle-related factors play a significant role in the development and progression of knee OA in rural women. Osteoarthritis is widely recognised as a multifactorial disease influenced by biological, biomechanical, metabolic, and environmental factors that interact to accelerate cartilage degeneration and joint damage.

The findings indicated that the majority of participants were postmenopausal, with a prevalence of 82%. One possible explanation for this is estrogen deficiency after menopause, which may accelerate cartilage turnover, promote cartilage erosion, and contribute to joint degeneration. Estrogen has been shown to exert a protective effect on articular cartilage and subchondral bone; therefore, its decline during menopause increases susceptibility to osteoarthritis. Macrini et al. demonstrated that estrogen deficiency in post-reproductive females contributes to cartilage degeneration and subchondral bone remodelling. Similarly, El Said et al. reported a higher frequency of primary knee OA among females, particularly those in postmenopausal age groups, confirming that hormonal changes are an important determinant of OA occurrence.

The association between obesity and knee OA identified in the present study corroborates previous findings that high BMI is a significant modifiable risk factor for knee osteoarthritis. Rahini and Hadaye also reported that overweight and obesity significantly increase the prevalence of knee OA among women above 45 years of age. Excess body weight increases mechanical loading across the knee joint, particularly in the medial compartment, leading to cartilage breakdown, joint space narrowing, and osteophyte formation. In addition to mechanical stress, adipose tissue releases inflammatory mediators such as interleukin-6 and tumour necrosis

factor- $\alpha$ , which contribute to systemic inflammation and cartilage degradation.

Hypertension was present in 46% of the participants, highlighting the increasing influence of metabolic comorbidities in the pathogenesis of knee OA. Hypertension may contribute to subchondral ischemia, thereby impairing cartilage nutrition and promoting cartilage destruction. Zhang et al. demonstrated that hypertensive individuals have a significantly increased risk of developing knee OA due to vascular insufficiency affecting the subchondral bone and cartilage metabolism. Cooper et al. also identified hypertension and other metabolic conditions as important contributors to OA incidence and progression.

In the present study, 52% of the participants were found to have diabetes mellitus, which was significantly associated with knee OA. Diabetes contributes to cartilage damage through the accumulation of advanced glycation end products (AGEs), which alter collagen properties and increase oxidative stress within joint tissues. Eymard et al. reported that diabetes mellitus significantly increases the risk of OA progression independent of BMI. These findings support the concept of metabolic osteoarthritis, where metabolic disorders such as diabetes, hypertension, and obesity act synergistically with mechanical factors to accelerate joint degeneration.

Another noteworthy risk factor identified in this study was tobacco chewing, reported by 46% of the participants. Tobacco exposure introduces oxidative stress and vascular compromise that may impair cartilage repair mechanisms and reduce subchondral bone perfusion. Yunus et al. highlighted the role of oxidative stress pathways in osteoarthritis pathogenesis, suggesting that environmental and lifestyle factors contributing to oxidative stress may accelerate cartilage degeneration. Furthermore, low levels of physical activity observed in 66% of the participants may further exacerbate OA progression by weakening periarticular muscles and increasing mechanical load on the knee joint.

The overall pattern of findings in the present study is consistent with the observations of Rahini and Hadaye, who reported that menopause, obesity, diabetes, and hypertension are major determinants of knee osteoarthritis among women above 45 years.

However, the present study extends these observations by including additional variables such as waist-hip ratio, tobacco use, and physical inactivity, which provide a broader understanding of risk exposure among rural women. Previous systematic reviews have also confirmed that OA is influenced by a complex interaction of hormonal, metabolic, and biomechanical factors.

In the context of rural India, these risk factors may be further amplified by limited healthcare access, delayed diagnosis, and lower awareness regarding preventive strategies. Rural women often prioritise occupational and family responsibilities over personal health, leading to late-stage presentation of musculoskeletal conditions. Therefore, community-based screening programs focusing on early identification of modifiable risk factors such as obesity, diabetes, hypertension, and physical inactivity are essential. Public health interventions promoting regular exercise, weight management, and cessation of tobacco use could significantly reduce the burden of knee osteoarthritis and improve quality of life in rural populations.

Despite providing valuable insights, the present study has certain limitations. The small sample size of 50 participants restricts the generalizability of the findings to the broader rural female population. As it was a cross-sectional study, the temporal relationship between risk factors and the development of knee osteoarthritis could not be established, limiting causal interpretation. The purposive sampling technique may have introduced selection bias, and reliance on self-reported information, such as tobacco use and menopausal status, may have led to recall bias. Furthermore, the study was limited to a single tertiary care hospital in Ahmednagar, which may not reflect the diverse socioeconomic and lifestyle characteristics of rural women in other regions. Additionally, the absence of radiological or biochemical confirmation and the lack of control for potential confounding factors such as dietary habits, genetic predisposition, and occupational stress further limit the comprehensiveness of the findings <sup>[15]</sup>.

## CONCLUSION

The present study confirms that postmenopausal status, high BMI, increased waist-hip ratio, hypertension, diabetes mellitus, and tobacco use are significant risk factors for knee OA among rural women above 40 years of age. These results emphasise the interplay of metabolic, hormonal, and lifestyle factors in OA pathogenesis. Early identification and modification of these risk factors through education, lifestyle changes, and preventive health initiatives can play a vital role in reducing the prevalence and disability associated with knee osteoarthritis in rural populations.

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## Conflict of interest

The authors declare that they have no conflict of interest.

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