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Beyond BMI: Muscle Mass Correlates with Reduced Low Back Pain Disability in Pre-Elderly Adults

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Abstract

Background: Low back pain (LBP) ranks among the most common musculoskeletal disorders that impact functional mobility and overall quality of life, especially in older adults who work at school teachers. Although body mass index (BMI) is frequently utilized as an indicator of health risk, it does not differentiate between fat and muscle mass, which may have varying implications for LBP risk.

Objectives: The objective of this research was to examine the correlation between body composition (BMI, muscle mass, body fat & visceral fat percentage) and the likelihood of experiencing LBP in pre-elderly individuals.

Methods: This study used a cross sectional analytic design and included 72 pre-elderly participants between 45-59 years old, who were selected through purposive sampling. Body composition metrics were obtained using a bioelectrical impedance analysis device, while LBP disability was evaluated by Oswestry Disability Index (ODI) questionnaire. The data were analyzed utilizing Spearman correlation due to the non-normal distribution of the variables with the aid of IBM SPSS Statistic 26.0 software.

Results: The analysis indicated a moderate negative correlation between muscle mass and ODI scores ($r2 = -0.488$, $p = 0.001$), implying that higher muscle mass correlates with reduced LBP related disability. Visceral fat percentage exhibited a weak yet significant negative correlation with ODI ($r2 = -0.293$, $p = 0.012$), whereas BMI and body fat percentage did not show significant correlation with LBP.

Conclusion: Muscle mass was identified as the most critical protective factor against LBP in pre-elderly adults, while BMI and total body fat did not serve as predictors of LBP risk. These results highlight the significance of muscle preservation in strategies aimed at preventing LBP and suggest that BMI alone is inadequate for evaluating musculoskeletal health risks in aging populations.

Keywords: body composition, low back pain, teacher school.

INTRODUCTION

Low back pain (LBP) is one of the leading causes of disability and work absence globally, particularly among individuals engaged in occupations requiring prolonged standing, repetitive movements, and static postures such us elementary school teachers (Mbarga et al., 2024; Monali K C & Saravankumar J, 2024; Vidal-Conti et al., 2021). In pre-elderly adults (ages 45-59), this condition is exacerbated by age-related physiological changes, especially in musculoskeletal and metabolic systems (Iizuka et al., 2015; Pano & Bogdani, 2021). As this age group approaches the threshold of older adulthood, the urgency to identify modifiable risk factors for LBP, including body composition changes, becomes critical for both occupational health and quality of life (Babaei Bonab, 2022; Irandoust & Taheri, 2015).

Recent studies have emphasized the significant relationship between altered body composition and the risk of LBP. Visceral obesity and sarcopenic conditions are increasingly recognized as contributors to chronic musculoskeletal pain, including in the lower back (Chen et al., 2023; Sakai et al., 2022). For instance, that excessive visceral fat was associated with increased musculoskeletal pain intensity (Shim et al., 2023). This study observed a strong link between LBP and sarcopenia in older adults (Roongsaiwatana et al., 2023). Supporting this, study result identified that higher body fat percentage and lower muscle mass significantly influenced LBP occurrence in middle-age populations (Jeon & Kim, 2018; Kook et al., 2023).

However, exiting literature has largely focused on elderly populations or generalized working adults, with limited attention to the pre-elderly demographic, particularly those in physically and cognitively demanding professions like teaching. The cumulative impact of standing for extended hours, minimal ergonomic support, and reduced physical activity outside of work places teachers at high risk of both altered body composition and LBP. As highlighted, sarcopenia obesity can be particularly detrimental when combined with occupational stressors, yet few studies have specifically examined this interaction in pre-elderly educators (Cankurtaran et al., 2021; Sakai et al., 2023).

This study aims to explore the relationship between various body composition components, such us BMI, body fat percentage, visceral fat, and muscle mass for the risk of LBP among pre-elderly elementary school teachers. By focusing on this specific population and integrating multidimensional body composition assessment, this research offers a novel approach to identifying early intervention.

METHODS

Study Design and Participants

This investigation utilized a cross-sectional analytical design to assess the correlation between body composition and the risk of LBP in pre-elderly adults. This design is appropriate for identifying associations between variables without requiring long-term follow up. It also efficient for exploring potential risk factors in specific population and help generate hypotheses for future longitudinal or experimental studies. The data collection was conducted in November-December 2024 at Surabaya State Elementary School. A total of 72 participants (36 Female and 36 Male) were engaged in this research endeavor. The calculation of the sample size of this study is based on research results and calculation of the correlation analysis formula. The Participants were selected using purposive sampling technique are justified based on the need for inclusion and exclusion criteria to target population at high risk for occupational LBP, with inclusion criteria being adults 45 to 59 years old, not currently diagnosed with several neurological or orthopedic disorders, and capable of independent ambulation. Exclusion criteria included individuals with recent spinal surgery, malignancies or pregnancy.

Research Instruments

We used Oswestry Disability Index instrument for a questionnaire used to assess the level of disability related to LBP, specifically in 10 activities of daily living (Cook et al., 2021; Jenks et al., 2022; Koivunen et al., 2024). Meanwhile, for body composition measurements such as BMI (body mass index), muscle mass, body fat and visceral fat percentage using Tanita TBF-400 Total Body Composition Analyzer.

Data Analysis

The data were analyzed using IBM SPSS Statistics 26.0. The result of the data is non-normal distribution ($p < 0.05$), the Spearman rank correlation test was used to evaluated the relationship between body composition components (BMI, body fat & visceral fat percentage, and muscle mass) and the risk of LBP.

RESULTS

The results of the Spearman correlation analysis are presented in table 1. The analysis revealed that muscle mass had the strong and most significant correlation with ODI scores, showing a moderate negative relationship ($r_2 = -0.488$, $p = 0.001$). This indicated that individuals with greater muscle mass tend to report lower levels of disability due to LBP. This finding

supports the hypothesis that muscular strength and tissue support around the spine may play a protective role against spinal pain and functional limitation.

Table 1. Spearman Correlation Between Body Composition Variables and ODI Score

Variable	Correlation Coeficient (r_s)	*p*-Value
BMI	0.000	1.000
Body Fat (%)	0.181	0.127
Visceral Fat (%)	-0.293*	0.012
Muscle Mass	-0.488**	0.001**

*Note. *significant at p<0.01, **significant at p<0.05*

In addition, visceral fat also showed a statistically significant negative correlation with ODI (r_2 = -0.293, p = 0.012). While the strength of this relationship is weaker than that muscle mass, it still suggests that higher visceral fat levels are associated with reduced disability. On the other hand, body fat percentage showed a weak positive correlation with ODI (r_2 = 0.181), but this relationship was not statistically significant (p = 0.127). BMI demonstrated no correlation whit ODI scores (r_2 = 0.000, p = 1.000). This result emphasized the limitation of BMI as an overall measure of body composition, as it does not distinguish between fat mass and leas=n mass. It reinforces the value of analyzing specific body composition components rather than solely on BMI when studying musculoskeletal conditions.

DISCUSSION

According to the findings of this research, the noteworthy inverse relationship between skeletal muscle mass and disability due to LBP corroborates previous research indicating the greater skeletal muscle mass correlates with diminished physical impairments and enhanced spinal functionality in elderly population (Almansour et al., 2024; Tesfaye et al., 2023). Additionally, existing literature suggests that sarcopenia, or the decline in lean body mass, considerably heightens the likelihood of disability associated with LBP, especially in conjunction with obesity (Kook et al., 2023). While our analysis revealed no significant correlation between BMI and body fat, this observation is in agreement with studies that propose BMI as an inadequate measure for predicting LBP, as it does not effectively differentiate between adipose tissue and muscle mass.

This research that greater muscle mass correlates with diminished levels of LBP disability aligns with wider patterns observed in occupational and aging studies, which underscore musculoskeletal strength as a vital protective element against LBP, especially in group subjected

to repetitive strain or extended periods of static posture (Raizah et al., 2023; Tai et al., 2019). Further highlight the importance of muscle quality and conditioning in alleviating mechanical stress on the spine and in thwarting the progression of chronic pain in at risk adults (Mushtaq et al., 2022; Peranson et al., 2024).

This study has identified muscle mass as a crucial protective factor against LBP in pre-elderly adults. However, future investigations should delve into the casual mechanism that supported this relationship through longitudinal or intervention methodologies. Furthermore, subsequent studies include measures of muscle function such as strength or power, as existing evidence indicates that muscle quality may serve as a more accurate predictor of LBP than mass alone (Imagama et al., 2019; Park et al., 2023).

CONCLUSION

This research concludes that muscle mass is the primary body composition factor linked to a decreased risk of LBP in pre-elderly adults. In contrast, BMI and body fat percentage did not exhibit significant associations, underscoring their limited diagnostic utility for LBP. Notably, visceral fat percentage was found to have a weak and inverse relationship with LBP, suggesting the need for the future research. These result underline the critical role of maintaining muscle mass in strategies aimed at preventing and managing LBP

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CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

AUTHOR'S CONTRIBUTION

Susanti contributes to the study concept and design, data analysis, interpretation of result and manuscript writing as the corresponding author. Nurpratiwi assisted in data collection,

literature review and statistical analysis. Adzillina contributed to the development of research instruments and supported participant recruitment and data management. Ayuningtyas was involved in formatting, writing and critical manuscript revision. Maulana contributed to data entry, visualization of findings and final manuscript proofreading.

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