

# The Relationship Between Body Mass Index and Lung Vital Capacity in FK UNJANI Students in the 2021-2022 Batch Year

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Body Mass Index (BMI) is a nutritional status indicator that can affect lung function, including vital lung capacity (VLC). Increased BMI may reduce lung capacity due to increased airway resistance, decreased lung tissue elasticity, and fat accumulation in the thoracic and abdominal walls, which restricts diaphragmatic movement. Conversely, low BMI may contribute to reduced vital lung capacity due to decreased respiratory muscle mass, which plays a crucial role in ventilation. This study aimed to analyze the relationship between BMI and vital lung capacity among FK UNJANI students. A cross-sectional study design was used with a total of 37 randomly selected students. BMI was calculated based on weight and height, while vital lung capacity was measured using a spirometer. Data were analyzed using the Pearson correlation test with a significance level of  $p < 0.05$ . The analysis showed a very weak correlation between BMI and vital lung capacity ( $r = 0.077$ ) and was not statistically significant ( $p = 0.652$ ). No meaningful relationship was found between BMI and vital lung capacity in this study sample. Besides BMI, other factors such as body composition (excess fat restricts lung expansion, while muscle mass supports ventilation), exercise habits (enhancing respiratory muscle strength), posture (poor posture can limit lung expansion), and environmental factors (pollutant exposure and allergies impair lung function) may have a greater impact on lung capacity. Further studies with larger sample sizes and more diverse variables are needed for more accurate and generalizable findings.

**Keywords:** Body Mass Index, Medical Students, Spirometry, Vital Lung Capacity

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## 1. Introduction

Identify lack or Nutritional status is indicator excess body weight. 3 BMI is calculated health someone who is related with share body weight (kg) with intake and utilization nutrition with square height (m<sup>2</sup>). in body. Generally, nutritional status According to Department Nutrition and categorized based on a number of University Public Health parameters such as weight, height Indonesia, BMI has long been used body, index mass body mass index (BMI), and as method for assess nutritional status. percentage. <sup>1</sup> WHO and BMI can also describe level The CDC recommends some fat in body so that often method For assess nutritional status, used in determine proportion including index mass body mass index (BMI), body mass index (BMI) and nutritional status 4.5 size circumference waist, and method According to WHO Asia Pacific, others. <sup>1,2</sup> BMI is used For nutritional status classification divided become monitoring the nutritional status of adults in underweight (<18.5 kg/m<sup>2</sup>), normal over 18 years, especially especially in (18.5 – 22.9 kg/m<sup>2</sup>), overweight (23 – 24.9 kg/m<sup>2</sup>), obesity level I (25 – 29.9 kg/m<sup>2</sup>), and obesity level II ( $\geq 30$  kg/m<sup>2</sup>).

<sup>6</sup> However, BMI is one of the factor affecting lung capacity. <sup>7</sup> Capacity lungs tend decrease along with increase in BMI. On the other hand, BMI in normal range related with forced vital capacity and expiratory volume force in One seconds (VEP1) which is also located in normal range. Function capacity lungs covers ventilation, diffusion, and perfusion with vital lung capacity as one of the ventilation parameters. <sup>8</sup> Capacity

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lungs evaluate amount incoming air moment inspiration maximum, while vital lung capacity shows maximum volume air that can issued after maximum inspiration.<sup>9,10</sup> If on the body happen disturbance breathing, things the can reduce function lungs and improve risk serious illness.<sup>6</sup> The presence of fat deposits in the diaphragm, abdomen, and muscles intercostal can lower capacity residue functional (KRF), reserve volume expiratory volume (ERV), expiratory volume force in One seconds (VEP1), and capacity total lung (TLC). Although vital capacity (VC) and KPT are generally normal, a decrease of  $\geq 30\%$  can occur occurs. Respiratory effort increase If There is abnormal resistance in the chest wall or respiratory tract.<sup>11</sup>

Higher BMI tall in a way significant lower capacity residue functional (KRF) and reserve volume expiration (VCE), but No Lots influence vital capacity and capacity total lung. Decrease this is the biggest occurs in the category excess weight. At a BMI of 30 kg/m<sup>2</sup>, KRF decreases to 75% and VCE only 47% of normal values, making breathing less efficient.<sup>12</sup> Jones's research (2006) states improvement one unit of IMT causes 0.5% of capacity lungs decreased. Compared reversed in research Ristianingrum (2010) stated existence correlation positive between BMI and vital lung capacity.<sup>13</sup> studies This will focus on three nutritional status categories (*underweight*, normal, *overweight*) and their relationship with vital capacity of the lungs which provides perspective How BMI variations can influence function lungs.

## 2. Materials and Methods

Study This use analytic observational use design *cross-sectional* For know connection index mass body weight (BMI) with vital lung capacity in students Faculty General Achmad Yani University Medical School, class of 2021-2022. Required samples as many as 34 samples and followed by 37 samples that have been fulfil criteria. Samples were taken use *consecutive sampling* where all subjects that meet the requirements criteria included in the research This until amount specified sample achieved. Things assessed in the research This consists of from type gender, age, weight, height, index mass body mass index (BMI), and vital lung capacity. Research done after get permission from Commission Ethics Faculty General Achmad Yani University of Medicine with number 046/UM1.12/2024 and subject study has willing follow research.

### Data Procedure

Body weight is measured use digital scales with accuracy of 0.1 kg, while height is measured use microtoise with accuracy of 0.1 cm. During the measurement, the subject No put on footwear and stand upright with feet together, knees straight, and heels, buttocks, and shoulders touch wall. View straight to front, hands at the side of the body, and the subject take a deep breath before measurement done. Microtoise pulled horizontally up to touch peak head Then the result noted. Index mass body mass index (BMI) is calculated use formula as as follows :

$$\text{BMI} = \frac{\text{Berat badan (kg}_2)}{\text{Tinggi badan (m)}}$$

Lung vital capacity, measured using a spirometer, with subject breathe through *mouthpiece* in condition nose closed. Measurement results recorded in unit liter use paper vitalograph and converted to in percentage based on "*predicted*" value. Measurement done as much as three times, and the value highest used as mark end.

### Data Processing and Analysis

Data obtained done *editing* for avoid error with inspect completeness and suitability answer. Next, given code For make it easier data analysis (*coding*) Then grouped in accordance with variables studied (tabulating). *After* grouped, data is processed *and* entered using Ms. Excel and SPSS 26. *Do* inspection reset data for ensure No existence error

(cleaning).

Done analysis univariate For describe characteristics BMI and lung vital capacity variables in form distribution frequency and percentage. Next, the analysis bivariate done For test correlation between second variables. If the data is normally distributed, the correlation test *Pearson* used, while if the data is not normally distributed, *Spearman test* used.

### 3. Results and Discussion

#### Characteristics Respondents Unjani Medical Faculty Students 2021-2022

Based on the data in table 1, as many as 22 people (59.5%) of the total respondents various sex male and 15 people (40.5%) were of the same sex sex Woman with average age  $21.22 \pm 0.85$  years. Average body weight obtained is  $66.39 \pm 15.39$  kg with average height body  $164.03 \pm 8.08$  cm. Average BMI of  $24.36 \pm 5.27$  and average vital lung capacity reflecting condition function lungs respondents of  $89.44 \pm 21.65$ . Age mature young become faakotr important Because Not yet happen decline physiological function normal lungs happen along increasing age. 14 In addition, individuals with normal BMI have capacity normal lungs because No happen decline lung function.<sup>15</sup>

**Table 1** Characteristics Respondents in the Faculty of Medicine, UNJANI Class of 2021-2022

	Mean $\pm$ SD	Amount	Percentage (%)
Gender			
Man		22	59.5
Woman		15	40.5
Age (in year)	21.22 $\pm$ 0.85		
Heavy Body (in kg)	66.39 $\pm$ 15.39		
Tall Body (in cm)	164.03 $\pm$ 8.08		
BMI	24.63 $\pm$ 5.27		
KVP (FVC)	89.44 $\pm$ 21.65		

As it grows age, vascular remodeling occurs lungs that improve pressure arteries lungs moment rest. Elderly woman age tend experiencing improvement pressure arteries lungs more bigger than men moment exercising light until moderate, although factor activity and size body taken into account. Effectiveness pulmonary gas exchange influenced by alveolar ventilation, perfusion, and diffusion oxygen, which decreases consequence aging capacity diffusion and PaO<sub>2</sub> decreases, elderly with fitness cardiorespiratory Good still can maintain level PaO<sub>2</sub> approaching mark Rest while exercising.<sup>16</sup>

#### Characteristics Based on BMI

Category index mass body mass index (BMI) divided into five groups namely *underweight*, normal, *overweight*, obesity I, and obesity II. As the data presented in table II, respondents with normal and obesity categories as many as 10 people (27.0%), followed by group obesity II as many as 7 people (18.9%), category *underweight* as many as 6 people (16.2%), and the group *overweight* with least amount as many as 4 people (10.8%). The difference BMI distribution can influenced by several factor among them style life, pattern eating and activities physical. Normal category dominates signify partial weight loss big student Already in accordance with standard health. There are variations samples can also be influence difference

distribution between category. Students with *underweight* BMI category data indicates existence lack nutrition or habit suboptimal eating.<sup>15</sup>

**Table 2** Characteristics of Student BMI Faculty Unjani Medical Faculty Class of 2021-2022

Body Mass Index	Frequency	Percentage (%)
<i>Underweight</i>	6	16.2
Normal	10	27.0
<i>Overweight</i>	4	10.8
<i>Obese I</i>	10	27.0
<i>Obese II</i>	7	18.9
Total	37	100

### Characteristics By Gender

Based on type gender obtained in table 3, the majority respondents is male (59.5%). The average age of males was  $21.05 \pm 0.72$  years, slightly more young from female ( $21.47 \pm 0.99$  years). Male own body weight ( $69.78 \pm 14.50$  kg) and height ( $168.66 \pm 5.31$  cm) big compared female ( $61.42 \pm 15.79$  kg;  $157.23 \pm 6.52$  cm). However, the BMI of both similar (male :  $24.51 \pm 4.95$ ; female :  $24.81 \pm 5.89$ ). Lung vital capacity (FVC) is greater high in men ( $95.21 \pm 17.32$ ) compared to women ( $80.96 \pm 25.03$ ), reflecting difference physiological capacity lungs.

**Table 3** Characteristics Based on Gender of Students of the Faculty of Medicine, Unjani Class of 2021-2022

	Man (n = 22)	Woman (n = 15)
Age (in year)	$21.05 \pm 0.72$	$21.47 \pm 0.99$
Body Weight (in kg)	$69.78 \pm 14.50$	$61.42 \pm 15.79$
Height (in cm)	$168.66 \pm 5.31$	$157.23 \pm 6.52$
BMI	$24.51 \pm 4.95$	$24.81 \pm 5.89$
KVP (FVC)	$95.21 \pm 17.32$	$80.96 \pm 25.03$

Based on height, generally man more tall from woman so that influence size more lungs big. However, the difference This No only caused by factors allometry. Even after customized with height or sitting height, lungs woman still more small. This is allegedly Because greater number of alveoli slightly in women, while man have more alveoli big. In addition, men own bone ribs more short with base more width that follows influence form lungs between second gender.<sup>17,18</sup>

### BMI Characteristics by Gender

Based on the data contained in table 4, male with a normal BMI more tall whereas BMI distribution in women more evenly with sufficient percentage balanced in each category. In terms of physiological, men own more Lots mass muscle and visceral fat whereas woman own more a lot of subcutaneous fat plays a role in metabolism energy and storage energy. Metabolism a man who is more tall make they more stand to obesity. Social factors also have an influence, where social pressure image body make woman tend lower body weight.<sup>19,20</sup>

The relationship between BMI and FVC is not linear, but rather affected by obesity central.

**Table 4** BMI Characteristics Based on Gender of UNJANI Faculty of Medicine Students Class of 2021-2022

	<i>Underweight</i>		<i>Normal</i>		<i>Overweight</i>		<i>Obese I</i>		<i>Obese II</i>	
	n	%	n	%	n	%	n	%	n	%
<b>Pria</b>	3		7		2		6		4	
<b>Wanita</b>	3	20	3	20	2	13,3	4	26,7	3	10
	13.6		31.8		9.1		27.3		18.2	

In individuals without obesity centrally, increasing BMI increases FVC, whereas in obesity central, fat accumulation presses diaphragm and decreases FVC. Men have capacity lungs more big Because size lungs, number of alveoli, and mass muscle deeper breathing high. Therefore that, fat distribution and type sex need considered in BMI analysis and FVC. <sup>21</sup>

In the normality test results show that fourth variables normally distributed with  $p > 0.05$  so that correlation test used *Pearson* test results can seen in Table 6 which shows  $p > 0.05$  so No There is connection significant between BMI and vital capacity.

**Results of Inter-Group Data Analysis**

**Table 5** Characteristics Pulmonary Vital Capacity (FVC) Based on BMI in UNJANI Faculty of Medicine Students Class of 2021-2022

	<i>Underweight</i> (n = 6)	<i>Normal</i> (n = 4)	<i>Overweight</i> (n = 10)	<i>Obese I</i> (n = 10)	<i>Obese II</i> (n = 7)
<b>KVP(FVC)</b>	91.9 ± 18.4	87.3 ± 18.6	76.7 ± 24.7	89.5 ± 30.3	97.4 ± 10.8

Previously done analysis characteristics vital lung capacity based on BMI of FK Unjani students 2021-2022 as in Table 5 which shows amount sample varies between group. Category sample most are normal and obese I (n = 10 each), whereas least *overweight* (n = 4). The highest average FVC was in obesity II (97.4±10.8 l/s) and the lowest in *overweight* (76.7±24.7 l/s). variation small samples, especially in *overweight*, can influence average interpretation.

Amount small sample can cause average fluctuations that not enough represent population. BMI and lung vital capacity (FVC) were not always linearly related, but influenced by factors biology and fat distribution. Individual obesity II tends to have more FVC tall as adaptation to improvement need oxygen, whereas *overweight* shows higher FVC tall Because pattern deeper breathing in. In addition, the number of small sample especially in groups *overweight* can influence results. Therefore that, fat distribution and amount sample need be considered for analysis more accurate. <sup>15,22</sup>

**Table 6** Correlation Test Results *Pearson* The relationship between BMI and Lung Vital Capacity Pulmonary Vital Capacity (FVC)

	p	r
<b>BMI</b>	0.652	0.077

Analysis correlation show that connection between BMI and lung vital capacity (FVC) was very weak (r = 0.077) and not significant (p = 0.652), so No There is connection meaningful between both of them. This result consistent with study Elsaidy (2024) and Bhatti (2019), who did not find difference significant in FVC between BMI category. In contrast, the VEP1/FVC ratio indicates connection significant with BMI, where the dim is getting bigger low BMI, the more tall the ratio. <sup>23,24</sup>

The relationship between BMI and FVC is not consistent can explained by factors fat distribution and inflammation. Ferreira (2020) showed that function lungs in individuals obesity varies greatly, while Huang

(2019) found that visceral and subcutaneous fat more influential to function lungs compared to BMI. <sup>25,26</sup> This is show that other factors, such as composition body and condition metabolic, more relevant in determine function lungs compared to BMI alone. Advantages weight and obesity proven decrease FVC and VEP1. Population study show that improvement weight in adulthood related with decline function lungs and rate further decline fast, loose from age and smoking status. <sup>27</sup> In addition, BMI  $\geq 30$  kg/m<sup>2</sup> associated with *obesity hypoventilation syndrome*, in which dyspnea and wheezing occur often happen consequence change mechanism breathing as well as decline level oxygen in the blood. <sup>28</sup>

#### 4. Conclusion

Based on results study can concluded that student BMI overview varies, with The normal and obesity I categories are the most dominant. Lung vital capacity is at in normal range, but more height in men compared to women. And not found connection significant between BMI and lung vital capacity.

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