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Physical Activity, Musculoskeletal Pain, and Muscle Strength Decline Among Office Workers: A Cross-Sectional Study

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Abstract

Introduction: Jakarta, the capital city of Indonesia, has experienced rapid development across various sectors, attracting residents for both living and working purposes. Among these residents, approximately 56.02 million are office workers. Office workers, defined as individuals employed in organizations to meet daily livelihood needs, typically work 8–10 hours per day. Prolonged sedentary work may limit physical activity, leading to musculoskeletal pain and reduced muscle strength, particularly in the lower limbs. This study aimed to examine the relationship between physical activity and the occurrence of musculoskeletal pain and muscle strength decline in office workers aged 20–35 years.
Methods: An observational analytic design with a cross-sectional approach was employed. Participants were selected using a non-probability sampling method, with 24 subjects meeting predetermined inclusion and exclusion criteria. Physical activity levels were assessed using the Baecke Physical Activity Questionnaire, musculoskeletal pain was measured using the Visual Analog Scale (VAS), and muscle strength was evaluated with an aneroid sphygmomanometer. The Spearman rank correlation test was used to analyze the relationship between physical activity, musculoskeletal pain, and muscle strength.
Results: Statistical analysis revealed a significant relationship between physical activity levels and both musculoskeletal pain and muscle strength decline among office workers aged 20–35 years ($p<0.05$).
Conclusion: Physical activity levels are significantly associated with the occurrence of musculoskeletal pain and reduced muscle strength in office workers aged 20–35 years.

Keywords: Physical activity; Musculoskeletal pain; Muscle strength; Office workers; Sedentary behaviour

Introduction

Jakarta, the capital city of Indonesia, has experienced rapid development across various sectors, including business, government, trade, and residential areas. This growth has increased the influx of people who move to the city for living and working purposes. Consequently, the population of Jakarta continues to grow annually due to both residential and occupational migration.

Among the workforce, approximately 56.02 million individuals are employed as office workers. Office workers are defined as individuals performing organizational tasks to meet daily livelihood needs, whether in private or government sectors. Typically, office workers spend 8–10 hours per day at work. Prolonged sedentary work limits physical movement, which can lead to musculoskeletal pain during movement and a reduction in muscle strength, particularly in the lower limb region.[1]

The lower limbs play a primary role in enabling body movement from one location to another.[2] Disruption in muscle contraction in the lower limbs can occur due to sudden or high-intensity use, especially when the muscles are subjected to heavy loads.[3] Such conditions increase sensitivity to pressure, restrict mobility, and weaken the lower limb muscles, eventually resulting in musculoskeletal pain and reduced muscle strength among office workers.[4]

Muscle pain and strength decline can also be associated with decreased physical activity.[5] In Jakarta, a significant proportion of the population consists of office workers, among whom physical activity levels are particularly low.[6] Data indicate that 44.2% of residents engage in low levels of physical activity due to prolonged sitting for 8–10 hours per day. Therefore, the daily physical activity of office workers is generally categorized as light or insufficient.[7]

According to the World Health Organization (WHO), physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity can range from simple to complex tasks.[8] Common types of physical activity include daily routines such as playing, working, performing household tasks, commuting, and climbing stairs.[9] Regular physical activity provides numerous health benefits, including the prevention of various non-communicable diseases and premature mortality, particularly in adults. Inactive individuals have a 6–10% higher risk of developing non-communicable diseases such as diabetes, coronary heart disease, and cancer.[10]

Adequate and consistent physical activity can also enhance mortality outcomes and cognitive function, as higher activity levels stimulate beneficial biochemical responses in the body.[11]

Physical activity can be classified according to intensity into heavy, moderate, and light categories.[12] In Indonesia, many individuals still exhibit low daily physical activity. According to the Basic Health Research (Riskesdas), only 33.3% of the population engage in sufficient physical activity, while 24.1% remain sedentary for more than six hours per day. These data indicate that overall physical activity levels in Indonesia are low. Consequently, lower daily activity levels, such as those observed in office workers in Jakarta, increase susceptibility to musculoskeletal pain and muscle strength decline when subjected to sudden or heavy activity.[13] The lower limb muscles, in particular, may respond with acute discomfort due to abrupt or intense movements.

To the best of the researchers' knowledge, studies investigating the relationship between physical activity, musculoskeletal pain, and muscle strength decline in office workers aged 20–35 years have not been published. Considering the observed decline in physical activity among office workers and existing evidence linking low activity to increased musculoskeletal pain and strength reduction, this study aimed to examine the association between physical activity and the occurrence of musculoskeletal pain and muscle strength decline in office workers aged 20–35 years. The study hypothesis was: "There is a significant relationship between physical activity and the occurrence of musculoskeletal pain and muscle strength decline in office workers aged 20–35 years."

Methods

This study employed an analytical observational design using a cross-sectional approach. The research was conducted on-site at the Kimia Farma Head Office in Gambir, DKI Jakarta, during September 2022. Participants were selected using purposive sampling based on predefined inclusion and exclusion criteria.

The inclusion criteria were: office workers aged 20–35 years, employed for 8–10 hours per day, with a minimum of two years of work experience, having a posture classified as category 1 according to the Ovako Work Posture Analysis System (OWAS), and exhibiting normal vital signs. The exclusion criteria included the presence of musculoskeletal disorders, mental health disorders, or muscle spasms. A total of 24 participants met these criteria and were included in the study.

The independent variable in this study was physical activity, while the dependent variables were muscle pain and lower limb muscle strength. Controlled variables included body posture, work duration, length of employment, and age.

Physical activity intensity was measured using the Baecke Index Questionnaire during participant selection. Only participants without musculoskeletal disorders or muscle spasms were included in the measurement. Muscle pain was assessed using the Visual Analog Scale (VAS), which ranges from 0 to 100. Muscle strength was measured using a modified aneroid sphygmomanometer with a baseline set at 20 mmHg. Prior to measurement, the sphygmomanometer cuff was inflated to 100 mmHg to eliminate folds and then deflated to the baseline of 20 mmHg, establishing a measurement range of 20–304 mmHg. The valve was securely closed to prevent air leakage. The sphygmomanometer was positioned to resist the force generated by the targeted muscle group, and participants applied force against the device. The examiner verified the baseline at 20 mmHg before each measurement, and the recorded value corresponded to the reading on the aneroid sphygmomanometer.[14]

Statistical analysis included univariate, normality, and bivariate analyses. Univariate analysis was used to describe participants' physical activity, age, muscle pain, sex, and muscle strength. Normality testing determined whether the data were normally distributed, as non-normal distribution is a prerequisite for non-parametric tests. Bivariate analysis was performed using Spearman's rank correlation, which is suitable for non-normally distributed data, minimizing potential bias in correlation assessment.

This study received ethical approval from the Research Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah General Hospital, Denpasar, with ethical clearance number 1603/UN14.2.2.VII.14/LT/2022.

Results

The characteristics of the study participants are presented in Table 1. This table provides an overview of the demographic and baseline data, including age, sex, physical activity intensity, muscle pain, and muscle strength. These data offer a foundational understanding of the study population and the variability within key variables assessed in the research.

Table 1. Characteristics of Study Participants (n = 24)

Variable	Value
Sex	Male: 16 (66.7%), Female: 8 (33.3%)
Age (years)	23.00 ± 0.30
Physical Activity Intensity (Baecke Index)	7.08 ± 3.20
Muscle Pain (VAS)	17.08 ± 25.78
Right Gastrocnemius Strength	97.92 ± 32.93
Left Gastrocnemius Strength	94.79 ± 43.57
Right Quadriceps Strength	48.33 ± 20.14
Left Quadriceps Strength	45.83 ± 17.91
Right Hamstring Strength	87.29 ± 27.50

Left Hamstring Strength	78.96 ± 28.12

As shown in Table 1, most participants were male (16/24; 66.7%), while females accounted for 8/24 (33.3%), with a mean age of 23.00 ± 0.30 years. The mean Baecke Index score for physical activity intensity was 7.08 ± 3.20, indicating moderate activity levels, with participants exhibiting a wide range of scores (2.25–12.10).

The mean muscle pain score, assessed using the Visual Analog Scale (VAS), was 17.08 ± 25.78. Most participants (58.3%) reported no pain (VAS 0), while the remaining participants reported varying pain levels from mild to severe (VAS 10–80).

Mean muscle strength values were as follows: right gastrocnemius 97.92 ± 32.93, left gastrocnemius 94.79 ± 43.57, right quadriceps 48.33 ± 20.14, left quadriceps 45.83 ± 17.91, right hamstring 87.29 ± 27.50, and left hamstring 78.96 ± 28.12. Detailed distributions for each muscle group are presented in Table 1. The relationships between physical activity intensity and both muscle pain and muscle strength are shown in Table 2. Spearman correlation analysis was conducted to examine these associations, providing insight into the potential impact of physical activity levels on musculoskeletal outcomes among the participants.

Table 2. Spearman Correlation Between Physical Activity Intensity and Muscle Pain/Muscle Strength

Variable	p-value
Physical Activity – Muscle Pain	0.000
Physical Activity – Right Gastrocnemius Strength	0.000
Physical Activity – Left Gastrocnemius Strength	0.000
Physical Activity – Right Quadriceps Strength	0.003
Physical Activity – Left Quadriceps Strength	0.000
Physical Activity – Right Hamstring Strength	0.004
Physical Activity – Left Hamstring Strength	0.001

As shown in Table 2, the Spearman correlation analysis indicated a significant relationship between physical activity intensity and both muscle pain and muscle strength decline among office workers aged 20–35 years ($p < 0.05$).

Discussion

This study was conducted at the Kimia Farma Head Office, Gambir, Jakarta. The participants consisted of 24 office workers aged 20–25 years. Participant selection was carried out using purposive sampling, in which the sample was chosen according to specific research objectives as well as inclusion and exclusion criteria. Data collection was performed directly at the study site.

As presented in Table 1, the majority of participants were male (16/24; 66.7%) compared to female participants (8/24; 33.3%). This finding aligns with employment statistics in Jakarta, where in 2019, male office workers numbered 16,601, while female office workers were 13,737. The mean age of participants was 23.00 years, with most participants aged 21 years. According to the Indonesian Central Bureau of Statistics, the most populous working age group is 15–35 years, totaling 729,843 individuals.

The mean physical activity intensity of participants, measured by the Baecke Index, was 7.08, which is classified as moderate physical activity. According to the Ministry of Health of the Republic of Indonesia, moderate activity is characterized by mild sweating, increased breathing and heart rate, the ability to converse, but inability to sing, with an energy expenditure of 3.5–7 kcal/min. Examples include light furniture moving, washing a car, and playing table tennis. Office workers in this study likely engage in moderate activity due to the presence of multiple staircases in the office, which increases their overall physical activity.

The mean muscle pain score, measured using the Visual Analog Scale, was 17.08, categorized as mild pain (VAS 10–30). Mild muscle pain may result from low stress or muscle tension due to prolonged sitting during office work.[15]

The mean muscle strength measurements were as follows: right gastrocnemius 97.92, left gastrocnemius 94.79, right quadriceps 48.33, left quadriceps 45.83, right hamstring 87.29, and left hamstring 78.96. Muscle strength on the right side was higher than on the left, likely because participants predominantly used their right leg for daily activities. Previous research by Cynthia reported that over 90% of the population is right-leg dominant, while 10% is left-leg dominant, supporting these findings.

Physical activity intensity among participants ranged from 2.25 to 12.10, with a mean of 7.08 ± 3.20. Regarding muscle pain, 58.3% of participants reported no pain (VAS 0), 4.2% VAS 10, 12.5% VAS 20, 4.2% VAS 30, 4.2% VAS 40, 8.3% VAS 60, 4.2% VAS 70, and 4.2% VAS 80.

Spearman correlation analysis (Table 2) revealed a significant relationship between physical activity intensity and muscle pain in office workers ($p = 0.000$). Physical activity, defined as bodily movements produced by skeletal muscles requiring energy expenditure, can prevent muscle pain while improving muscular endurance and flexibility. Aerobic exercise and activities engaging the arms and thighs can enhance cardiovascular efficiency at rest and during activity. Physical activity also improves joint flexibility and range of motion. Consequently, higher physical activity intensity may reduce muscle pain severity.

These results are consistent with the study by Jafar et al., which involved 93 participants using a cross-sectional design. Physical activity data showed that 23.7% of respondents had low activity levels, 66.7% moderate, and 9.7%

high activity levels. Muscle pain assessment revealed that 73.5% experienced no pain, 22.6% had moderate pain, and 2.2% reported severe pain. Correlation analysis indicated a significant association between physical activity and muscle pain (p = 0.010), with a strong correlation coefficient of 0.616.[16]

Similarly, Zamorano et al. reported that among 17,777 respondents, the prevalence of muscle pain was 40.5% in those with low physical activity intensity, 35.1% in moderate activity, and 31.9% in high activity. Pairwise Z-test results showed p = 0.000, indicating a significant relationship between lower physical activity and higher muscle pain prevalence.[17]

Physical activity stimulates ATP synthesis and adaptation in muscle fibers, leading to structural and functional changes in response to mechanical demands.[18] Stretching and strengthening exercises have been shown to reduce joint pain, improve flexibility, strengthen bones, and enhance blood circulation. Strengthening exercises specifically minimize muscle pain by enhancing contractile efficiency and structural integrity.

Spearman correlation analysis also demonstrated significant associations between physical activity intensity and muscle strength across all measured muscle groups. For right gastrocnemius strength, p = 0.000; left gastrocnemius, p = 0.000; right quadriceps, p = 0.003; left quadriceps, p = 0.000; right hamstring, p = 0.004; and left hamstring, p = 0.001.

Office workers typically engage in low physical activity due to prolonged static postures during 8–10 hours of work, which reduces musculoskeletal stimulation and consequently decreases muscle strength. Reduced lower-limb strength may impair walking speed and overall mobility, as major muscle groups are essential for ambulation.[19] Cross-sectional studies by Gauvain et al. showed that individuals with higher physical activity had greater muscle mass compared to those with lower activity levels.[20] Bastos Lopes et al. reported that among 100 participants, walking speed was significantly correlated with physical activity intensity (p < 0.005), demonstrating alignment between activity level and lower-limb strength.[21]

Sativani et al. found that regular exercise sessions of 40–60 minutes, 2–3 times per week, can increase muscle strength after 8 weeks through neural activation, muscle fiber hypertrophy, and enhanced vascular response.[22] Repeated muscle contraction induces anaerobic conditions, promoting myosin and actin cross-bridge formation, mitochondrial proliferation, and increased muscular endurance. These adaptations enhance both strength and functional capacity.[23]

This study has several limitations. First, the sample size was relatively small, which may affect the accuracy and generalizability of the findings. Increasing the number of participants in future studies is recommended. Second, the cross-sectional design limits the ability to establish causal relationships between physical activity, muscle pain, and muscle strength. Future studies should include longitudinal designs and consider additional variables such as postural factors during daily activities, use of office equipment, and wider demographic representation.

Participants are encouraged to monitor and maintain moderate physical activity levels, as the statistical analysis indicates significant relationships between activity intensity, muscle pain, and muscle strength. Preventive measures and ergonomic interventions may reduce the risk of muscle complaints.

Overall, the findings indicate a significant relationship between physical activity intensity and both muscle pain and muscle strength reduction among office workers aged 20–35 years. Higher physical activity intensity within this population may increase the likelihood of muscle pain and decreased muscle strength. However, these results are specific to office workers in this age group and should not be generalized to older populations, manual laborers, or other occupational settings.

Conclusion

Based on the results of this study, it can be concluded that there is a significant relationship between physical activity intensity and both muscle pain and decreased muscle strength among office workers aged 20–35 years. Low levels of physical activity among office workers are directly associated with increased muscle pain and reduced muscle strength in this population.

These findings provide important insights for office workers and populations with low physical activity levels, as well as for employers and workplace planners. Implementing policies that promote balanced physical activity, considering prolonged sitting time, and incorporating preventive strategies can help reduce muscle pain and prevent strength decline. Moreover, attention should be given to other potential contributing factors that may influence musculoskeletal health in the workplace.

Author Contribution

Yuli Pryanka: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.

Gede Parta Kinandana: Supervision, guidance on research design, and critical review of the manuscript.

Anak Agung Gede Angga Puspa Negara: Supervision, validation, and manuscript editing.

Ni Komang Ayu Juni Antari: Supervision, methodological consultation, and final manuscript review.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was not required as the study involved only non-invasive procedures (blood pressure measurement and questionnaire surveys) and posed minimal risk to participants. Informed consent was obtained from all participants prior to their inclusion in the study, and confidentiality was strictly maintained.

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