The Relationship Between Physical Activity And Nutritional Intake By Measuring Upper Arm Circular Folds And Measurements In Students Of The Medical Education Study Program, Faculty Of Medicine, Islamic University Of Malang

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Abstract

Physical activity and diet are key factors that influence nutritional status, especially during late adolescence and early adulthood when energy needs increase due to higher activity levels. Skipping meals and engaging in low physical activity can negatively affect an individual's nutritional condition. This study aimed to examine the effects of physical activity and nutritional intake on adult nutritional status among medical students at the Faculty of Medicine, Universitas Islam Malang (UNISMA), using mid-upper arm circumference (MUAC) and mid-upper arm fold (LLA) as indicators.A descriptive-analytical design with a cross-sectional approach was used. The sample consisted of 87 students selected through total sampling. Physical activity was measured using the International Physical Activity Questionnaire (IPAQ), while nutritional intake was assessed with a food frequency questionnaire. MUAC and LLA measurements were taken using standardized tools. Data were analyzed using the Chi-Square test with a significance level of $p < 0.05$.Most respondents were 19 years old (58.6%) and female (69.0%). The majority had light physical activity (70.1%) and inadequate nutritional intake (66.7%). MUAC results showed that 54% had good nutritional status, 28.7% were malnourished, and 17.3% were obese. Physical activity and nutritional intake significantly affected both MUAC and LLA ($p < 0.001$). These findings highlight the importance of maintaining balanced nutrition and regular physical activity to support healthy nutritional status in adult students.

1. Introduction

According to the Indonesian Ministry of Health (2015), physical activity is any body movement that increases energy expenditure or calorie burning.(Ministry of Health, 2020)Meanwhile, sport is a planned and structured physical activity that involves repeated body movements and aims to improve physical fitness.(Suryani et al., 2017)(Farizati in Khomarun, 2013). According to KBBI (2023) Sport is body movement to strengthen and make the body healthy, such as soccer, swimming, javelin throwing, and so on.(Big Indonesian Dictionary, 2023)Sport is defined as structured and planned physical activity that follows established rules, with the goal of not only improving physical fitness but also achieving success. Sport is a form of physical activity that helps maintain and improve one's health. (Aditia, 2015).

In adolescence, nutritional problems are usually related to lifestyle and eating habits, which influence physical changes and energy needs. (Amila et al., 2020)According to Vania et al. (2024), in the midst of busy lecture activities, students can require more energy.(Vania et al., 2024)On the other hand, it also often causes students to skip meals, such as rarely eating breakfast or having irregular meal times. Poor eating habits can lead to nutritional problems, such as being underweight. If underweight persists for a long period of time, there is a risk of chronic energy deficiency (CED). According to Dieny & Rahadiyanti (2019), chronic energy deficiency (CED) is a condition in women who have experienced significantly low energy levels over a long period of time. (Dieny, Fillah Fithra, 2019). Where if experiencing the risk of chronic energy deficiency (CED) can be seen through nutritional status measured based on the Upper Arm Circumference (MUAC) and Upper Arm Fold. (Vania et al., 2024). According to Bujani et al (2023), skinfold thickness and mid-upper arm circumference are indirect measurements to assess two important components in the body, namely, fat and fat-free mass. (Bujani et al., 2023).

Data from the 2018 Basic Health Research indicates that 35% of Indonesians are physically inactive. Inactive individuals have a 20% to 30% increased risk of death compared to those who are moderately active.(Ministry of Health of the Republic of Indonesia, 2023). Lack of physical activity in Indonesian society can lead to a high risk of obesity. According to the Basic Health Research (Riskesdas) (2018), this can lead to the risk of obesity. In Indonesia, the results of the 2018 Basic Health Research (Riskesdas) showed an increase in the prevalence of obesity in the population aged > 18 years from 15.4% (2013) to 21.8% (2018). In addition, Riskesdas data also showed an increase in the prevalence of central obesity in the population aged > 15 years from 26.6% (2013) to 31.0% (2018).(Ministry of Health of the Republic of Indonesia, 2022)According to the Malang Regency Health Service, there is 19.7% obesity in men and 32.9% obesity in women.(Malang City Health Office, 2022)Prof. Dr. Sri Andarini (2021) stated that there was a trend of overweight and obesity in Malang City in 2021. The prevalence of obesity by gender showed that women were more obese than men. As many as 15.7% of women were overweight, and 33.78% were obese. Meanwhile, among men, 12.98% were overweight and 13.71% were obese.(Prof. Dr. dr. Sri Andarini, 2021).

This research supports SDG 3 by providing scientific evidence on the relationship between physical activity, nutritional intake, and nutritional status to strengthen health literacy, prevent non-communicable diseases, and increase public awareness of the importance of balanced nutrition and physical activity.

1.1 Literature Review

Physical Activity

According to WHO (2020) and the Indonesian Ministry of Health (2022), physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure, including daily activities, exercise, work-related movement, and transportation. Physical activity is classified by type, frequency, duration, and intensity. The main types include endurance, flexibility, and strength activities. Good physical activity is defined as at least 30 minutes per day or 3–5 days per week. Intensity levels are categorized as light, moderate, or vigorous. Physical activity provides numerous health benefits, such as weight control, improved muscle and bone strength, enhanced immunity, and reduced risk of non-communicable diseases. Assessment of physical activity commonly uses the International Physical Activity Questionnaire (IPAQ), which categorizes results by MET-minutes/week.

Nutrition

According to WHO (2024), nutrition refers to nutrients obtained from foods and beverages essential for cellular health, immune function, growth, and reduced risk of non-communicable diseases. Nutrients are classified into macronutrients (carbohydrates, fats, proteins) and micronutrients (vitamins and minerals). A commonly used dietary assessment method is the 24-hour food recall, which records all foods and drinks consumed in the previous 24 hours. This method is easy, inexpensive, and quick but depends heavily on the respondent's memory and may not reflect usual intake.

Mid-Upper Arm Circumference (MUAC)

MUAC is an anthropometric indicator used to assess nutritional status through the measurement of muscle and subcutaneous fat in the upper arm. MUAC classification includes severe malnutrition (<70%), moderate malnutrition (70.1–84.9%), normal nutrition (85–110%), overweight (110–120%), and obesity (>120%). MUAC percentiles are calculated by comparing the measured MUAC to standard values.

Upper Arm Skinfold (Triceps Skinfold)

The upper arm skinfold (TSF) is measured using a fat caliper at the midpoint of the upper arm and serves to estimate subcutaneous fat thickness and evaluate nutritional status. TSF assessment involves MUAC, TSF thickness, and calculations of upper arm muscle area (UMA).

2. Research Methods

Research Design, Time, and Place

The research design used in this study was descriptive analytical with a cross-sectional approach that aims to determine the relationship between physical activity and nutritional intake measurements of the upper arm circumference and upper arm fold of students of the 2024 class of the Faculty of Medicine, Islamic University of Malang. The study was conducted offline at the Faculty of Medicine, Islamic University of Malang in June 2025 and has obtained ethical approval based on the Health Research Ethics Committee of the Islamic Hospital of Malang with number 48/KEPK/RSI-U/X/2024.

Research Sample

The population in this study were active second-year students of the Faculty of Medicine, UNISMA. The details of the respondents were 87 students. Respondents who met the inclusion criteria were 87 students. The inclusion criteria in this study were The inclusion criteria that met were active students in the Class of 2024 of the Medical Education Study Program, Faculty of Medicine, UNISMA who were willing to participate as research subjects and were physically healthy. The sampling technique used Total Sampling with a minimum number determined based on calculations using the Lemeshow formula, namely a minimum of 71 students. The flow of research respondents can be seen.

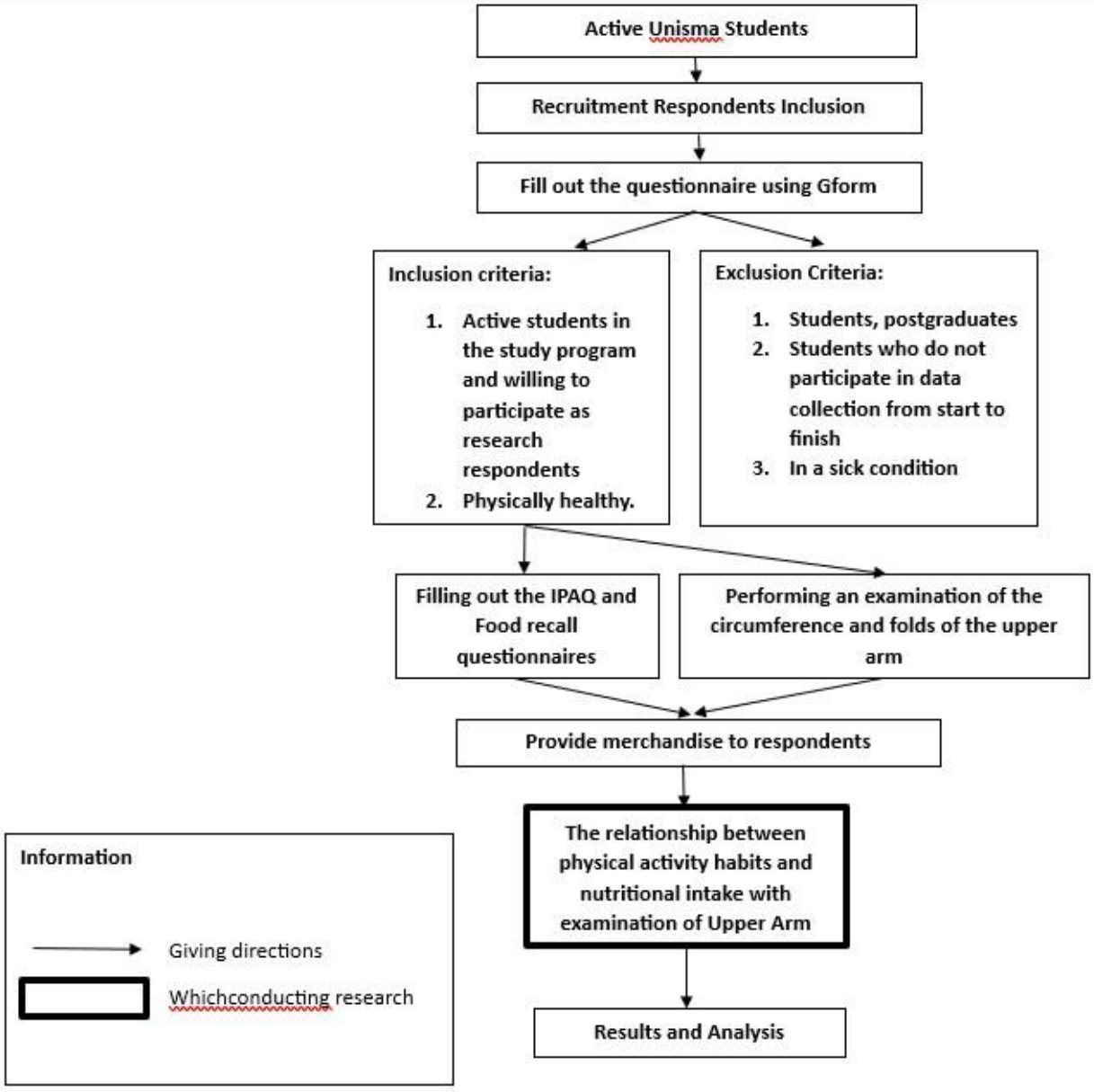

Figure 1 The flow of research respondents

3. Result and Discussion

The population of this study was all 87 students from the Faculty of Medicine, Class of 2024, at the Islamic University of Malang. The population consisted of 27 male students and 80 female students. The 87 students were willing to participate and complete the questionnaire. The sampling technique used was total sampling.

The age range of respondents in this study was 17 – 21 years old. With the number of respondents aged 17 years 2 students, 13 students aged 18 years, 51 students aged 19 years, 19 students aged 20 years and 2 students aged 21 years.

The residential characteristics in this study were in dormitories. Among the 2024 class, all respondents resided in dormitories at the Ar-Razi Islamic Boarding School, and the majority of students were from outside Malang.

Tabel 1 Respondent Characteristics

Characteristics	Number (n)	Percentage (%)
Gender		
Man	27	31.0
Woman	60	69.0
Age (years)		
17	2	2.3
18	13	14.9
19	51	58.6
20	19	21.8
21	2	2.3
Residence		
Hostel	87	100.0
Total	87	100.0

Description: Data is presented in n (%), n: 87p

Results of Student Physical Activity Assessment

Physical activity assessments for the Class of 2024 students were categorized into two groups: light (total score <600 MET minutes/week) and heavy (total individual MET score ≥3,000 MET minutes). These scores were compiled from questions on the International Physical Activity Questionnaire (IPAQ).

The results of the study showed that the majority of second-year students had physical activity in the light category, amounting to 61 students with a percentage of 70.1%, while physical activity in the heavy category was amounting to 26 students with a percentage of 29.9%.

Tabel 2 Physical Activity Levels

	Category	Number (n)	Percentage (%)
Physical Activity	Light	61	70.1
	Heavy	26	29.9
Total		87	100.0

Student Nutrition Assessment Results

Nutritional assessment using Food Frequency in second-year students was categorized into two groups: inadequate (score <90%) and adequate (90%-110%). These scores were the sum of the questions in the Food Frequency questionnaire.

The results of the study showed that the majority of students in the Class of 2024 had insufficient nutrition, amounting to 58 students with a percentage of 66.7%, while 29 students had sufficient nutrition, amounting to 33.3%.

Tabel 3 Food Intake Levels

Food Frequency	Category	Number (n)	Percentage (%)
	Not enough	58	66.7
	Enough	29	33.3
Total		87	100.0

Results of Upper Arm Circumference (MUAC) Measurements for Students

The Mid-Upper Arm Circumference (MUAC) assessment of second-year students was categorized into three groups: well-nourished (score 85-110%), malnourished (score 70.1-84.9%), and obese (score >120%). These scores are the accumulation of MUAC measurements using the Metline tool.

The results of the study showed that the majority of second-year students had LILA in the good nutrition category, amounting to 47 students with a percentage of 54%, LILA in the malnutrition category amounting to 25 students with a percentage of 28.7%, while LILA in the obesity category amounting to 15 students with a percentage of 17.3%.

Tabel 4 Nutritional Status Based on UAC

Upper Arm Circumference (UMC)	Category	Number (n)	Percentage (%)
	Good Nutrition	47	54.0
	Malnutrition	25	28.7
	Obesity	15	17.3
Total		87	100.0

Upper Arm Fold (ALL) Measurement Results for Students

Upper Arm Crease (ALL) measurements for second-year students were categorized into three groups: Ideal (score 10.5-14.3), Average (score 16.0-21.3), and Above Average (score 22.3-24.9). These scores are the accumulation of LLA measurements using a Fat Calliper.

The results of the study showed that the majority of second-year students had LILA in the good nutrition category, amounting to 47 students with a percentage of 54%, LILA in the malnutrition category amounting to 25 students with a percentage of 28.7%, while LILA in the obesity category amounting to 15 students with a percentage of 17.3%.

Tabel 5 Upper Arm Crease Status

Upper Arm Crease (ALL)	Category	Number (n)	Percentage (%)
	Ideal	24	27.6
	Average	51	58.6
	Above Average	12	13.8
Total		87	100.0

The Relationship of Physical Activity to Upper Arm Circumference Measurements in the 2024 Class of Students of the Medical Education Study Program, Faculty of Medicine, Islamic University of Malang

Decision making is done by looking at the Pearson chi-square value, if the chi-square value is significant <0.05.*Table1*shows the Asym. Sig value <,001 is smaller than 0.05, so it can be concluded that there is a significant relationship between Physical Activity and Upper Arm Circumference Measurement.

Tabel 6 Chi-Square Test of Physical Activity and Upper Arm Circumference

Physical Activity on Upper Arm Circumference			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	73.293a	2	<,001
Likelihood Ratio	80,696	2	<,001
N of Valid Cases	87		
Description: The table shows the results of the chi-square test on research respondents.			

Chi-Square Test Results of the Relationship between Physical Activity and Upper Arm Folds in the 2024 Class of Students of the Medical Education Study Program, Faculty of Medicine, Islamic University of Malang

Table2 shows an Asym. Sig value of <0.001 which is smaller than 0.05, so it can be concluded that there is a significant relationship between Physical Activity and Upper Arm Fold Measurement.

Tabel 7 Chi-Square Test of Physical Activity and Upper Arm Folds

Physical Activity on the Upper Arm Folds			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	39.779a	2	<,001
Likelihood Ratio	40,019	2	<,001
N of Valid Cases	87		
Description: The table shows the results of the chi-square test on research respondents.			

The Relationship Between Nutritional Intake and Upper Arm Circumference Measurements in the 2024 Class of Students of the Medical Education Study Program, Faculty of Medicine, Islamic University of Malang

*Table3*shows an Asym. Sig value of .035 which is smaller than 0.05, so it can be concluded that there is a significant relationship between Nutritional Intake and Upper Arm Circumference Measurement.

Tabel 8 Nutritional Intake and MUAC Association

Nutritional Intake Against Upper Arm Circumference Measurement			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.694a	2	.035
Likelihood Ratio	6,754	2	.034
N of Valid Cases	87		
Description: The table shows the results of the chi-square test on research respondents.			

Chi-Square Test Results of the Relationship Between Nutritional Intake and Upper Arm Folds in the 2024
Class of Students of the Medical Education Study Program, Faculty of Medicine, Islamic University of Malang

Table4 shows an Asym. Sig value of <.001 which is smaller than 0.05, so it can be concluded that there is a significant relationship between Nutritional Intake and Upper Arm Fold Measurement.

Tabel 9 Nutritional Intake and Upper Arm Crease Association

Nutritional Intake Against Upper Arm Crease Measurement			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.694a	2	.035
Likelihood Ratio	6,754	2	.034
N of Valid Cases	87		
Description: The table shows the results of the chi-square test on research respondents.			

Discussion

The Role of Respondent Characteristics on Research Results
The respondents in this study were 87 students from the Class of 2024, with the majority being female (69.0%) and the highest age being 19 (58.6%). All respondents lived in dormitories. These characteristics played a significant role in influencing the study's results.

Gender influences nutritional status and body composition. Women have a higher percentage of body fat than men due to differences in hormones, metabolism, and activity patterns. This may explain the proportion of respondents with average to above average LLA scores. Furthermore, most respondents were aged 18-20, the transition period from late adolescence to early adulthood. During this phase, energy needs increase due to the busy schedule of college activities.

Living conditions in dormitories are also a factor influencing eating patterns and physical activity. Students living in dormitories typically have limited access to a variety of nutritious, balanced meals and fewer opportunities for physical activity. This is evident in the study, which showed that the majority of respondents reported light physical activity (70.1%) and inadequate nutritional intake (66.7%). Thus, respondent characteristics play a role in shaping physical activity patterns and eating habits, and have implications for the results of the MUAC and LLA measurements.

The Relationship Between Physical Activity and Upper Arm Circumference and Folds
Chi-square test results showed a significant relationship between physical activity and MUAC ($p < 0.001$) and LLA ($p < 0.001$). Students with heavy physical activity tended to have more ideal MUAC and LLA than students with light physical activity.

These findings support the theory that physical activity plays a role in maintaining energy balance and body composition. Physical activity increases energy expenditure, reduces subcutaneous fat accumulation, and helps maintain muscle mass. Conversely, low levels of physical activity are associated with an increased risk of body fat and obesity (Ministry of Health of the Republic of Indonesia, 2020; Suryani et al., 2017).

Students with little physical activity tend to spend more time studying, sitting, or engaging in other sedentary activities, resulting in decreased energy metabolism. This can lead to energy imbalance, which is ultimately reflected in MUAC and MUAC measurements. Therefore, regular physical activity is crucial for preventing multiple nutritional problems in students.

The Relationship Between Nutritional Intake and Upper Arm Circumference and Folds

Analysis showed a significant relationship between nutritional intake and MUAC ($p = 0.035$) and LLA ($p < 0.001$). Respondents with adequate nutritional intake had more MUAC and LLA in the ideal category compared to respondents with insufficient nutritional intake.

A balanced nutritional intake plays a role in supporting energy metabolism, muscle mass growth, and body fat reserves. Insufficient nutritional intake can lead to malnutrition or the risk of chronic energy deficiency (CED), as seen in the proportion of respondents with low MUAC. Conversely, irregular eating patterns and the consumption of foods with low nutritional quality but high calories can lead to increased body fat, reflected in MUAC values ranging from average to above average (Bujani et al., 2023; Dieny & Rahadiyanti, 2019).

Thus, a healthy diet is crucial for college students. Skipping breakfast, consuming instant foods, and a lack of healthy food variety in dormitories can be major causes of inadequate nutritional intake. These findings emphasize the need for nutrition education interventions to increase students' awareness of healthy and balanced diet choices.

The results section summarizes the data collected for the study in the form of descriptive statistics and also reports the results of relevant inferential statistically analysis (e.g., hypothesis tests) conducted on the data. You need to report the results in sufficient detail so that the reader can see which statistical analyses were conducted and why, and to justify your conclusions. Mention all relevant results, including those that are at odds with the stated hypotheses (American Psychology Association 2001: 20).

There is no fixed recipe for presenting the findings of a study. We will, therefore, first consider general guidelines and then turn our attention to options for reporting descriptive statistics and the results of the hypothesis test.

4. Conclusions

The characteristics of the study respondents were dominated by 19-year-old students (58.6%), female (69.0%), and all living in dormitories. These characteristics influenced physical activity patterns, which tended to be light, and nutritional intake, which was largely insufficient, thus impacting variations in nutritional status as indicated by LILA and LLA.

There is a significant relationship between physical activity and Upper Arm Circumference (MUAC) and Upper Arm Crease (LLA) ($p < 0.001$). Students with heavy physical activity are more likely to have MUAC and LLA in the ideal category compared to students with light physical activity.

There is a significant relationship between nutritional intake and Upper Arm Circumference (MUAC) and Upper Arm Crease (LLA) ($p = 0.035$ and $p < 0.001$). Students with sufficient nutritional intake are more likely to have normal nutritional status, while students with insufficient nutritional intake tend to experience malnutrition or excess body fat.

Overall, the results of this study confirm that physical activity and nutritional intake play an important role in determining the nutritional status of students, so that intervention efforts are needed in the form of balanced nutritional education and promotion of regular physical activity to prevent multiple nutritional problems in students.

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