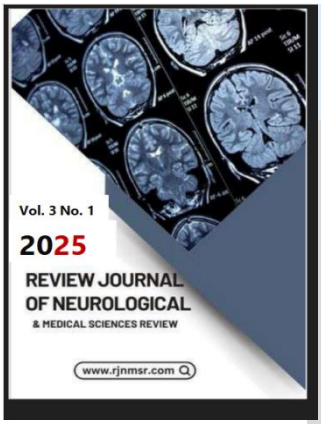

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Prevalence of Knee Osteoarthritis in Rural Adults of District Swat, KPK: A Cross-Sectional Study

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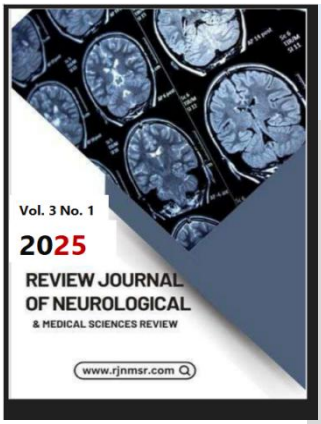
Abstract

Background: Knee osteoarthritis (KOA) is a prevalent degenerative joint disease causing significant disability, particularly in rural populations with limited healthcare access and physically demanding lifestyles. **Objective**: This study aimed to estimate the prevalence of KOA among adults aged 40 and above in rural Swat, Khyber Pakhtunkhwa (KPK), Pakistan, and identify associated demographic, occupational, and lifestyle risk factors. **Methods**: A cross-sectional community-based study was conducted with a sample size of 361 participants, selected through stratified random sampling. Data were collected using a self-structured questionnaire for demographic and lifestyle information and clinical assessments based on the American College of Rheumatology (ACR) criteria and Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain scale. Statistical analysis was performed using SPSS, with chi-square tests to assess associations. **Results**: The overall prevalence of KOA was 70%, with 80% in females (n=105/130) and 64%



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in males (n=148/231). Key risk factors included female gender (p=0.001), higher body mass index (BMI) (p<0.001), older age (p<0.001), lower education levels (p<0.001), and occupations involving heavy physical labor (p<0.001). Rural residency was associated with higher prevalence (58% in villages vs. 43% in towns). **Conclusion**: KOA is highly prevalent in rural Swat, particularly among females, older adults, and those with higher BMI and labor-intensive occupations. Targeted interventions, such as mobile joint care units and community education, are recommended to address this burden.

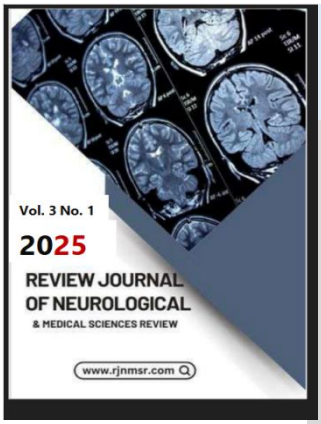
Keywords: Knee osteoarthritis, prevalence, risk factors, rural population, ACR criteria, WOMAC score

Introduction

In the rugged, verdant valleys of District Swat, Khyber Pakhtunkhwa, where the rhythm of life is dictated by the demands of agriculture and manual labor, a silent epidemic unfolds. Knee osteoarthritis (KOA), a degenerative joint disease marked by the gradual erosion of cartilage, inflammation of the synovium, and alterations in subchondral bone, casts a long shadow over the lives of rural adults. The condition manifests as persistent pain, stiffness, and reduced mobility, transforming routine tasks—such as tending to crops or carrying water from a distant well—into daunting challenges. For many in Swat's rural communities, where healthcare facilities are sparse and often hours away, KOA is not merely a medical condition but a profound disruptor of daily existence, eroding quality of life and limiting participation in the cultural and economic fabric of their villages.

Globally, KOA is a formidable public health concern, recognized as the eleventh leading cause of disability according to the Global Burden of Disease Study of 2010. Its impact is particularly pronounced in regions like South Asia, where prevalence rates in rural areas can soar as high as 13.7%, nearly double the 6.9% observed in urban settings. The disease disproportionately affects older adults, women, and those whose livelihoods depend on physically demanding work. In Pakistan, where urban studies have reported KOA prevalence as high as 56.7%, the rural landscape remains underexplored, particularly in regions like Swat, where unique socio-economic and environmental factors converge to amplify risk. The agricultural backbone of Swat, coupled with limited access to medical care, creates a perfect storm for KOA, as repetitive knee stress from farming, squatting during household chores, and carrying heavy loads takes its toll on aging joints.

The roots of KOA are multifactorial, intertwining biological, environmental, and lifestyle elements. Age is a relentless driver, with cartilage naturally deteriorating over time, a process accelerated in those over 50. Gender plays a pivotal role, with women facing heightened risk, potentially due to hormonal shifts post-menopause that weaken joint integrity. Obesity, a growing concern even in rural Pakistan, exerts excessive mechanical stress on the knees, with studies indicating that each kilogram of body weight generates up to six kilograms of force on the joint. Occupations that involve prolonged standing, heavy lifting, or repetitive knee bending—common in Swat's farming and labor-intensive households—further exacerbate the condition. Low education levels, prevalent in rural areas, compound the issue by limiting health



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literacy and awareness of preventive measures. These factors, woven into the fabric of rural life, create a complex tapestry of risk that demands localized investigation.

In Swat, the absence of comprehensive data on KOA prevalence and its determinants has left a critical gap in public health planning. While studies from urban Pakistan and neighboring countries like India and Bangladesh provide valuable insights, they fail to capture the unique challenges of rural KPK, where cultural practices, such as prolonged squatting during meals or prayers, and environmental factors, like uneven terrain, may amplify KOA's burden. The reliance on traditional healers and over-the-counter painkillers, coupled with delayed healthcare-seeking behavior, further complicates management, allowing the disease to progress unchecked until it severely impairs mobility and independence.

This study was born out of a need to illuminate the scale and drivers of KOA in rural Swat, a region where the interplay of poverty, physical labor, and limited healthcare access creates a crucible for joint disease. By estimating the prevalence of KOA among adults aged 40 and above, we sought to quantify the burden on this community, providing a foundation for targeted interventions. Equally important was our aim to identify the demographic, occupational, and lifestyle factors fueling this condition—whether it be the weight of obesity, the wear of manual labor, or the vulnerability of aging women. We hypothesized that KOA would be more prevalent among females, older adults, and those with higher body mass indices and labor-intensive occupations, mirroring global trends but intensified by Swat's rural context. Through a cross-sectional lens, this research endeavors to not only document the scope of KOA but also to amplify the voices of those whose daily struggles with knee pain often go unnoticed, paving the way for solutions that resonate with the realities of rural life.

A systematic review by Cui et al. (2020) estimated a global KOA prevalence of 654.1 million individuals in 2020, with higher rates in Asia (1.69% in females vs. 1.39% in males) [6]. In South Asia, studies from India, Pakistan, and Bangladesh report rural prevalence rates of 13.7% compared to 6.9% in urban areas [7]. In Pakistan, a study in Bahawalpur found 72% of KOA patients were female, highlighting gender disparities [8].

Key risk factors for KOA include:

Age: Prevalence increases with age, with rates of 60% in those aged 60–75 years [9].

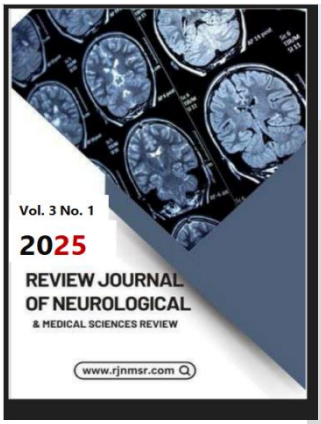
Gender: Females are more susceptible, potentially due to hormonal changes post-menopause [10].

Obesity: Higher BMI increases mechanical stress on knees, with each kilogram of body weight producing 6 kg of stress [11].

Occupation: Manual labor and household chores, common in rural settings, are associated with higher KOA risk [12].

Education: Lower education levels correlate with increased KOA prevalence, possibly due to limited health literacy [13].

The American College of Rheumatology (ACR) criteria, which include knee pain plus three of age >50 years, morning stiffness <30 minutes, crepitus, bony tenderness, bony enlargement, and no palpable warmth, are widely used for clinical diagnosis



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[14]. The WOMAC scale assesses pain and functional limitations, complementing ACR criteria [15].

While global and regional studies provide robust data, there is a lack of research specific to rural KPK, particularly Swat. This study addresses this gap by providing localized prevalence estimates and risk factor analysis.

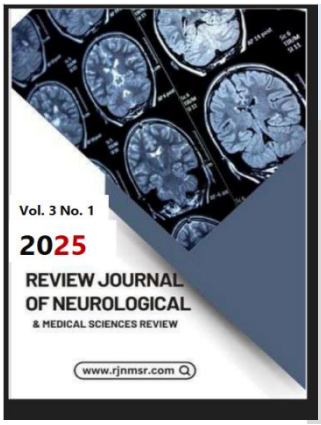
Materials and Methods

To explore the prevalence and risk factors of knee osteoarthritis (KOA) in rural Swat, we embarked on a cross-sectional, community-based journey that unfolded across the verdant villages and small towns of District Swat, Khyber Pakhtunkhwa, from June 2023 to September 2024. Over these 15 months, we sought to capture a snapshot of KOA's burden among adults aged 40 and above, permanent residents of this rural landscape, whose lives are shaped by the rhythms of agriculture and manual labor. Our approach was methodical, designed to ensure both scientific rigor and respect for the communities we served, weaving together careful planning, ethical considerations, and hands-on data collection.

The foundation of our study rested on a carefully calculated sample size, determined using Cochran's formula, which assumed a 30% prevalence of KOA based on regional estimates, a 5% margin of error, and a 95% confidence level. This yielded an initial sample of 323 participants, which we adjusted to 350 to account for potential non-responses, ultimately enrolling 361 individuals. To ensure our sample reflected the diversity of Swat's rural terrain, we employed stratified random sampling, dividing the region into geographic clusters of villages and small towns. This approach allowed us to capture the nuances of life in both remote hamlets and slightly more connected townships, ensuring representativeness across the district.

We set clear boundaries for participation to focus our inquiry. Only adults aged 40 and above, who had lived in rural Swat long-term, were included, as this group is most vulnerable to KOA's degenerative effects. We excluded those with traumatic knee injuries, rheumatoid arthritis, or other joint diseases to avoid confounding our findings, as well as non-residents or those unwilling to participate, respecting their autonomy. This careful selection process ensured our data would reflect the true burden of KOA in our target population.

Data collection was a multifaceted endeavor, blending structured tools with clinical precision. At the heart of our approach was a self-structured questionnaire, meticulously designed to capture the intricacies of participants' lives. It gathered demographic details—age, gender, education, occupation, marital status, and residency—alongside lifestyle habits like physical activity, smoking, and diet, and clinical histories, including family history and chronic diseases. To diagnose KOA, we relied on the American College of Rheumatology (ACR) criteria, a clinical standard that identifies the disease through symptoms like knee pain, morning stiffness, and physical signs such as crepitus or bony tenderness. For those reporting knee pain, we used the Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain scale to quantify symptom severity, providing a deeper understanding of KOA's impact. Anthropometric measurements rounded out our data collection, with height



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measured using a stadiometer, weight recorded via a digital scale, and body mass index (BMI) calculated to assess obesity's role in KOA risk.

Ethics guided every step of our process. The study received approval from the Institutional Review Board (IRB) of Iqra National University Swat Campus, ensuring alignment with international standards of research integrity. We sought informed consent from each participant, offering forms in English, Pushto, and Urdu to ensure accessibility across linguistic divides. Confidentiality was paramount; all data were anonymized, protecting participants' identities while allowing us to analyze trends with candor. Participation was voluntary, and we communicated clearly that while the study offered no direct benefits, it could contribute to future healthcare improvements in their communities.

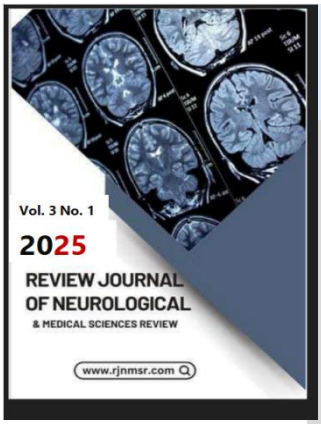
Our data collection unfolded in the heart of rural Swat, through house-to-house surveys and gatherings at community meeting points, where trust and cooperation were fostered by local leaders. Trained researchers, fluent in local languages and customs, administered questionnaires with sensitivity, ensuring participants felt heard and respected. Physical examinations, guided by ACR criteria, were conducted with care, often in the privacy of homes or shaded community spaces, while WOMAC scores were calculated for those reporting pain, adding depth to our clinical insights. This hands-on approach, spanning months of fieldwork, allowed us to build a rich dataset grounded in the realities of rural life.

Once collected, the data were analyzed using SPSS version 25, a robust statistical tool that brought clarity to our findings. Descriptive statistics painted a vivid picture of participant characteristics, from age and gender to occupation and education levels. To explore associations between KOA and risk factors like gender, BMI, age, education, occupation, and residency, we employed chi-square tests, setting a significance threshold of $p<0.05$. This analytical approach allowed us to uncover patterns and relationships, illuminating the drivers of KOA in Swat's rural communities.

Through this meticulous process, we sought not only to quantify KOA's prevalence but also to honor the lived experiences of those who shared their stories, their pain, and their resilience. Our methods, rooted in scientific precision and cultural sensitivity, aimed to lay the groundwork for meaningful interventions that could ease the burden of KOA in rural Swat.

Results

As we move through the villages and small towns of rural Swat, our study of knee osteoarthritis (KOA) revealed a stark reality about the health challenges faced by this community. Among the 361 adults aged 40 and above who participated, we found a diverse group reflective of the region's rural fabric. Men made up 63% of the sample, with 231 individuals, while women comprised 36%, totaling 130. Their ages averaged 56 years, ranging from the early 40s to over 70, capturing a broad spectrum of life stages. Most were married, with 93% tied to family life, and a striking 82% lived in villages, immersed in the agricultural rhythms of Swat. Education levels were low, with 52% of participants illiterate, a testament to the region's socio-economic challenges. Occupations painted a picture of hard labor: 33% were housewives, 43%



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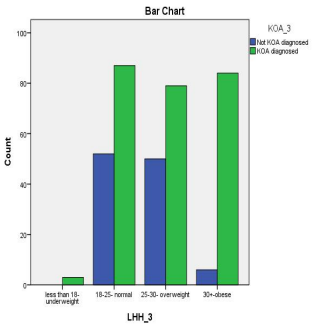
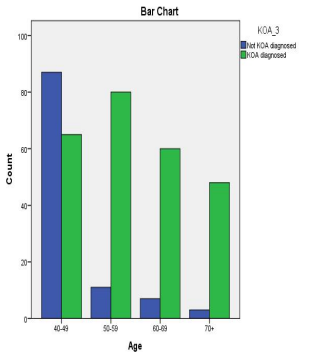
were employed in various roles, and 10% were farmers, their days shaped by physical demands.

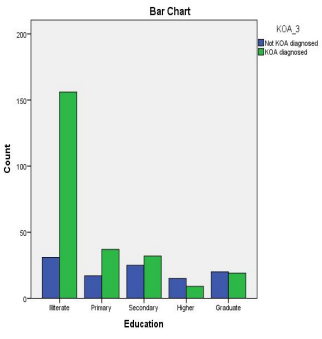
The prevalence of KOA emerged as a sobering centerpiece of our findings. Across the entire sample, 70%—or 253 individuals—met the American College of Rheumatology criteria for KOA, signaling a profound burden on this rural population. Women were particularly affected, with 80% of the 130 female participants (105 individuals) diagnosed, compared to 64% of the 231 men (148 individuals). Statistical analysis using chi-square tests confirmed this gender disparity as significant, with a p-value of 0.001, underscoring that women in Swat face a heightened vulnerability to KOA.



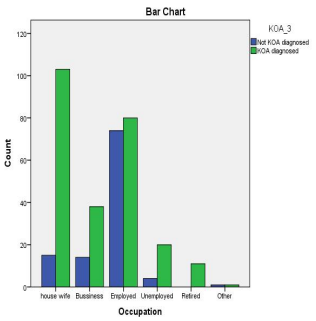
Delving deeper, we explored how body mass index (BMI) intertwined with KOA's prevalence. Among the 90 participants classified as obese (BMI ≥30), a staggering 93% (84 individuals) had KOA, the highest rate observed. Those who were overweight (BMI 25–30) followed, with 61% of 129 individuals (79 people) affected, while 63% of the 139 participants with normal BMI (18–25) (87 individuals) were diagnosed. The three underweight participants (BMI <18) all had KOA, though their small number limited broader conclusions. The association between BMI and KOA was highly significant (p<0.001), with a clear trend—illustrated in our data visualizations—showing that higher BMI amplified KOA risk, likely due to increased mechanical stress on the knees.

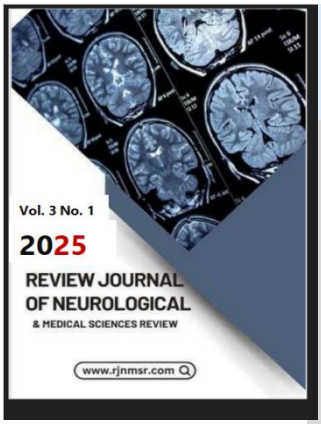


Age proved another powerful driver of KOA. Among the 152 participants aged 40–49, 43% (65 individuals) had KOA, a notable but relatively lower rate. The prevalence surged with advancing age: 88% of the 91 participants aged 50–59 (80 individuals), 90% of the 67 aged 60–69 (60 individuals), and 94% of the 51 aged 70 and above (48 individuals) were diagnosed. This sharp escalation, statistically significant at p<0.001, highlighted the relentless progression of joint degeneration over time, with older adults bearing the brunt of KOA's impact.



Education levels also shaped KOA's footprint. Among the 187 illiterate participants, 83% (156 individuals) had KOA, the highest rate across educational categories. Those with primary education (69%), secondary education (56%), higher education (38%), and graduate-level education (49%) showed progressively lower prevalence, though numbers in higher education groups were smaller. This inverse relationship, significant at p<0.001, suggested that limited education—and potentially lower health literacy—amplified KOA's prevalence,





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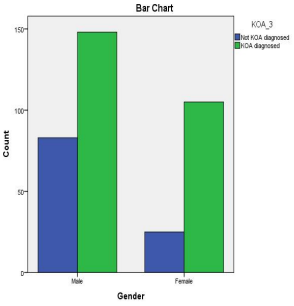
perhaps by hindering awareness of preventive measures.



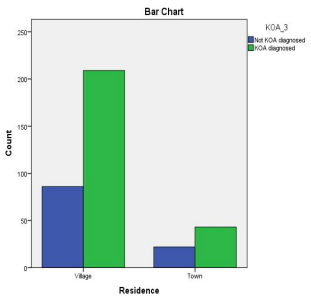
Occupational patterns further illuminated KOA's reach. Housewives, numbering 118, faced an 87% prevalence (103 individuals), reflecting the toll of repetitive tasks like squatting and lifting in domestic work. Employed individuals, totaling 154, had a 52% prevalence (80 individuals), while farmers, though fewer at 36, showed a 72% rate (26 individuals). These differences, significant at $p<0.001$, underscored the impact of labor-intensive roles, where prolonged physical strain on the knees likely accelerated joint wear.

Residency offered a subtler insight. Village residents, comprising 295 participants, had a 71% KOA prevalence (209 individuals), slightly higher than the 66% among the 65 town residents (43 individuals). However, this difference was not statistically significant ($p=0.455$), suggesting that the rural lifestyle—whether in remote villages or small towns—imposed similar risks, likely due to shared occupational and environmental stressors.

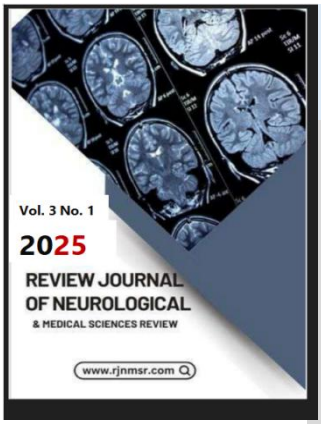
Our statistical analysis, anchored in chi-square tests, confirmed that gender, BMI, age, education, and occupation were significantly associated with KOA ($p<0.05$), painting a clear picture of the risk factors driving its prevalence. Residency, however, stood apart as the only factor without a significant link, hinting at the uniformity of KOA's burden across Swat's rural landscape. These findings, visualized in tables and figures, brought to life the complex interplay of demographic and lifestyle factors fueling KOA, offering a foundation for understanding its profound impact on this community.

Discussion

The journey through rural Swat revealed a stark truth: knee osteoarthritis (KOA) casts a heavy shadow over the lives of its people, with 70% of the 361 adults studied bearing its burden. This prevalence, far exceeding the 13.7% reported in other Asian rural settings, paints a picture of a community grappling with a public health challenge amplified by the region's unique circumstances. The agricultural lifestyle, where days are spent bending over crops or hauling heavy loads, coupled with scarce healthcare access and a rising tide of obesity, creates a perfect storm for KOA in Swat. Unlike urban centers, where medical facilities and awareness might temper the disease's impact, rural Swat's isolation and resource constraints allow KOA to flourish, often unchecked until it robs individuals of mobility and independence.



The pronounced gender disparity, with 80% of women affected compared to 64% of men, echoes findings from studies like those in Bahawalpur, where 72% of KOA patients were female. This gap likely stems from a blend of biology and culture. Hormonal changes post-menopause may weaken women's joints, but the daily grind of household chores—squatting to cook, clean, or wash clothes—adds a relentless mechanical strain. In Swat, where traditional roles often confine women to such tasks, these repetitive movements become a silent catalyst for KOA. Men, while not spared, face different



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pressures, often tied to farming or labor-intensive jobs, which explains their still-high 64% prevalence. This male burden, notably higher than in some global studies, suggests that Swat's occupational landscape, with its unrelenting physical demands, leaves few unscathed.

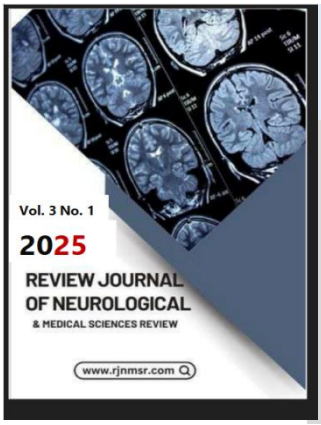
Obesity emerged as a formidable driver, with 93% of obese participants suffering from KOA, a finding that aligns with research showing that each kilogram of body weight exerts up to six kilograms of force on the knees. In Swat, where dietary shifts toward processed foods and sedentary habits are creeping into rural life, the obesity epidemic is no longer an urban concern. The stark correlation between higher BMI and KOA underscores a critical need for weight management programs, yet the challenge lies in delivering these in a region where nutritional education is scarce and economic pressures prioritize survival over health. The data, visualized in our figures, tell a clear story: as BMI rises, so does the likelihood of KOA, a trend that demands urgent attention.

Age, too, tells a relentless tale. The prevalence leapt from 43% in those aged 40–49 to 94% in those over 70, mirroring global patterns where cartilage degeneration accelerates with time. In Swat, where life expectancy is climbing but healthcare lags, older adults face a double burden: their joints bear the cumulative wear of decades of labor, and their access to pain relief or joint care is limited. The sharp rise after age 50 signals a window for early intervention—perhaps through community-based exercise programs or joint protection education—but implementing these in remote villages requires innovative solutions like mobile health units.

Education, or the lack thereof, further deepens KOA's grip. The 83% prevalence among illiterate participants, compared to just 38% among those with higher education, points to a knowledge gap that shapes health outcomes. Limited literacy likely curbs understanding of preventive measures, like proper posture or weight control, leaving illiterate individuals—over half our sample—vulnerable. This finding resonates with studies linking low health literacy to chronic disease burdens, yet in Swat, where 52% of participants never attended school, the challenge is not just education but access to it. Community outreach, perhaps through local leaders or radio campaigns, could bridge this gap, but it requires resources and commitment.

Occupational patterns reinforce the physical toll of rural life. Housewives, with an 87% prevalence, and farmers, at 72%, bear the brunt of KOA, their days filled with repetitive knee stress—squatting, lifting, or trudging over uneven fields. Employed individuals, at 52%, fare better but are still at risk, particularly those in manual labor. These findings align with research tying occupational knee strain to KOA, but Swat's context, where mechanization is rare and manual work is a way of life, intensifies the risk. Interventions like ergonomic training or affordable knee supports could help, but their delivery in a region with limited infrastructure is a logistical puzzle.

Residency, surprisingly, showed no significant divide, with village and town prevalence rates nearly identical. This lack of difference, with a p-value of 0.455, suggests that KOA's drivers—labor, obesity, and limited healthcare—permeate all corners of rural Swat. Villages, with their rugged terrain and farming demands, might be expected to fare worse, but towns, despite slightly better access to services,



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mirror the same risks. This uniformity hints at a shared rural lifestyle, where occupational and environmental stressors outweigh geographic distinctions.

Comparing Swat's 70% prevalence to other regions reveals both similarities and anomalies. Rural India reports 41%, and China just 10.3%, suggesting Swat's burden is unusually high. Methodological differences, like our reliance on clinical rather than radiographic diagnosis, may inflate estimates by capturing symptomatic cases, but Swat's socio-economic reality—poverty, physical labor, and healthcare gaps—likely plays a larger role. The gender disparity aligns with global trends, yet the high male prevalence points to local factors, like farming's toll, that set Swat apart. These comparisons highlight the need for context-specific interventions, as solutions from India or China may not translate to Swat's rugged terrain and cultural norms.

The study's limitations temper our conclusions. Its cross-sectional design captures a moment in time, not causality, leaving questions about how risk factors like obesity or occupation drive KOA's onset. The absence of radiographic confirmation risks overdiagnosing symptomatic cases or missing silent ones, a common challenge in resource-constrained settings. Self-reported data, prone to recall bias, may skew lifestyle or health history responses. The findings, while robust for rural Swat, may not extend to urban areas or other regions, where lifestyles and healthcare access differ. Finally, while our sample size of 361 was adequate, a larger cohort could refine precision, particularly for smaller subgroups like underweight participants.

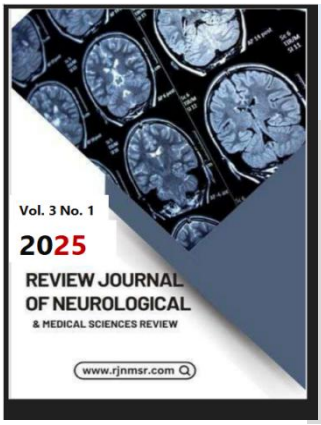
Despite these constraints, the implications are clear: KOA is a public health crisis in rural Swat, demanding action. Community education on weight management and joint protection could empower residents, but it must be accessible, perhaps through local health workers trained in KOA basics. Mobile joint care units, bringing screening and treatment to remote villages, could bridge the healthcare gap, a strategy proven effective in other rural settings. Training local providers to manage KOA, from prescribing exercises to administering basic pain relief, could build resilience in a region where specialists are rare. These steps, while ambitious, are critical to easing the burden on Swat's people, whose resilience in the face of pain and disability inspires both urgency and hope.

Conclusion

This study confirms a high KOA prevalence (70%) in rural Swat, with significant associations with female gender, older age, higher BMI, lower education, and labor-intensive occupations. Rural residency amplifies risk due to occupational and healthcare access challenges. These findings underscore the urgent need for public health interventions to mitigate KOA's burden in rural KPK.

Recommendations

1. **Incorporate Radiographic Diagnosis**: Future studies should use Kellgren-Lawrence grading to validate clinical findings.
2. **Validate Tools**: Employ standardized instruments like KOOS to assess quality of life and functional limitations.
3. **Multivariate Analysis**: Use logistic regression to identify independent risk factors, controlling for confounders.



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4. **Community Interventions**:
   - Implement mobile joint care units for screening and treatment.
   - Launch weight management and physical therapy programs.
   - Partner with local leaders to promote health literacy.
5. **Longitudinal Research**: Track KOA progression to understand long-term impacts.
6. **Qualitative Studies**: Explore patient experiences and barriers to healthcare access.

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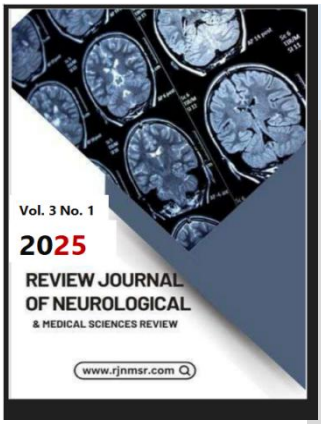

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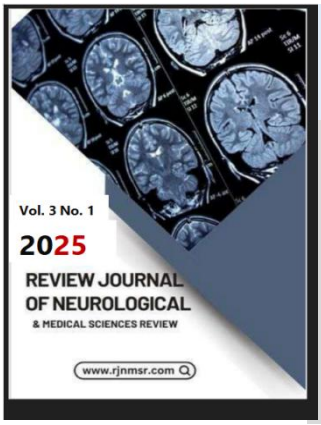

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Annexures

Consent Form

Consent Form for Research Study

Title: Prevalence of Knee Osteoarthritis in Rural Adults of District Swat, KPK

Purpose: To determine the prevalence of KOA and its impact on daily life.

Procedure: Participants will provide demographic information and undergo a 10–15-minute physical examination.

Confidentiality: All data will be anonymized and used solely for research.

Voluntary Participation: Participation is voluntary, with no direct benefits but potential contributions to healthcare improvements.

Questionnaire

Demographic Information: Name, age, gender, occupation, education, marital status, residency.

KOA Assessment: ACR criteria, WOMAC pain scale.

Lifestyle and Health: BMI, physical activity, smoking, diet, chronic diseases.

Daily Activities: Sitting/standing hours, footwear, medication use.

Master Table

Variable	Category	KOA Not Diagnosed	KOA Diagnosed	Total
Gender	Male	83	148	231
	Female	25	105	130
BMI	<18	0	3	3
	18–25	52	87	139
	25–30	50	79	129
	≥30	6	84	90
Age	40–49	87	65	152
	50–59	11	80	91
	60–69	7	60	67
	70+	3	48	51

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