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Comparison of Serum Vitamin D Levels Between Arthralgia and Non-Arthralgia Groups Among Indoor Workers with Suspected Knee Osteoarthritis in Kupang City, Indonesia

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ABSTRACT

Background: Osteoarthritis is a degenerative joint disease commonly affecting the knee and often begins with joint pain or arthralgia. Vitamin D deficiency has been suggested as a contributing factor to musculoskeletal pain and cartilage metabolism disorders. Indoor workers may be at increased risk due to limited sunlight exposure and prolonged sitting duration.

Objective: To compare serum vitamin D levels between arthralgia and non-arthralgia groups among indoor workers with suspected knee osteoarthritis in Kupang City.

Methods: An observational analytic study with a cross-sectional design was conducted among 46 indoor workers from several government institutions in Kupang City. Participants were assessed through anamnesis, body mass index measurement, and evaluation of knee pain using the Visual Analogue Scale (VAS). Serum 25-hydroxyvitamin D levels were measured using the electrochemiluminescence immunoassay (ECLIA) method. Subjects were classified into arthralgia and non-arthralgia groups. Data were analyzed using the independent t-test.

Results: All participants were female, aged 18–59 years. Of the 46 respondents, 22 were classified as having arthralgia and 24 as non-arthralgia. A significant difference in serum 25-hydroxyvitamin D levels was observed between the two groups ($p < 0.05$). The arthralgia group showed a lower mean serum vitamin D level (17.2 ± 2.94 ng/mL) with a mean VAS score of 5.83, indicating moderate pain. In contrast, the non-arthralgia group had a higher mean serum vitamin D level (24.1 ± 2.51 ng/mL) with a VAS score of 0.

Conclusion: There was a significant difference in serum vitamin D levels between arthralgia and non-arthralgia indoor workers with suspected knee osteoarthritis in Kupang City, with lower vitamin D levels observed in the arthralgia group.

KEYWORDS: Arthralgia, Indoor Workers, Osteoarthritis, Serum Vitamin D, Vitamin D Deficiency.

INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disorder characterized by pain, stiffness, and progressive functional limitation, most commonly affecting weight-bearing joints such as the knee.[1] The global burden of OA continues to increase and is not limited to older adults, as hip and knee osteoarthritis are also prevalent among younger and working-age populations, leading to reduced productivity and impaired quality of life.[2]

Arthralgia is frequently an early manifestation of musculoskeletal disorders and often represents the initial symptom that motivates individuals to seek medical care.[3,4] In suspected knee osteoarthritis, pain perception is influenced by structural joint changes, inflammatory mechanisms, and biomechanical stress, which together contribute to functional impairment.[1]

Vitamin D plays an essential role in musculoskeletal health. Vitamin D deficiency has been associated with musculoskeletal pain, muscle weakness, fatigue, and impaired functional performance.[5] Evidence from a systematic review and meta-analysis demonstrated

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an association between serum vitamin D concentration and pain-related outcomes, although heterogeneity among studies suggests population-specific effects.[6] A case–control study focusing on unexplained arthralgia also reported a significant relationship between joint pain and vitamin D deficiency.[7]

In Indonesia, vitamin D insufficiency remains prevalent despite abundant sunlight exposure. Population-based mapping among adults has demonstrated suboptimal serum 25-hydroxyvitamin D levels, particularly among individuals with limited outdoor activity.[8] However, inconsistent findings have been reported. A local study evaluating patients with knee osteoarthritis found no statistically significant association between serum vitamin D concentration and pain severity, highlighting the need for further investigation.[9]

Occupational exposure is another important contributor to osteoarthritis risk. Ergonomic stressors in the workplace, including prolonged static posture and repetitive joint loading, have been associated with symptomatic osteoarthritis.[10] Longitudinal cohort evidence further indicates that extended sitting duration may increase the incidence and progression of radiographic knee osteoarthritis.[11]

Given the biologic plausibility and conflicting evidence, clarification of the relationship between vitamin D status and arthralgia in occupational populations remains necessary. Current clinical guidelines emphasize the importance of early risk identification in knee osteoarthritis.[12] Therefore, this study aimed to compare serum vitamin D levels between arthralgia and non-arthralgia groups among indoor workers with suspected knee osteoarthritis in Kupang City.

METHODS

This study employed an observational analytic design with a cross-sectional approach. The research was conducted in Kupang City, East Nusa Tenggara, Indonesia, involving indoor workers from several governmental institutions, namely the Central Bureau of Statistics (BPS), the Department of Public Housing and Settlement Areas (DPRKP), and the Transportation Agency (DISHUB) of East Nusa Tenggara Province.

A total of 46 indoor workers participated in this study. Participants were recruited using a consecutive sampling technique during the study period. All eligible participants who met the study criteria and agreed to participate were included until the required sample size was achieved. Detailed inclusion and exclusion criteria were not available in the accessible documentation.

Baseline data were obtained through structured anamnesis, followed by anthropometric assessment for body mass index (BMI) measurement. Knee joint pain was evaluated using the Visual Analogue Scale (VAS). Based on pain assessment, participants were categorized into arthralgia and non-arthralgia groups.

Venous blood samples were collected from all participants for laboratory analysis. Serum vitamin D status was determined by measuring serum 25-hydroxyvitamin D [25(OH)D] concentrations using the electrochemiluminescence immunoassay (ECLIA) method.

Statistical analysis was performed to compare serum vitamin D levels between the arthralgia and non-arthralgia groups. The independent t-test was used for group comparison. A p-value of less than 0.05 was considered statistically significant. Information regarding the specific statistical software used was not available.

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Faculty of Medicine and Veterinary Medicine, Universitas Nusa Cendana, Kupang, Indonesia (Ethical Clearance No. 58/UN15.21/KEPK/2024, approved on 8 August 2024). All participants provided written informed consent prior to data collection, and confidentiality of participant information was maintained throughout the study.

RESULTS

A total of 46 indoor workers were included in the final analysis. All participants were female, with an age range of 18–59 years. The distribution of participants according to knee joint pain status showed that 22 individuals (47.8%) experienced knee arthralgia, whereas 24 individuals (52.2%) did not report knee pain at the time of assessment.

General demographic and clinical characteristics of the participants are summarized in Table 1. No male participants were included in the study population. All respondents were actively working in indoor office environments at the time of data collection.

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Table 1. General Characteristics of Study Participants (n = 46)

Characteristic	n (%)
Sex	
Female	46 (100)
Age range (years)	18–59
Arthralgia status	
Arthralgia	22 (47.8)
Non-arthralgia	24 (52.2)

Assessment of knee joint pain using the Visual Analogue Scale (VAS) demonstrated clear differences between the two study groups. Participants classified in the arthralgia group reported measurable pain intensity, while participants in the non-arthralgia group did not report pain symptoms.

Laboratory analysis revealed variability in serum vitamin D concentrations across participants. The distribution of serum 25-hydroxyvitamin D [25(OH)D] levels differed between groups, with lower concentrations observed among individuals reporting knee arthralgia.

The detailed comparison of serum vitamin D levels and pain scores between the arthralgia and non-arthralgia groups is presented in Table 2.

Table 2. Comparison of Serum Vitamin D Levels and Pain Scores Between Arthralgia and Non-Arthralgia Groups

Variable	Arthralgia (n = 22)	Non-arthralgia (n = 24)	p-value
Serum 25(OH)D (ng/mL), mean ± SD	17.2 ± 2.94	24.1 ± 2.51	0.000
VAS score, mean	5.83	0	–

Abbreviations:
25(OH)D = 25-hydroxyvitamin D;
VAS = Visual Analogue Scale;
SD = standard deviation.

Statistical analysis using the independent t-test demonstrated a significant difference in serum vitamin D levels between the arthralgia and non-arthralgia groups ($p = 0.000$; $p < 0.05$). The arthralgia group exhibited a lower mean serum 25(OH)D concentration compared with the non-arthralgia group. Pain assessment results further showed that participants with arthralgia experienced moderate pain intensity, as reflected by the mean VAS score of 5.83, whereas no pain was reported among participants in the non-arthralgia group.

DISCUSSION

This study demonstrated a significant difference in serum 25-hydroxyvitamin D [25(OH)D] levels between indoor workers with arthralgia and those without arthralgia. Participants experiencing knee joint pain exhibited lower vitamin D concentrations compared with asymptomatic individuals, suggesting that vitamin D status may play a role in musculoskeletal discomfort among indoor workers with suspected knee osteoarthritis.

Osteoarthritis is a complex degenerative joint disorder involving progressive cartilage degradation, subchondral bone remodeling, and low-grade inflammation affecting the entire joint organ.[1,2,17] Global epidemiological data indicate that osteoarthritis represents one of the leading causes of years lived with disability worldwide, with knee osteoarthritis contributing the greatest burden.[13] Arthralgia commonly appears as an early clinical manifestation and may precede radiographic evidence of disease.[3,4]

Vitamin D plays an important role in musculoskeletal physiology beyond calcium–phosphate regulation. Vitamin D receptors are expressed in chondrocytes, synoviocytes, and skeletal muscle cells, indicating its involvement in cartilage metabolism, muscle

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function, and inflammatory modulation.[5,14] Vitamin D deficiency has been associated with musculoskeletal pain, proximal muscle weakness, and impaired neuromuscular control, all of which may contribute to pain perception in knee osteoarthritis.[5,14]

The findings of this study are consistent with previous evidence demonstrating an association between low vitamin D levels and pain outcomes. A systematic review and meta-analysis reported that lower serum vitamin D concentrations were significantly associated with increased pain intensity across various populations.[6] Similarly, a case–control study focusing on unexplained arthralgia found that individuals with joint pain were more likely to exhibit vitamin D deficiency.[7] Interventional evidence has also suggested that vitamin D supplementation may improve pain outcomes in selected populations with deficiency.[16]

Nevertheless, findings regarding vitamin D and osteoarthritis-related pain remain inconsistent. An Indonesian study reported no significant association between serum 25(OH)D levels and pain severity in knee osteoarthritis.[9] Such discrepancies may be explained by differences in baseline vitamin D status, occupational exposure, sunlight behavior, body composition, and pain assessment instruments.

Vitamin D insufficiency remains prevalent in Indonesia despite year-round sunlight exposure. Mapping studies among urban adult populations have demonstrated a high proportion of individuals with suboptimal vitamin D levels, particularly among those with limited outdoor activity.[8] This paradox highlights the importance of behavioral and occupational determinants of vitamin D synthesis rather than geographic factors alone.

Occupational exposure may further contribute to knee joint symptoms. Ergonomic risk factors, including prolonged sitting, static posture, and limited joint movement, have been associated with symptomatic osteoarthritis.[10] Longitudinal cohort studies have demonstrated that extended sitting duration increases the risk of radiographic knee osteoarthritis incidence and progression.[11] Indoor workers may therefore experience a combined effect of metabolic vulnerability related to vitamin D deficiency and biomechanical stress associated with prolonged sitting.

Current clinical guidelines emphasize early identification and modification of risk factors in knee osteoarthritis to prevent disease progression and functional decline.[12] While the cross-sectional design of this study does not permit causal inference, the findings underscore the importance of considering vitamin D status as part of a comprehensive assessment in indoor workers presenting with knee arthralgia.

Several limitations should be acknowledged. The cross-sectional nature of the study limits causal interpretation. In addition, the study population consisted exclusively of female participants, which may restrict generalizability. Data regarding sunlight exposure duration, dietary vitamin D intake, and physical activity were not available. Despite these limitations, this study provides relevant local evidence supporting the potential role of vitamin D status in knee arthralgia among indoor workers in Kupang City.

CONCLUSION

This study demonstrated a significant difference in serum vitamin D levels between indoor workers with arthralgia and those without arthralgia in Kupang City. Lower serum 25-hydroxyvitamin D concentrations were observed among participants experiencing knee joint pain, suggesting that vitamin D status may be an important factor associated with arthralgia in indoor working populations.

These findings highlight the relevance of considering metabolic and occupational factors simultaneously in the assessment of knee pain among indoor workers. Evaluation of vitamin D status may support early identification of individuals at risk for musculoskeletal symptoms and contribute to preventive strategies aimed at reducing functional limitation and disease progression.

Further longitudinal studies incorporating sunlight exposure, dietary intake, and physical activity assessment are needed to clarify causal relationships and to determine the potential role of vitamin D optimization in the management of knee arthralgia among occupational populations.

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