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Comparison of Skeletal Muscle Mass Between Undergraduate Physiotherapy Students with and Without Masked Obesity

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Abstract

Masked obesity is defined as a condition where individuals have a normal body mass index (BMI) but a high body fat percentage. This condition may contribute to a reduction in skeletal muscle mass, potentially increasing the risk of sarcopenia. The aim of this study was to compare skeletal muscle mass between physiotherapy students with masked obesity and those without. This cross-sectional observational study involved 124 undergraduate physiotherapy students. Measurements of BMI, body weight, height, body fat mass, skeletal muscle mass, and body fat percentage were conducted using the InBody 570 body composition analyzer. Differences in body composition between masked obesity and non-masked obesity groups were analyzed using the independent t-test and Mann–Whitney U test. The results showed that 76.5% of female students were classified as having masked obesity. Female students with masked obesity had significantly lower skeletal muscle mass compared to their non-masked counterparts. However, no significant differences were observed among male students. These findings suggest the need for targeted preventive and health promotion strategies to mitigate the risk of sarcopenia, particularly in women with masked obesity.

Keywords: body fat percentage; masked obesity; physiotherapy students; sarcopenia; skeletal muscle mass

INTRODUCTION

Masked obesity refers to a condition where the body mass index (BMI) is normal but the body fat percentage is high (Yamashiro et al. , 2023). Individuals with a normal BMI but a body fat percentage of ≥30% in women and ≥20% in men are categorized as having **masked obesity** (Fukuoka et al. , 2012).
Individuals with masked obesity need to improve their physical and mental health (Ashtary-Larky et al. , 2023). In some literature, this condition is also referred to as **normal- weight obesity (NWO)** . Various factors contribute to the development of masked obesity , including sociodemographic factors , diet, and physical activity (Wijayatunga & Dhurandhar , 2021).

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In Indonesia, obesity screening is generally performed by measuring body mass index (BMI). A BMI between 18.5–25 is categorized as normal (Ministry of Health of the Republic of Indonesia, 2018). However, BMI has low sensitivity in detecting body fat levels (Wijayatunga & Dhurandhar , 2021). A person can have a high body fat percentage despite low muscle mass, which then becomes a risk factor for impaired metabolic function and physical fitness levels (Wijayatunga & Dhurandhar , 2021).

College students are a vulnerable population with unhealthy lifestyles, including low physical activity and poor sleep quality (Alhashemi et al. , 2022 ; Yamashiro et al. , 2023). Physical therapy students (including physiotherapy) are potential future healthcare providers. Within the promotional and preventive sphere, physiotherapists must act as role models for patients, particularly in health promotion efforts (Tavolacci et al. , 2018).

Therefore, increased attention to the health status of physiotherapy students is needed before they enter the professional world. A first step is to detect potential health problems early. Based on the results of the literature review, this study will be the first to provide a basis for further research comparing anthropometric status between **masked obesity** and normal obesity groups.

This study aims to identify the comparison of body mass composition and physical fitness status between physiotherapy students with masked obesity and those with normal body status.

METHOD

This is an observational , **cross -sectional** study conducted on 124 Physiotherapy students at the Veteran National Development University, Jakarta. The study will be conducted from October to December 2022 **.**

The students who participated were those with a normal body mass index (BMI) and willing to participate in this study. Exclusion criteria included students undergoing hormone therapy or taking weight-loss medication.

Prior to data collection, participants were asked to complete and sign an **informed consent** form as a form of agreement to participate in the study. Several parameters, including body mass, height, body fat mass, and other body composition parameters, were measured using the **InBody 570 Body Composition Analyzer** .

The normal BMI category is defined as 18.5–25.0 (Ministry of Health of the Republic of Indonesia, 2018). However, individuals with a normal BMI but a body fat percentage of ≥30% in women and ≥20% in men are categorized as **masked obesity** (Fukuoka et al. , 2012).

The data obtained are presented in the form of frequency distributions and percentages. Comparisons between the masked obesity group and the normal group were analyzed using the normal distribution test. All data analysis was performed using **SPSS version 26** .

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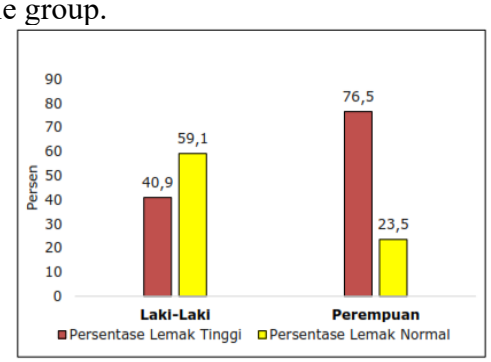
RESULTS

Of the 230 students screened, **124** with **a normal Body Mass Index (BMI)** were recruited into the study. The majority of participants were female, at **82.3%** . The distribution of general sample characteristics is shown in **Table 1** .

Table 1. General Characteristics of the Sample

Characteristics	Frequency (n)	Percentage (%)
Gender		
Man	22	17,7
Woman	102	82,3
Age (years)		
17–18	56	45,1
19–20	65	52,4
21–22	3	2,4

Figure 1 shows that the prevalence of masked obesity is higher in women, at 76.5% . Further analysis revealed significant differences between body components in the masked obesity group and the normal weight group , as shown in Table 2 .
The most prominent differences were in body mass, body fat mass, and body fat percentage, which were significantly higher in the masked obesity group , in both men and women.
However, different results were found for skeletal muscle mass . Significant differences were only found in the female group, while no significant differences were found in the male group.



Normal

(N=9), (N=13), (N=78), (N=24)

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Body weight Body Height	64.6±7.0* 170±5.7	57.8±6.2 168±4.8	52.6±4.7* 155.8±4.8	49.8±5.4 157±6.2
Body Mass Index	22.3±1.8#	20.4±1.8	21.7±1.6*	20.1±1.3
% Body Fat	23±3.1*	13.8±3.1	34.8±3.3*	27.8±1.5
Body Fat Mass	14.9±2.8*	8.0±2.4	18.7±3.6#	13.8±1.8
Massa Otot Skeletal	27.6±3.2	27.8±2.7	18.2±1.6*	19.2±2.3

DISCUSSION

This study reports a high prevalence of **masked obesity** among female physiotherapy students. This finding aligns with previous studies conducted in Europe, which similarly found a higher incidence of masked obesity in women compared to men. However, research conducted in China reported a different pattern, where the prevalence of masked obesity was higher among men than women.

These differences may be attributed to biological and cultural variations between populations (Wijayatunga & Dhurandhar, 2021). Nonetheless, more recent research among Japanese students also found a higher prevalence in women. In a longitudinal observation between 2011 and 2019, Yamashiro et al. (2023) reported an increase in masked obesity among women but not in men, although the exact reasons behind this pattern remain unclear.

One possible explanation lies in the differences in body composition. Men typically have greater skeletal muscle mass, which may protect against masked obesity and its metabolic implications. Although the prevalence of masked obesity among men in this study was not particularly high, the condition still presents a potential health risk due to increased fat mass despite normal BMI.

This study is the first in Indonesia to explore masked obesity among physiotherapy students. The findings serve as an initial reference for future studies addressing the phenomenon and its associated health risks.

A major finding from this research is that the majority of masked obesity cases were observed in **female students**, consistent with the study by De Lorenzo et al. (2022), which identified a higher prevalence of **normal-weight obesity (NWO)** among women (36.5%) compared to men (14.1%). Elevated levels of pro-inflammatory cytokines may impair protein synthesis, leading to reduced skeletal muscle mass (De Lorenzo et al., 2022). Reduced skeletal muscle mass can contribute to **insulin resistance**, **diabetes**, and **metabolic syndrome** (Yasuda, 2019).

Other studies have also observed reduced lower limb strength in women with normal-weight obesity (Nakanishi et al., 2020; Oshita et al., 2022). These findings support the importance of assessing body composition in individuals with normal BMI, especially women, to detect potential hidden health risks. Therefore,

appropriate **preventive** and **promotive** strategies must be developed to prevent the onset of **sarcopenic obesity** or masked obesity.

It is important to note that the sample in this study was predominantly female, which may have influenced the findings. This gender imbalance limits generalizability, particularly in evaluating masked obesity prevalence among men. Future studies should involve a larger and more balanced sample of male and female participants to confirm these observations and expand understanding of the phenomenon across populations.

CONCLUSION

This study found a notable prevalence of **masked obesity** among female physiotherapy students. Additionally, women with masked obesity exhibited significantly lower physical indicators compared to their counterparts with normal body composition. This pattern was not observed in male students.

The **phenomenon of masked obesity** represents a hidden health risk that may not be detected through BMI alone. As such, special attention is required to assess **body composition parameters**, especially in women, as part of early screening and prevention strategies.

Further research involving a larger and more proportionally distributed sample is recommended to confirm the presence and characteristics of masked obesity across different population groups

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