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Associations of BMI and obesity with physical literacy, lung capacity, and cardiorespiratory performance in obese adult women

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ABSTRACT

This study aimed to: (1) assess the level of physical literacy among obese adult women; (2) evaluate their lung capacity and cardiorespiratory performance; and (3) examine the interrelationships among these variables. A cross-sectional observational study was conducted involving 18 obese adult women in Tegal Regency, Central Java, Indonesia. Participants were assessed for Body Mass Index (BMI), physical literacy using a validated 24-item questionnaire, lung capacity using spirometry, and cardiorespiratory performance using the Six-Minute Walk Test (6MWT). The mean BMI of participants was 31.95±4.26 (Kg/m²), with an average physical literacy score of 76.21±10.01 (moderate level). Lung capacity (FVC) averaged 1.76±0.60 L, and the FEV1/FVC ratio was 82.14±16.63%. Participants completed an average 6MWT distance of 352.08±32.37 meters, indicating reduced cardiorespiratory performance (63.30±6.89% of predicted). Obesity level was significantly correlated with lung capacity, cardiorespiratory performance, and inversely with physical literacy ($p<0.05$). BMI showed significant negative correlation with physical literacy ($p<0.05$), but not with lung capacity ($p>0.05$). Most participants retained normal lung function despite obesity. Obese adult women in this study generally demonstrated moderate physical literacy and average lung and cardiorespiratory function. Obesity level, more than BMI alone, was a stronger predictor of reduced lung capacity and physical performance. Findings highlight the importance of integrating physical literacy into gender-responsive obesity interventions.

KEYWORDS

Obesity; Physical Literacy; Lung Capacity; Cardiorespiratory Performance; Functional Assessment

1. INTRODUCTION

The World Health Organization (WHO) defines overweight and obesity as the abnormal or excessive accumulation of body fat that can negatively impact health. For Asian populations, WHO recommends lower BMI thresholds, with 23 (Kg/m^2) indicating overweight and 25 (Kg/m^2) indicating obesity. Although Body Mass Index (BMI) may not accurately reflect nutritional status in certain groups-such as athletes or individuals with physically demanding jobs-it remains the most widely used measure for evaluating obesity and informing weight management in both clinical and public health settings (Wang et al., 2022).

Obesity is a multifaceted condition shaped by a combination of genetic, biological, behavioral, socioeconomic, and environmental factors. Key contributors include physical inactivity, energy-dense diets, inadequate sleep, prenatal and postnatal influences, certain medications and health conditions, psychosocial stress, ethnicity, exposure to endocrine-disrupting chemicals, and disruptions in the gut microbiome (Masood and Moorthy, 2023). In addition, limited public awareness and weak health policies hinder prevention efforts. Obesity is also closely linked to poverty, especially in high-income countries, highlighting its complex relationship with socioeconomic status (Christaki et al., 2025).

Based on the national health survey of Indonesia, the prevalence of obesity is 36.8% of Indonesian population at year 2023. Sex-specific factors influence the development and progression of obesity. Women, in particular, face distinct challenges in managing weight due to hormonal fluctuations during pregnancy, perimenopause, and menopause. These hormonal shifts affect fat distribution and heighten the risk of cardiometabolic and kidney-related diseases, making women more susceptible to obesity-related complications than men (Saha et al., 2023; Kim et al., 2025).

Obesity adversely affects lung function and overall respiratory health through several mechanisms, including mechanical restriction from excess body fat, reduced lung compliance, impaired efficiency of respiratory muscles, altered ventilation and gas exchange, and chronic systemic inflammation impacting the airways. In severe cases, these factors can contribute to the development of obesity hypoventilation syndrome (Salome et al., 2010; Zammit et al., 2011; Mafort et al., 2016). Obesity also significantly reduces cardiorespiratory fitness. Research indicates that individuals with obesity tend to have a lower VO_2max relative to body weight, reduced oxygen

utilization efficiency, quicker onset of fatigue, and both cardiac and ventilatory limitations during physical activity (Gallagher et al., 2005; Deng et al., 2024).

It is well established that physical inactivity is strongly and consistently linked to a higher prevalence of obesity. As a result, interest in Physical Literacy (PL) has been growing, particularly within the field of public health (Silveira et al., 2022). Physical literacy promotes increased levels of physical activity (PA), while regular engagement in PA, in turn, enhances physical literacy. This bidirectional relationship is evident across all stages of life (Ying et al., 2025). PL is increasingly recognized as a key determinant of health, particularly due to its association with motor skill deficiencies and coordination disorders in children. Differences in physical literacy levels are linked to variations in motor competence, motivation, and emotional well-being. PL encompasses the motivation, confidence, physical ability, knowledge, and understanding necessary to value and participate in lifelong physical activity (Cairney et al., 2019).

Although the consequences of obesity are well-documented, there remains a significant gap in understanding its simultaneous impact on physical literacy, lung function, and cardiorespiratory performance particularly in adult women, who experience distinct physiological and hormonal challenges. With obesity rates rising in Indonesia and physical literacy increasingly recognized as a key determinant of health, a comprehensive investigation into these interconnected factors is both timely and essential. Such research can provide deeper insights into the multifaceted effects of obesity on women's health and support the development of more holistic, gender-responsive health promotion and intervention strategies. Therefore, this study aims to: (1) assess the level of physical literacy among obese adult women; (2) evaluate their lung capacity and cardiorespiratory performance; and (3) explore the interrelationships among physical literacy, lung function, and cardiorespiratory performance in this population.

2. METHODS

2.1. Participants

This study employed a cross-sectional and observational design to examine the associations between Body Mass Index (BMI) and obesity with physical literacy, lung capacity, and cardiorespiratory performance in obese adult women. The research was conducted in Tegal Regency, Central Java, Indonesia, and received ethical approval from the Institutional Ethics Committee of Universitas Diponegoro (No. 309/EC/KEPK/FK-UNDIP/X/2025).

Participants were selected using purposive sampling based on predefined eligibility criteria. A

total of 18 adult women voluntarily participated in the study. Inclusion criteria included being female, classified as obese, of adult age, free from cognitive impairments or disabilities, capable of correctly performing a spirometry blow test, and has no physical activity obstacles. Participants who did not meet these criteria were excluded from the study.

2.2. Instruments

Anthropometric measurement

Body Mass Index (BMI), expressed in (Kg/m²), was calculated using each participant's weight (Kg) and height (m²) to assess nutritional status. Measurements were obtained using a stadiometer and the GEA Medical Electronic Personal Scale (EB Series No. 26SM), following the manufacturer's instructions and guidelines. This study applied the Asian-specific BMI cut-off points to categorize obesity.

Physical literacy questionnaire (PLQ)

It was developed and validated by three experts in the fields of physical literacy, sports psychology, and sports medicine. First, the PLQ draft was submitted to experts and reviewed twice. Feedback from the first review was used to improve the clarity, quality, and scoring system of the questionnaire, while the second review focused mainly on minor revisions and final approval. The PLQ was designed to assess four key components: motivation to engage in physical activity, confidence in one's physical abilities, knowledge related to maintaining physical activity, and understanding of its long-term benefits. Each component consists of six questions, resulting in a total of 24 items. Respondents were instructed to answer all questions honestly. To reduce response bias, the questionnaire included a balanced mix of positively and negatively worded statements. PLQ using five-point of Linkert scale, and every response has score. A total score maximum is 100, and it indicates that respondent giving all the answer with strongly agree. Physical literacy levels were categorized into three groups: high (81–100 points), moderate (61–80 points), and low (≤60 points). The minimum score is 20, which would result if the respondent selected the lowest option for all items.

Pony FX portable spirometer

Lung capacity and function variables were measured using the Pony FX portable spirometer from COSMED (Yeung and Lee, 2023). Data collection adhered strictly to the provided instructions and guidelines. These portable spirometers are well-suited for clinical use due to their cost-effectiveness, compact design, and user-friendly operation.

Six-minutes-walk test (6MWT)

Due to space limitations, a 15-meter track was used for the 6MWT in this study. The test was conducted according to the protocol outlined by Nusdwinuringtyas et al. (2021). To estimate the expected walking distance for healthy adults, the Enright and Sherrill equation based on height, weight, and age were applied (Kammin, 2022; Enright and Sherrill, 1998). The actual distance walked was divided by the predicted distance to calculate a percentage score. Performance was then categorized as poor, average, or excellent based on a normal distribution curve.

2.3. Data Collection Procedures

On the day of data collection, participants followed a four-step process. Upon arrival, they received a thorough explanation of the procedures. First, anthropometric measurements were taken to assess nutritional and obesity status. Second, participants completed a physical literacy interview. Third, lung capacity was evaluated using a spirometer through a standardized blow test. Finally, participants performed the Six-Minute Walk Test (6MWT), during which performance data were recorded for analysis. Refer to Figure 1 for a visual representation of the data collection flow.

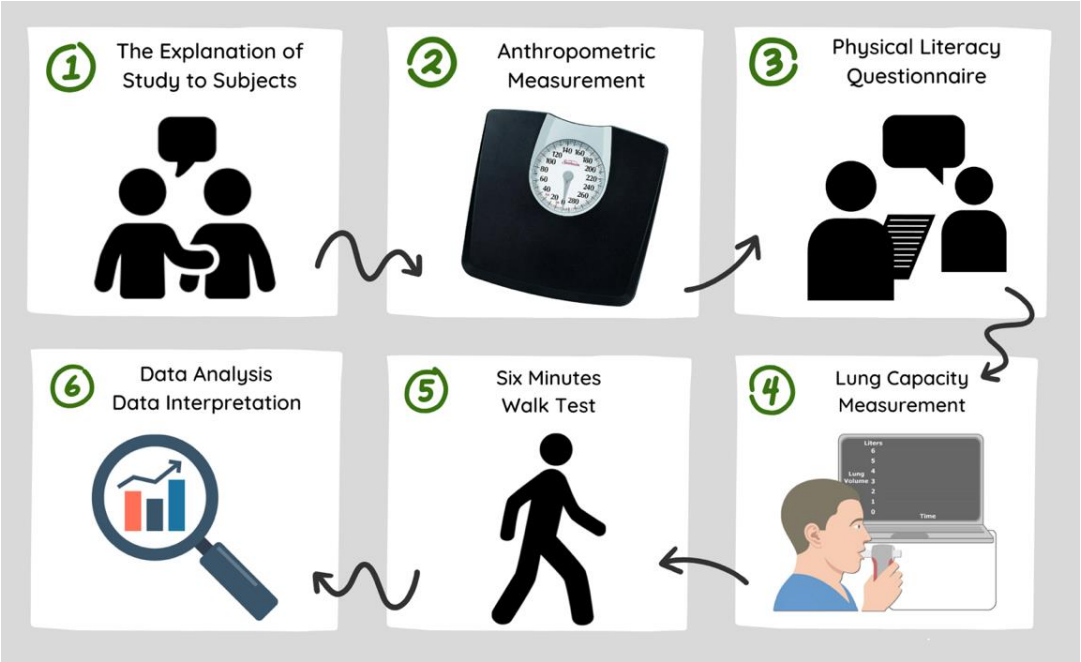

Figure 1. Study procedures

2.4. Statistical Analyses

All statistical analyses were conducted using IBM SPSS version 27, including descriptive statistics and one-tailed Spearman bivariate correlation analysis. A significance level of $p < 0.05$ was used to determine statistical significance. Data are presented as ratios, means ± standard deviations

(SD), minimum and maximum values, and percentages.

3. RESULTS

Table 1 presents detailed information on the participants' characteristics. All participants in this study were Javanese women who did not smoke or consume alcohol.

Table 1. Characteristics of subjects

Age (years old)	**n = 18**
Young adult (18–25)	0
Adult (26–44)	10
Middle-age (45–59)	7
Old age (> 60)	1
Educational Background	
Elementary School	11
Junior High School	4
Senior High School	1
Never Attended School	2
Occupation	
Housewife	16
Tailor	1
Farmer	1
Reproductive status	
Not in period	9
In period	2
Menopause	7

Their ages were distributed as follows: 55.56% were between 26 and 44 years old, 38.89% between 45 and 59 years old, and 5.55% were over 60 years old. Regarding educational background, 61.12% had completed elementary school, 22.22% junior high school, 5.55% senior high school, while 11.11% had never attended school. Most of the participants were housewives (88.90%), with tailors and farmers each comprising 5.55% of the group. Concerning reproductive status, half of the women were still in their productive years but not menstruating, 11.11% were menstruating, and 38.89% were postmenopausal. Table 2 presents the descriptive data of the anthropometric measurements.

Table 2. Descriptive statistics (*Source: primary research data*)

Variables	n	Minimum	Maximum	Mean ± SD
Age (years old)	18	37.00	63.00	46.77 ± 7.76
Weight (Kg)	18	57.70	89.50	72.01 ± 8.38
BMI (Kg/m^2)	18	25.88	41.42	31.95 ± 4.26
Obesity Levels	18	1.00	2.00	1.66 ± 0.48
Lung Capacity (L)	18	0.75	2.78	1.76 ± 0.60
Obstructive Lung (%)	18	29.30	93.56	82.14 ± 16.63
Physical Literacy Score	18	43.20	90.40	76.21 ± 10.01
Cardiorespiratory Performance (%)	18	46.03	75.27	63.30 ± 6.89

Descriptive data from the anthropometric measurements indicated that the average age of participants was 46.77 ± 7.76 years old, with body weight 72.01 ± 8.38 (Kg) and the average body mass index (BMI) was 31.95 ± 4.26 (Kg/m²), classifying the group as obese. Spirometry results showed an average lung capacity of 1.76 ± 0.60 (Liters). The FEV1/FVC ratio is a key indicator for detecting lung obstruction, it was 82.14 ± 16.63 (%). The average physical literacy score was 76.21 ± 10.01 out of a possible 100 points, and the average cardiorespiratory performance was 63.30 ± 6.89 (%), expressed as a percentage of the predicted value. Table 3 presents the results of the distribution of physical literacy score and the cardiorespiratory performance.

Table 3. The distribution of physical literacy score and the cardiorespiratory performance

Physical Literacy Classification	Obese I		Obese II	
	n	percentage	n	percentage
Low Physical Literacy = 20 - 60 points	0	0.00%	1	5.56%
Moderate Physical Literacy = 61 - 80 points	3	16.67%	11	61.10%
High Physical Literacy = 81 - 100 points	3	16.67%	0	0.00%
6MWT Classification Dist./Est. (%)				
Poor < 59%	3	16.67%	0	0.00%
Average 59% - 72%	3	16.67%	10	55.56%
Excellent > 72%	0	0.00%	2	11.10%

The physical literacy score reflects participants' motivation to maintain physical activity, confidence in their ability to be active, knowledge about sustaining physical activity, and understanding of its long-term benefits. Notably, none of the subjects with obesity level I fell into the low physical literacy category, while n= 1 (5.56%) of those with obesity level II did. Conversely, n= 3 (16.67%) of participants classified as having high physical literacy were in obesity level I, with no subjects from obesity level II in this category. The majority of subjects n= 14 (77.77%), regardless of

being in obesity level I or II, fell within the moderate physical literacy classification.

On average, participants completed a distance of 352.08 ± 32.37 meters, this value is shorter compared to a predicted distance of 542.55 ± 46.90 meters, with a minimum completion distance of 270.00 meters and a maximum of 390.00 meters. Regarding cardiorespiratory performance, 16.67% (n= 3) of subjects with obesity level I were categorized as poor, while another 16.67% (n= 3) were in the average category. No subjects with obesity level II were classified as poor; instead, 11.10% (n= 2) achieved an excellent rating, and 55.56% (n= 10) fell into the average category. Table 4 presents the results of the distribution of total volume exhale and volume exhale in the first second.

Table 4. The distribution of total volume exhale and volume exhale in the first second

Age (years old)	FVC Percentage of Prediction				Actual FEV1/FVC			
	n	≤ 80%	n	≥ 80%	n	≤ 70%	n	≥ 70%
≥ 30	2	11.11%	2	11.11%	1	5.55%	3	16.67%
≥ 40	4	22.22%	6	33.35%	0	0.00%	10	55.56%
≥ 50	2	11.11%	2	11.11%	1	5.55%	3	16.67%

Based on table 4, forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) are key indicators in assessing lung function. The FVC values reported here represent the percentage of the actual FVC compared to the predicted FVC values. Meanwhile, the FEV1/FVC ratio is calculated as the percentage of the actual FEV1 relative to the actual FVC.

According to the data distribution, over half of the participants n= 10 (55.56%), regardless of being in obesity level I or II, had FVC values ≥ 80%, while n= 8 (44.44%) had values ≤ 80%. Additionally, the majority n= 16 (88.90%) had an FEV1/FVC ratio exceeding 70%, with n= 2 (11.10%) falling below this threshold. The FVC value indicates lung capacity in liters, whereas the FEV1/FVC ratio helps detect potential lung obstruction or restriction.

Table 5 below presents the correlations among variables: age, anthropometric, lung capacity, FEV1/FVC, physical literacy score, and cardiorespiratory performance. Weight was found to have a strong, significant positive correlation with both BMI and obesity levels. Additionally, weight showed a significant moderate negative correlation with physical literacy scores and a significant positive correlation with cardiorespiratory performance (6MWT). As expected, BMI had a strong, significant positive correlation with obesity levels. Interestingly, only obesity levels but not BMI showed a significant moderate positive correlation with lung capacity (FVC).

Table 5. Correlations among variables: age, anthropometric, lung capacity, FEV1/FVC, physical literacy score, and cardiorespiratory performance

Spearman's rho		Age (years old)	Weight (Kg)	BMI (Kg.m^2)	Obesity Levels	FVC (L)	The FEV1/FVC (%)	Physical Literacy Score	6MWT Dist./Est. Score
Age (years old)	*r*	1.000	-.131	-.066	.034	-.092	.249	.048	.113
	P	.	.303	.397	.446	.358	.160	.426	.328
Weight (Kg)	*r*	-.131	1.000	.899**	.727**	.327	-.222	-.452*	.525*
	P	.303	.	.000	.000	.092	.188	.030	.013
BMI (Kg/m^2)	*r*	-.066	.899**	1.000	.818**	.340	-.053	-.634**	.463*
	P	.397	.000	.	.000	.084	.418	.002	.026
Obesity Levels	*r*	.034	.727**	.818**	1.000	.477*	-.136	-.716**	.522*
	P	.446	.000	.000	.	.023	.295	.000	.013
FVC (L)	*r*	-.092	.327	.340	.477*	1.000	.114	-.301	-.034
	P	.358	.092	.084	.023	.	.327	.113	.447
The FEV1/FVC (%)	*r*	.249	-.222	-.053	-.136	.114	1.000	.011	-.344
	P	.160	.188	.418	.295	.327	.	.482	.081
Physical Literacy Score	*r*	.048	-.452*	-.634**	-.716**	-.301	.011	1.000	-.367
	P	.426	.030	.002	.000	.113	.482	.	.067
6MWT Dist./Est. Score	*r*	.113	.525*	.463*	.522*	-.034	-.344	-.367	1.000
	P	.328	.013	.026	.013	.447	.081	.067	.

Note. **. Correlation is significant at the 0.05 level (1-tailed); **. Correlation is significant at the 0.01 level (1-tailed).*

Moreover, based on table 5 above, both BMI and obesity levels were significantly negatively correlated with physical literacy scores and positively correlated with cardiorespiratory performance. On the other hand, age and the modified Tiffeneau-Pinelli index (FEV1/FVC) did not show any significant correlations with the other variables in this study.

4. DISCUSSION

The participants in this study were exclusively Javanese women who neither smoked nor consumed alcohol. Most were between the ages of 37 and 63, had low levels of formal education, and were primarily employed as housewives. This occupational role may limit daily physical activity and reduce opportunities for structured exercise, potentially contributing to the development of obesity. Considering a regular physical activity is crucial factor in preserving muscle mass, maintaining metabolic rate, and preventing fat accumulation. Women who remain physically active during the perimenopausal period typically exhibit lower BMI, reduced fat mass-particularly abdominal fat-greater lean body mass, and higher bone density (Marsh et al., 2023).

Reproductive age generally spans from 15 to 49 years old, with fertility begins to decline

around age 30 and accelerated after 35. Perimenopause commonly begins in the early to mid-forties. Hormonal changes, particularly a decline in estrogen levels during the late 30s and early 40s, can alter fat distribution, impair metabolic processes, and reduce physical activity. These are factors that collectively increase the risk of obesity. Estrogen typically promotes fat storage in the hips, thighs, and buttocks (a "gynoid" fat distribution). However, as estrogen levels decrease during menopause, fat tends to redistribute toward the abdominal region, increasing visceral fat and associated metabolic risks. Low estrogen levels are also linked to decreased lean muscle mass and reduced energy expenditure (Fenton, 2021; Munshi & Garg, 2025).

Another contributing factor of obesity is a low level of education to a complex cycle of disadvantages, particularly affecting health literacy, awareness of physical activity, and lifestyle choices. Limited health literacy is associated with poorer health behaviors (such as smoking), reduced knowledge and participation in physical activity, unhealthy dietary habits, and a higher risk of obesity (Friis et al., 2016; Alpat Yavaş et al., 2024; Baek & Yoon, 2025).

Anthropometric data indicated that participants had an average BMI of 31.95 (Kg/m^2), placing them in the obese category, with relatively low variability in both weight and BMI. It is well known that obesity is associated with structural and functional cardiovascular changes, including left ventricular hypertrophy, elevated blood pressure, endothelial dysfunction, and increased arterial stiffness, all of which heighten the risk of heart failure and coronary artery disease (Al Suwaidi et al., 2001). Obesity contributes to chronic inflammation within adipose tissue that can results in the development of insulin resistance and type 2 diabetes mellitus (Wu & Ballantyne, 2020). The risk of osteoarthritis (OA) increases by 36% for every 5 Kg of weight gained, characterized by a joint pain and functional impairment tend to progressively worsen over time (Vincent et al., 2012), and in older adults with or at risk of developing OA, obesity has been linked to slower gait speed, lower levels of physical activity, higher disability scores, and diminished quality of life over a six-year follow-up period (Batsis et al., 2015).

Interestingly, spirometry results from obese individuals in this study showed that most participants have a normal lung function, with average FVC and FEV1/FVC ratios remaining above clinically relevant thresholds. Previous research suggests that while FEV1 and FVC often stay within normal limits in obese individuals (particularly men), they may still exhibit reduced peak expiratory flow rates, restrictive ventilatory patterns, and increased airway resistance (Al Ghobain, 2012). In addition, obesity is consistently associated with marked reductions in expiratory reserve volume (ERV), functional residual capacity (FRC), and in some cases total lung capacity (TLC) even among

non-smoking individuals without underlying respiratory disease (Dixon and Peters, 2018). These impairments, however, are reversible with weight loss. In morbidly obese patients who undergo bariatric surgery, significant improvements in lung volumes (TLC, ERV, FRC) have been observed, along with enhanced arterial oxygenation and more efficient carbon dioxide elimination (Thomas et al., 1989). However, in this study we did not evaluate the duration of participants' obesity, whether chronic or acute, which might have potentially influenced the results of the spirometry tests. Chronic obesity may lead to both anatomical and physiological changes, whereas acute obesity might not.

Participants demonstrated a moderately high average physical literacy (PL) score of 76.21 out of 100 points. Only a small subset of individuals with class II obesity showed low PL levels. Lower physical literacy is both associated with and likely contributes to a higher risk of obesity, primarily through its negative impact on physical fitness and daily activity levels (Nezondet, Gandrieau, Nguyen, et al., 2023). Since physical literacy is a modifiable construct encompassing physical, cognitive, affective, and behavioral domains, it offers strong potential for promoting sustained physical activity-particularly among women with lower educational attainment (Nezondet et al., 2023). PL-based interventions have been shown to reduce adiposity, while also enhancing confidence, enjoyment, and motivation for long-term physical activity. By fostering autonomy, knowledge, and competence, physical literacy supports lifelong engagement in active lifestyles (Trecroci et al., 2022). These results highlight that a holistic intervention is needed to address obesity, incorporating multiple approaches such as physical activity management, dietary management, pharmacological therapy, and educational programs to promote behavioral change.

The six-minute walk test used to assess the cardiorespiratory fitness from obese individual, and it was generally moderate distance 352.08 ± 32.37 meters or about 63.30 ± 6.89 (%) of the predicted total distance 542.55 ± 46.90 meters. The ranges of distance start from 400 up to 700 meters is considered for healthy individuals can completed (Giannitsi et al., 2019). The 6MWT is a validated, practical, and accessible tool for assessing real-world physical capacity, particularly in middle-aged and older women with limited education or healthcare access. By mimicking routine daily activities such as walking in a park or shopping, it provides a reliable measure of functional endurance and mobility, which are essential for maintaining independence with age (Holland et al., 2014). Both walking speed and 6MWT distance are strong predictors of survival and physical independence in older adults, especially among women (Studenski et al., 2011).

According to the correlation analysis, the results revealed significant positive relationships between weight, BMI, and obesity level. This relationship is categorized intrinsically linked to each

other. Next, in this study we found that anthropometric variables have negative relationship with physical literacy (meaning that as BMI increases, PL often decreases). This aligns with previous research showing that individuals with higher perceived physical literacy (PPL) tend to have significantly lower BMI, BMI z-scores, waist circumference, waist-to-height ratios, and skinfold thickness. In contrast, those with lower PPL are more likely to present with excess body weight, general obesity, and abdominal obesity (Domínguez-Martín et al., 2024). Furthermore, obese adolescents often perceive their physical abilities more negatively than their peers, even when actual performance differences are relatively modest (Robinson et al., 2020).

We found that there is a lack of significant correlation between BMI and lung capacity (FVC), unlike the positive correlation found with obesity level. BMI, a simple calculation based on weight divided by height squared, does not differentiate between fat mass and lean muscle. Consequently, individuals with similar BMIs may have markedly different body compositions such as varying levels of fat, muscle, or visceral adiposity, all of which can influence lung function in distinct ways (Han et al., 2015). Research indicates that body fat percentage and abdominal fat are more reliable predictors of reduced lung volumes, including FVC, than BMI alone. For instance, studies conducted in India have identified body fat percentage as a stronger indicator of lung function decline compared to BMI (Kamal et al., 2015). Central obesity measures such as waist-to-hip ratio (WHR), waist-to-height ratio, and body fat percentage are consistently associated with negative correlations to FVC and FEV1 (Zeng et al., 2021).

In this study, we found that obesity level showed a moderate positive correlation with cardiorespiratory performance. Based on the characteristics of the subjects (obese individuals with good physical literacy, normal lung function, but only moderate distances in the 6MWT), we assumed that they may represent cases of recent-onset obesity caused by behavioral factors and a lack of training. Hence, since the 6MWT is self-paced and relatively low in intensity, excess body weight may not significantly hinder performance. Psychological and motivational factors such as competitive drive or familiarity with the test can also disproportionately influence outcomes in non-clinical populations. As a result, obese individuals who are otherwise mobile and motivated may perform well on the 6MWT, potentially masking underlying cardiorespiratory impairments. It's important to note that the 6MWT assesses functional capacity and everyday mobility, not maximal aerobic fitness. In contrast, tests like VO_2max or graded exercise protocols offer more accurate assessments of cardiorespiratory fitness, though they are less accessible and more demanding (Ross et al., 2010). Additional confounding factors, such as habitual physical activity, may also impact

results. For example, some obese individuals may engage in regular walking as part of their daily routines, leading to more efficient gait mechanics and improved walking economy. However, the total distance covered in the 6MWT does not accurately reflect true aerobic capacity (VO_2max).

The observed associations between physical literacy, obesity, and functional capacity suggest potential intervention points for improving health outcomes in this population, particularly through educational and activity-based programs tailored to women's daily routines and cultural context. However, authors acknowledge cultural homogeneity, low educational background, and the cross-sectional design as limitations of this study. Thus, future investigations with comparison between rural and urban lifestyle may provide better picture and generalization. Involving uncontrolled cofounders such as dietary habits, daily physical activity levels, hormonal status, and psychosocial factors also can deepen the exploration on this field.

5. CONCLUSIONS

Based on the results, we concluded that the majority of obese Javanese women in this study had moderate physical literacy and average lung and cardiorespiratory functions; obesity level was more strongly linked to lung capacity and cardiorespiratory performance than BMI alone; physical literacy tended to decline with increasing weight and obesity level, and most participants maintained relatively normal lung function despite obesity.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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