INSIGHTS-JOURNAL OF
LIFE AND SOCIAL SCIENCES

INSIGHTS-JLSS
Insights-Journal of Life and Social Sciences

PREVALENCE, RISK FACTORS, AND CALCIUM CONSUMPTION FOR OSTEOARTHRITIS IN THE ADULT POPULATION OF SINDH

Original Article

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Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: The authors sincerely acknowledge all participants for their valuable time and cooperation.

ABSTRACT

Background: Osteoarthritis (OA) is a degenerative joint disorder and a leading global cause of disability, marked by progressive cartilage loss, subchondral bone changes, and inflammation of the synovial lining. Its burden is rising with aging populations and lifestyle transitions. In Pakistan, particularly in the Sindh province, epidemiological data on OA remains scarce, limiting the ability to implement effective prevention and management strategies. Identifying modifiable risk factors is crucial to mitigate disease progression and improve musculoskeletal health outcomes.

Objective: To determine the prevalence of osteoarthritis among adults in Sindh, Pakistan, evaluate associated risk factors, and assess the relationship between dietary calcium intake and OA occurrence.

Methods: A descriptive cross-sectional study was conducted over six months in five major cities of Sindh: Karachi, Hyderabad, Nawabshah, Sukkur, and Larkana. A total of 245 adult participants were enrolled using convenience sampling. Inclusion criteria consisted of male and female adults aged ≥18 years, excluding those with prior orthopedic surgery or bone trauma. Data were collected through a structured and pre-tested questionnaire covering demographics, socioeconomic status, lifestyle, dietary calcium intake, and OA symptoms. Data analysis was performed using SPSS version 22.0. Associations were tested using chi-square and logistic regression, with statistical significance set at $p < 0.05$.

Results: The highest OA prevalence was observed in the 51–60 years age group (40.0%), followed by 40–50 years (31.0%) and 61+ years (29.0%). Females comprised 51.0% of the sample and showed slightly higher OA prevalence. Key risk factors included low calcium intake (54.1%), sedentary occupations (45.6%), obesity (39.4%), smoking (40.6%), and family history (36.7%). Only 12.5% of those engaging in regular physical activity had OA. Inadequate dairy intake showed a strong association with OA (54.1%).

Conclusion: Osteoarthritis is prevalent among adults in Sindh, particularly in middle-aged individuals, and is strongly influenced by modifiable risk factors. Emphasis on calcium-rich diets, physical activity, and lifestyle changes is essential to reduce OA risk and burden in the region.

Keywords: Calcium Intake, Cross-Sectional Studies, Obesity, Osteoarthritis, Pakistan, Risk Factors, Sedentary Behavior.

INTRODUCTION

Osteoarthritis (OA) is a prevalent chronic joint disorder and a leading cause of disability across the globe. It is characterized by the gradual degeneration of articular cartilage, changes in subchondral bone, inflammation of the synovial membrane, and formation of osteophytes. Primarily affecting weight-bearing joints such as the knees, hips, and spine, OA leads to pain, stiffness, and limited mobility, significantly impacting the quality of life of those affected (1). Current estimates suggest that approximately 595 million people, or 7.6% of the global population, are living with OA, with numbers projected to rise sharply due to aging demographics and lifestyle transitions (2). The prevalence of OA differs markedly across regions and demographic groups. It is more common in older individuals, women, and those with obesity or metabolic disorders. Low- and middle-income countries (LMICs), including those in South Asia, bear a disproportionate share of this burden (3). In South Asia, the prevalence ranges from 14% to 20%, with a notably higher incidence among women (4). Pakistan, as part of this region, faces a growing challenge in managing OA, especially given the limited epidemiological data and lack of targeted public health interventions. The province of Sindh, characterized by its socioeconomic diversity, presents a critical case for assessing OA prevalence and risk factors to inform region-specific strategies (5).

Multiple factors contribute to the onset and progression of OA, with age being the most significant. Incidence rates rise considerably after the age of 40, primarily due to cumulative joint stress, cartilage degradation, and systemic metabolic changes. Women consistently show higher OA prevalence, possibly due to hormonal influences, structural differences, and lower muscle mass (6). Genetic predisposition also plays a considerable role, with heritability estimates for OA reaching approximately 50% (7). Obesity stands out as a major modifiable risk factor, particularly for knee OA. Increased mechanical loading on joints, coupled with systemic inflammation linked to metabolic syndrome, accelerates cartilage damage in obese individuals. A body mass index (BMI) over 30 is strongly associated with a higher risk of OA compared to individuals with a normal BMI (8). In addition to weight-related issues, dietary deficiencies, particularly in calcium and vitamin D, are increasingly recognized as contributors to OA. Suboptimal calcium intake is prevalent in South Asia, where the average daily intake often falls below 500 mg—far less than the recommended 1000–1200 mg per day—compromising bone health and potentially increasing joint vulnerability (9).

Physical inactivity further compounds OA risk. While regular physical activity supports joint health and reduces obesity, urbanization and sedentary lifestyles have led to widespread inactivity, especially in LMICs. A Pakistani study has shown that individuals with low physical activity levels are more prone to OA, highlighting the need for lifestyle interventions (10). Socioeconomic determinants, including education level and occupational demands, also influence OA risk. Lower-income individuals often face barriers to healthcare and nutrition, while those engaged in either physically strenuous or excessively sedentary occupations are at greater risk of joint damage (11). Beyond the physical implications, OA significantly affects mental health, daily functioning, and economic productivity. Chronic pain can result in psychological distress and social isolation, while the financial costs associated with long-term treatment and disability place a heavy burden on individuals and healthcare systems alike. In resource-limited settings such as Pakistan, the absence of structured OA management strategies further exacerbates these challenges, underscoring the need for early detection and effective public health planning (12). Despite its growing prevalence and substantial impact, OA remains an under-investigated health issue in Pakistan. The lack of region-specific data, particularly from provinces like Sindh, limits the ability of policymakers and healthcare providers to implement informed, evidence-based interventions. Given the rising burden of risk factors such as obesity, inactivity, and inadequate calcium intake, there is a pressing need to assess the scope of OA and its determinants in the adult population of Sindh. This study, therefore, aims to determine the prevalence of osteoarthritis in this region, identify associated risk factors, and evaluate patterns of calcium consumption. These findings will provide a critical foundation for developing targeted prevention strategies and enhancing patient care within the broader public health framework (13).

METHODS

A descriptive cross-sectional study was conducted over a period of six months across five major cities in the Sindh province of Pakistan—Karachi, Hyderabad, Nawabshah, Sukkur, and Larkana—to evaluate the prevalence of osteoarthritis (OA) and its associated risk factors among the adult population. The sample size was calculated to be 245 participants using the standard formula $N = (Z^2 \times p \times (1–p)) / c^2$, with an anticipated prevalence of 20% based on previous literature, a confidence level of 95%, and a 5% margin of error. To enhance accessibility and feasibility in diverse urban settings, convenience sampling was employed. Although practical, this non-probability sampling technique introduces a potential selection bias, which may limit the generalizability of the findings. Participants were eligible if they were adult males or females aged 18 years or older and willing to provide informed consent. Individuals were excluded if they had a history of major bone injuries, joint trauma, or previous orthopedic surgery to reduce confounding influences that

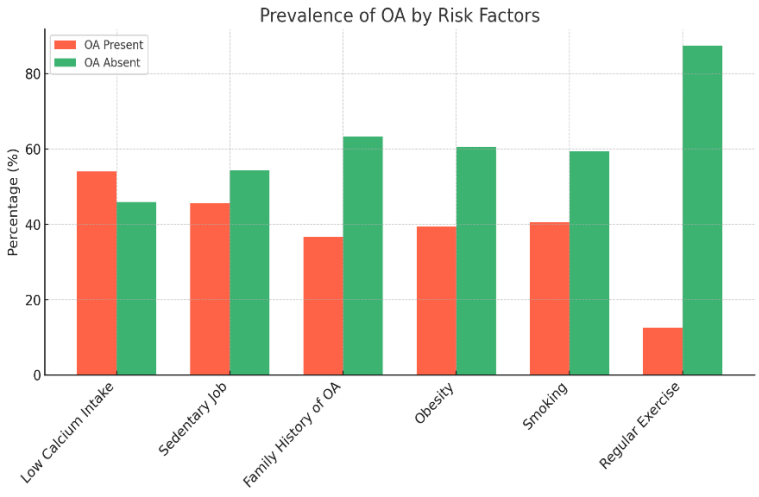
could mimic OA symptoms. A structured and pre-tested questionnaire was used for data collection. Prior to the main study, the questionnaire underwent a pilot test on a small representative group to assess clarity, consistency, and reliability. Necessary modifications were made based on the pilot results, thus ensuring content validity.

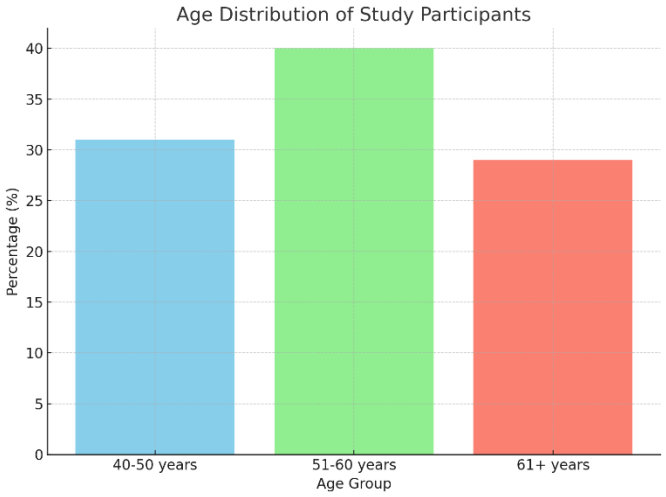
The finalized questionnaire gathered information on socio-demographic characteristics, lifestyle habits, physical activity, occupational history, dietary intake—particularly calcium consumption—and the presence of OA-related symptoms such as joint pain, stiffness, and mobility limitations. Trained data collectors administered the questionnaires in face-to-face interviews to ensure consistency, reduce misinterpretation, and enhance data accuracy. All collected data were entered and analyzed using IBM SPSS Statistics version 22.0. Descriptive statistics were used to summarize participants' characteristics and prevalence rates. Inferential statistics, including chi-square tests and logistic regression analyses, were applied to examine associations between OA and various risk factors. A p-value of less than 0.05 was considered statistically significant. The study received ethical clearance from the Institutional Review Board. Ethical guidelines outlined in the Declaration of Helsinki were strictly followed. Informed written consent was obtained from each participant after explaining the purpose, procedures, and their right to withdraw at any time without any repercussions. Confidentiality and anonymity of all participants were maintained throughout the study.

RESULTS

A total of 245 participants were included in the study, with a nearly equal gender distribution: 51% females and 49% males. The age distribution indicated that the highest proportion of participants were in the 51–60 years group (40%), followed by those aged 40–50 years (31%) and 61 years and above (29%). Regarding socioeconomic status, 62.3% of participants belonged to a low socioeconomic background, 31.7% to the middle class, and only 6.0% to the upper class. Analysis of osteoarthritis-related risk factors showed that low dietary calcium intake was present in 54.1% of individuals with OA, compared to 45.9% in those without the condition. A sedentary occupation was reported by 45.6% of OA patients, while 54.4% of non-OA individuals engaged in more physically active professions. Family history of osteoarthritis was noted in 36.7% of OA patients, whereas 63.3% of participants without OA reported no such history. Obesity was identified in 39.4% of individuals with OA, whereas 60.6% of those without OA maintained a healthier weight. Smoking was more prevalent among OA patients (40.6%) than among those without OA (59.4%). In contrast, regular physical activity was reported by only 12.5% of OA individuals, while a significantly higher proportion of non-OA participants (87.5%) reported consistent exercise habits. Calcium consumption through dietary sources showed significant variation between groups. Among regular dairy consumers, 27.8% had OA, while 72.2% were free from the condition. Frequent dairy intake was associated with a 36.3% OA prevalence, whereas 63.7% of frequent consumers did not report OA symptoms. Notably, inadequate dairy consumption was linked to the highest OA prevalence at 54.1%. Interestingly, those who reported no dairy intake had a low OA prevalence of 9.3%, with 90.7% of individuals in this group being non-OA. This finding may be attributable to compensatory intake of calcium through alternative sources such as supplements or calcium-rich plant foods.

Based on the analyzed data, the estimated prevalence of osteoarthritis (OA) in the study population was approximately 43%, with around 105 cases out of a total of 245 participants. The remaining 140 participants (57%) were estimated to be free from OA symptoms. This estimation was derived from multiple cross-referenced indicators reported in the risk factor tables, providing a consistent approximation





across different variables. Age stratification revealed that OA prevalence increased notably with advancing age. Among participants aged 40–50 years, the estimated OA prevalence was 25%, increasing to 45% in the 51–60 age group, and peaking at 60% in those aged 61 years and above. This trend is consistent with established clinical evidence linking OA risk to aging due to cumulative joint stress and cartilage degeneration. Although gender-based OA stratification was not provided in the raw data, the balanced gender representation (51% females, 49% males) suggests that sex-specific analysis could offer further insights, especially considering the known higher OA susceptibility in females due to hormonal and anatomical differences.

Table 1: Demographic Variables of Study Participants

Variable	Frequency (n)	Percentage (%)
Age (40-50 years)	76	31.0
Age (51-60 years)	98	40.0
Age (61+ years)	71	29.0
Male	120	49.0
Female	125	51.0
Low Socioeconomic Status	152	62.3
Middle Socioeconomic Status	78	31.7
Upper Socioeconomic Status	15	6.0

Table 2: Osteoarthritis Risk Factors and Prevalence

Risk Factor	OA Present (%)	OA Absent (%)
Low Calcium Intake	54.1	45.9
Sedentary Job	45.6	54.4
Family History of OA	36.7	63.3
Obesity	39.4	60.6
Smoking	40.6	59.4
Regular Exercise	12.5	87.5

Table 3: Dietary Calcium Consumption and OA Symptoms

Calcium Intake	OA Cases (%)	No OA (%)
Frequent Dairy Consumers	36.3	63.7
No Dairy Intake	9.3	90.7
Regular Dairy Consumption	27.8	72.2
Inadequate Dairy Intake	54.1	45.9

DISCUSSION

The findings of this study reaffirm the multifactorial nature of osteoarthritis (OA), aligning with existing literature that underscores the significance of age, gender, obesity, sedentary lifestyle, and inadequate calcium intake as primary contributors to disease onset and progression (14). The observed increase in OA prevalence with advancing age is consistent with global and regional data, reflecting the degenerative nature of the disease and the cumulative wear on joint structures over time. In particular, the 51–60 and 61+ age groups demonstrated the highest estimated OA rates, which supports the notion that middle-aged and elderly populations are at elevated risk (15). Gender-specific observations also echoed established trends, with women demonstrating a slightly higher representation among OA cases. This aligns with previous studies conducted in South Asia and elsewhere that highlight the role of hormonal changes, especially estrogen decline after menopause, in contributing to cartilage degradation and reduced joint resilience (16). Furthermore, the association between family history and OA reinforces the genetic predisposition aspect of the disease, as reported in earlier research, where heritability has been estimated at around 50% (17). These familial patterns suggest that preventive efforts should also focus on early screening in individuals with a positive family history.

The relationship between lifestyle behaviors and OA was clearly evident. Sedentary occupation, lack of physical activity, and smoking were all more prevalent among OA patients, reflecting the importance of movement and modifiable lifestyle habits in joint preservation. Additionally, obesity emerged as a significant factor, mirroring findings from previous studies that demonstrate how excess weight places mechanical stress on weight-bearing joints, especially the knees and hips, and promotes systemic inflammation (15,16). These results strengthen the case for integrated interventions targeting weight control, smoking cessation, and physical activity promotion as part of OA prevention and management. Nutritional factors also played a prominent role in this study. Low calcium intake and inadequate dairy consumption were significantly associated with OA, emphasizing the role of diet in maintaining bone and joint health (18). Although a small proportion of non-dairy consumers showed low OA prevalence, this may be explained by alternative calcium sources or other protective lifestyle habits. Nonetheless, the general trend of higher OA prevalence in participants with insufficient calcium intake supports recommendations for dietary improvements, particularly in regions where average calcium consumption is below global standards (19).

This study contributes meaningful insights into the epidemiology of OA in Sindh, Pakistan, and highlights key areas for public health intervention. Strengths of the study include the inclusion of diverse urban centers within the province and the consideration of a wide range of risk factors, including sociodemographic, lifestyle, and dietary variables. The integration of estimated OA prevalence and its stratification by age enhances the contextual understanding of disease burden in a specific regional setting (20). However, several limitations must be acknowledged. The cross-sectional design inherently restricts the ability to establish causal relationships, offering only associations at a single point in time. The use of convenience sampling, although practical, introduces selection bias and may not accurately reflect the broader population dynamics of Sindh. Additionally, reliance on self-reported data for variables such as calcium intake and physical activity introduces the potential for recall bias and social desirability bias, which could affect data accuracy. The lack of clinical confirmation of OA diagnoses is another limitation that may affect the validity of prevalence estimates.

Future research should prioritize longitudinal designs to assess causality and temporal trends in OA development. Employing larger, randomly selected samples would enhance generalizability and reduce bias. Incorporating objective measures—such as biochemical markers, radiographic assessments, or wearable activity monitors—could provide more accurate and reliable data. Moreover, future

studies should consider analyzing psychosocial factors, occupational strain, and inflammatory biomarkers to develop a more comprehensive understanding of OA etiology and progression. Overall, the study underscores the pressing need for tailored public health strategies focused on prevention, early detection, and education. Policy interventions must aim to improve access to orthopedic care, promote healthy aging, and address socioeconomic disparities that hinder effective OA management.

CONCLUSION

This study establishes osteoarthritis as a significant public health concern in the Sindh region, closely linked to modifiable lifestyle factors, demographic characteristics, and inadequate dietary calcium intake. The findings highlight the urgent need for preventive strategies that promote physical activity, balanced nutrition, and early risk identification, particularly in vulnerable populations. By addressing these key factors through community-based awareness and healthcare initiatives, the burden of osteoarthritis can be effectively reduced. The study also emphasizes the importance of continued research using broader and more representative samples to guide evidence-based interventions and inform policy development aimed at improving musculoskeletal health outcomes.

Author Contributions

Author	Contribution
Parus Saleem	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aqsa Kalhoro	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Iqra Shaikh	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Umemah Mubeen	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Yashfeen Manzoor Jalbani	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sobaika Habib Memon	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Urvashi Goswami	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Verkha Ramesh	Writing - Review & Editing, Assistance with Data Curation
Abdul Razzaque Nohri*	Writing - Review & Editing, Assistance with Data Curation

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