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Energy, Fat, Carbohydrate Adequacy, Physical Activity: Relation to Nutrition Students' Body Fat Percentage

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ABSTRACT

Obesity is caused by excessive fat accumulation due to high energy, carbohydrate, fat intake, and low physical activity, leading to serious health risks. This study examines the relationship between the adequacy levels of energy, fat, carbohydrates, and physical activity with body fat percentage in nutrition students at Universitas Negeri Surabaya. This research used a quantitative method with a cross-sectional design involving 111 respondents selected through cluster random sampling based on student cohorts. Data were collected using a 3x24-hour Food Record questionnaire and the IPAQ Short Form to assess physical activity levels, and body fat percentage was measured using BIA. The results showed that most respondents had a deficit in energy adequacy (72.1%) and carbohydrate adequacy (91%), 57.6% had adequate or higher fat intake, and 64% were physically active. Statistical analysis showed a significant relationship between energy adequacy levels (p=0.024; OR=4.4) and fat adequacy (p=0.000; OR=6) with body fat percentage, as well as a significant relationship between physical activity (p=0.028; OR=2.3) and body fat percentage. No significant relationship was found between carbohydrate adequacy levels and body fat percentage (p=0.316). This study highlights the importance of maintaining balanced energy and fat intake and increasing physical activity to control body fat percentage and prevent obesity among female students. Nutrition and physical activity intervention programs tailored to the needs of female students are necessary to achieve optimal body health.

Keywords: Body fat percentage, Energy adequacy level, Fat, Obesity, Physical activity

INTRODUCTION

Obesity is an unnatural or excessive accumulation of fat that can lead to health problems (WHO 2021). Obesity occurs when the number of calories consumed through food exceeds the body's energy needs, causing the excess calories to be converted into triglycerides and stored in various body tissues (Setyawati and Lasroha 2021). Uncontrolled obesity can lead to various degenerative diseases that can ultimately result in death (Boubertakh et al., 2022). According to a WHO report, more than 1.9 billion adults worldwide suffer from obesity, with a higher prevalence in the 18-64 age group, reaching 51.2% (WHO 2018). In Indonesia, data from the 2018 Riskesdas shows that obesity in adult women (>18 years) is 29.3%, while in East Java, this figure reaches 29.8%. In Surabaya, the prevalence of obesity in adult women is even higher, at 35.03% (Kemenkes 2018). Research also shows that the prevalence of obesity in female university students, with a sample size 24,826, reaches 32.6% (Nurkhopipah et al. 2017).

Various factors, including energy intake, carbohydrates, fat, and physical activity levels, cause obesity. Research by Harna et al. (2021) indicates that energy and carbohydrate intake are significantly related to obesity. Additionally, Dixon et al. (2021) found that energy intake, fat, and physical activity levels are also related to the incidence of obesity. Obesity can be measured using the Body Mass Index (BMI), where a BMI ≥ 25 kg/m2 falls into the obesity category (Kemenkes 2018). However, BMI has limitations because it does not account for differences in body composition among individuals and is less suitable for the Asian population (Misra and Dhurandhar 2019; Mohajan and Mohajan 2023). As an alternative, obesity can also be measured through body fat percentage, which is more accurate in estimating the risk of obesity-related diseases such as type 2 diabetes (Kesztyüs et al. 2021; Zhang et al. 2022). Body fat percentage is commonly measured using Bioelectrical Impedance Analysis (BIA) and is more frequently used than BMI because it assesses body fat directly (Marra et al. 2019; Silveira et al. 2020). Excessive energy intake can lead to obesity due to inefficient metabolic processes, resulting in fat accumulation (Kurniasanti 2020). Research by Lange et al.

(2020) also shows a significant relationship between energy intake and body fat percentage.

Energy is obtained from consuming macronutrients such as carbohydrates, protein, and fat (Remesar and Alemany 2020; Phan et al. 2021). Carbohydrates are the primary source of energy for the body, while fat acts as an efficient energy storage (Alghannam et al. 2021; Kolnes et al. 2021). Several studies show that fat and carbohydrates are related to body fat percentage. Rai et al. (2023) research indicates that fat is related to body fat percentage. Habibaturochmah and Shan et al. (2019) found a relationship between carbohydrate and fat intake and body fat percentage. Energy balance and physical activity play a crucial role in obesity. This condition is caused by consuming high-calorie foods and a lack of physical activity, which hinders energy expenditure (Vujović et al., 2022). Research by Sultana et al. (2019) shows that physical activity affects body fat percentage. The relationship between protein and body fat percentage is minimal, but protein is related to lean body mass due to the amino acid leucine, which stimulates muscle protein synthesis (Stanzione et al., 2022). Research by Tagawa et al. (2021) and Haaf et al. (2019) shows that protein intake is related to lean body mass.

Health students are at risk of obesity due to factors such as lack of physical activity and excessive energy intake. Research by Olodu et al. (2020) shows that 72.1% of respondents' health students were obese, and research by Breheny et al. (2020) shows that the body fat percentage of health students in the obesity category reaches 48.33%. Excessive intake and low physical activity are also supported by research by Kljajević et al. (2022), which shows that 60% of health students have low physical activity levels. As mentioned earlier, the description shows that many health students experience problems related to poor intake, low physical activity, and high obesity risk.

Several previous studies highlight the importance of nutritional knowledge and adequate nutrient intake in influencing body composition and individual health. Jagim et al. (2021) show the relationship between sports nutrition knowledge and body composition and athletes' weight goals, emphasizing the importance of nutritional understanding in achieving optimal body composition. Priyono et al. (2023) examine the nutritional status of physical education teachers and relate it to theoretical impacts on their fitness and health, highlighting the influence of nutrient intake and physical activity on body composition and nutritional status. Gallo et al. (2021) evaluate whether Australian biomedical students meet nutritional guidelines and the relationship between dietary patterns and physical activity with their body composition and metabolic health, using a cross-sectional approach to emphasize the importance of meeting nutritional guidelines.

Thus, this research is unique, as it specifically examines the relationship between the adequacy level of energy, fat, carbohydrates, and physical activity with body fat percentage in female students. The detailed measurement approach through food records provides a new contribution focusing on nutrition students. Unlike previous studies that are more general or focus on different groups, such as athletes or teachers, this study provides in-depth insights into the factors affecting body fat percentage in the context of students. The results of this study can serve as a basis for nutritional interventions and health programs in academic environments, offering more specific and relevant solutions for female students to achieve optimal body health. Therefore, this research highlights the importance of maintaining a balance of nutrient intake and physical activity levels to control body fat percentage, particularly in female students. With a specific focus on female students, this research can provide deeper insights into the factors influencing their body composition and serve as a foundation for developing more effective intervention programs to prevent obesity among students.

METHODS

This research employed a quantitative method with a cross-sectional approach. In a cross-sectional approach, observations and assessments of risk variables and emerging issues in the research subjects are conducted simultaneously. This research utilizes secondary data to simultaneously collect information related to independent and dependent variables (Taherdoost 2021). This study examines the relationship between the adequacy levels of energy, fat, carbohydrate intake, and physical activity with the body fat percentage of Nutrition Students at Universitas Negeri Surabaya.

The research location was in Building U4, Faculty of Sports and Health Sciences, Universitas Negeri Surabaya, Lidah Wetan, Surabaya City. The secondary data collection was conducted in October 2023, and the research was carried out from April 2024 to October 2024. The population of nutrition students at that time was 400. Thus, a total sample of 117 students was determined. However, this study used only 111 respondents who met the inclusion criteria. Cluster random sampling is used, with clusters based on student cohorts (Parker et al. 2021). Data was collected through self-administered questionnaires using the 3x24-hour Food Record to gather data on energy, fat, and carbohydrate intake. The study also employed the IPAQ Short Form questionnaire to collect data on physical activity. Body fat percentage was measured using BIA (Bioelectrical Impedance Analysis), and careful observation was made to record body fat percentage data accurately.

Univariate analysis provides data on the percentage and frequency distribution of the independent and dependent variables, describing the values of energy, fat, carbohydrate intake, body fat percentage, and physical activity. Statistical data analysis was conducted to examine the linear relationship between variables. Statistical analysis determined the correlation between energy, fat, carbohydrate intake, physical activity, and body fat percentage. The Chi-Square test was performed to obtain results regarding the relationship between data. All analysis processes were conducted with the help of computer programs. The requirements for determining

relationships from the Chi-Square test include no cell with an observed frequency (F0) of zero. Secondly, if the 2x2 table form is used, no cell should have an expected frequency (Fh) of less than five. If any cell has an expected frequency of less than five, Fisher's exact test is performed to find the relationship between variables.

Categorization In this study, the variable of intake adequacy level is divided into three categories: more than (>80% of RDA), sufficient (80%-100% of RDA), and deficient (<80% of RDA). For the physical activity level variable, it is divided into two categories: inactive (<600 MET) and active (≥600 MET). For the body fat percentage variable, it is divided into two categories: obesity (if body fat percentage >30%) and non-obesity (if body fat percentage ≤30%).

The Odds Ratio is used to determine the comparative likelihood of an event occurring in one group compared to the exact likelihood in another group. The odds ratio for the adequacy level of energy, fat, and carbohydrate intake data is calculated using the formula ad/bc. The interpretation of the Odds Ratio is: OR > 1 indicates an increased risk factor, OR < 1 indicates a decreased risk factor, and OR = 1 indicates no risk factor. This study uses secondary data, so further validation is not required.

RESULTS AND DISCUSSION

The population in this study consisted of female nutrition students from the 2022 and 2023 cohorts at Universitas Negeri Surabaya. The sample size, selected using the clustered random sampling method, comprised 111 respondents who met the inclusion criteria. Data was collected by completing a three-day, non-consecutive food record using a self-administered questionnaire to obtain data on energy, fat, and carbohydrate intake adequacy. Physical activity data were gathered using the IPAQ-Short Form questionnaire, administered self-administered. Body fat percentage data were collected using BIA (Bioelectrical Impedance Analysis). Further discussion of respondent characteristics is presented in Table 1 below:

Table 1
Frequency Distribution

Respondent Characteristics	Criteria	N (%)	Mean ± SD
Energy Adequacy Level	Adequate and Excessive	31 (27.9)	67.1 ± 16.8
	Deficit	80 (72.1)	
	Total	111 (100)	
Fat Adequacy Level	Adequate and Excessive	64 (57.6)	89.1 ± 29.1
	Deficit	47 (42.4)	
	Total	111 (100)	
Carbohydrate Adequacy Level	Adequate and Excessive	10 (9)	53.8 ± 17.3
	Deficit	101 (91)	
	Total	111 (100)	
Physical Activity Level	Inactive	40 (36)	1195.1 ± 1165.1
	Active	71 (64)	
	Total	111 (100)	
Body Fat Percentage	Obesity	43 (38.7)	29.5 ± 4
	Non-Obesity	68 (61.3)	
	Total	111 (100)	

Note: "N" indicates the number of individuals in each category, while "%" indicates the percentage of individuals in each category based on the total population.

Table 1 above shows the results of statistical tests using computer software that presents data on respondents' characteristics. The study results indicate that respondents aged 19 (80.2%) were the majority. The average age of respondents was 19 years, with the youngest being 18 and the oldest being 21. Class distribution was evenly divided for each class.

Characteristics of energy adequacy level show that most female students had an energy adequacy level of deficit, with 80 respondents (72.1%). The average value for energy adequacy level was 67.1% of RDA, with a minimum value of 34% of RDA and a maximum value of 111.8% of RDA.

Characteristics of fat adequacy level show that most female students had a fat adequacy level of adequate or more, with 64 respondents (57.6%). The average value for fat adequacy level was 89.1% of RDA, with a minimum value of 38.3% of RDA and a maximum value of 189.8% of RDA.

Characteristics of carbohydrate adequacy level show that most female students had a carbohydrate adequacy level of deficit, with 101 respondents (91%). The average value for carbohydrate adequacy level was 53.8% of RDA, with a minimum value of 21.9% of RDA and a maximum value of 106.4% of RDA.

Characteristics of physical activity level show that most female students had a physical activity level of activity, with 71 respondents (64%). The average value for physical activity level using the IPAQ-Short Form was 1195.1 MET, with a minimum value of 0 MET and a maximum value of 5706 MET.

Characteristics of body fat percentage show that most female students had a non-obesity body fat percentage, with 68 respondents (61.3%). The average body fat percentage measured by BIA was 29.5%, with a minimum value of 20.3% and a maximum value of 40.3%.

The relationship between energy adequacy level and body fat percentage was examined using a 3-day non-consecutive food record questionnaire, administered as a self-administered questionnaire. The relationship between energy adequacy level and body fat percentage is shown in Table 2 below:

Table 2
Relationship Between Energy Adequacy Level and Body Fat Percentage

			Body Fat Percentage			p-Value	Odds ratio
			Obesity	Non-Obesity	Total		
Energy Intake Level	Excessive	N	2	1	3	0.024	
		(%)	1.8	0.9	2.7		4.4
	Adequate	N	16	12	28		2.9
		(%)	14.4	10.8	25.2		
	Deficit	N	25	55	80		1
		(%)	22.5	49.5	72.1		
	Total	N	43	68	111		
		(%)	38.7	61.3	100		

Note: "N" indicates the number of individuals in each category, while "%" indicates the percentage of individuals in each category based on the total population

Table 2 presents the results of Fisher's exact test, which still needs to be met by the Chi-Square requirements and the odds ratio. The table is presented in a cross-tabulation format, with the p-value and the number of respondents. The results showed a p-value of 0.024 ($p < 0.05$), indicating a relationship between energy adequacy level and body fat percentage. Since this is a Chi-Square with a 3x2 table, the odds ratio (OR) calculation was performed manually as follows:

OR_1 (Energy Intake Level: Excessive) : $\frac{2 \times 55}{1 \times 25} = 4{,}4$

OR_2 (Energy Intake Level: Adequate) : $\frac{16 \times 55}{12 \times 25} = 2{,}9$

The odds ratio results indicate that female students with a higher energy adequacy level had a 4.4 times higher risk of obesity than those with a deficit energy adequacy level. Female students with an adequate energy adequacy level had a 2.9 times higher risk of obesity than those with a deficit energy adequacy level.

The statistical analysis of Table 2 resulted in a p-value of 0.024, showing a significant relationship between energy adequacy level and body fat percentage, thus accepting the alternative hypothesis (Ha), indicating a relationship between energy adequacy level and body fat percentage. This finding aligns with studies by Sari et al. (2018) and Flieh et al. (2021), which also showed a relationship between energy adequacy and body fat percentage, with p-values of 0.040 and 0.000, respectively. However, this finding differs from the study by Sholichah et al. (2021), which indicated no relationship between energy adequacy and body fat percentage, with a p-value of 0.467. Similarly, a study by Amelia and Syauqy (2014) found no relationship between energy adequacy and body fat percentage, with a p-value of 0.080. The differences in results between this study and those by Sholichah et al. (2021) and Amelia and Syauqy (2014) could be attributed to different methods of measuring energy adequacy. Sholichah et al. (2021) used a 2x24-hour food recall method, while Amelia and Syauqy (2014)used the SQ-FFQ method for the past month.

The relationship between fat adequacy level and body fat percentage was also examined using a 3-day non-consecutive food record questionnaire, administered as a self-administered questionnaire. The relationship between fat adequacy level and body fat percentage is shown in Table 3 below:

Table 3
Relationship Between Fat Adequacy Level and Body Fat Percentage

			Body Fat Percentage			p-Value	Odds ratio
			Obesity	Non-Obesity	Total		
Fat Sufficiency Level	Excessive	N	27	13	40	0.000	
		(%)	24.3	11.7	36.1		6
	Adequate	N	4	20	24		0.5
		(%)	3.6	18	21.6		
	Deficit	N	12	35	47		1
		(%)	10.8	31.5	42.3		
	Total	N	43	68	111		
		(%)	38.7	61.3	100		

Note: "N" indicates the number of individuals in each category, while "%" indicates the percentage of individuals in each category based on the total population.

Table 3 presents the results of Chi-Square and the odds ratio. The table is presented in a cross-tabulation format, with the p-value and the number of respondents. According to the results, the p-value was 0.000 (p < 0.05), indicating a relationship between fat adequacy level and body fat percentage. Since this is a Chi-Square with a 3x2 table, the odds ratio (OR) calculation was performed manually as follows:

OR_1 (Excess Fat Adequacy Level) : $\frac{27 \times 35}{13 \times 12} = 6$

OR_2 (Adequate Fat Adequacy Level) : $\frac{4 \times 35}{20 \times 12} = 0{,}5$

The odds ratio results indicate that female students with a higher fat adequacy level had a six times higher risk of obesity than those with a deficit fat adequacy level. Female students with an adequate fat adequacy level had a 0.5 times higher risk of obesity than those with a deficit fat adequacy level.

The statistical analysis of Table 3 resulted in a p-value of 0.000, showing a significant relationship between fat adequacy level and body fat percentage, thus accepting the alternative hypothesis (Ha), indicating a relationship between fat adequacy level and body fat percentage. This finding aligns with studies by (Christofolini et al. 2020) and Rahman et al. (2021), which also indicated a relationship between fat adequacy and body fat percentage, with p-values of 0.021 and 0.002, respectively. However, this finding differs from the study by Kuswari et al. (2021), which showed no relationship between fat adequacy and body fat percentage, with a p-value of 0.301. Another study by Nuraida et al. (2017) found no relationship between fat adequacy and body fat percentage, with a p-value of 0.131. The differences in results between this study and those by Kuswari et al. (2021) and Nuraida et al. (2017) could be attributed to the different research methods and the use of food recall questionnaires, as well as the different respondents who were athletes rather than students.

The relationship between carbohydrate adequacy level and body fat percentage was examined using a 3-day non-consecutive food record questionnaire, administered as a self-administered questionnaire. The relationship between carbohydrate adequacy level and body fat percentage is shown in Table 4 below.

Table 4
Relationship Between Carbohydrate Adequacy Level and Body Fat Percentage

			Body Fat Percentage			p-value	Odds ratio
			Obesity	Non-Obesity	Total		
Carbohydrate Intake Level	Excessive	N	1	1	2	0.316	1.4
		(%)	0.9	0.9	1.8		
	Adequate	N	1	7	8		0.2
		(%)	0.9	6.3	7.2		
	Deficient	N	41	60	101		1
		(%)	36.9	54.1	91		
	Total	N	43	68	111		
		(%)	38.7	61.3	100		

Note: "N" indicates the number of individuals in each category, while "%" indicates the percentage of individuals in each category based on the total population.

Table 4 presents the results of Fisher's exact test, which shows that it did not meet the Chi-Square requirements and the odds ratio. The table is presented in a cross-tabulation format, with the p-value and the number of respondents. The results showed a p-value of 0.316 (p > 0.05), indicating no relationship between carbohydrate adequacy level and body fat percentage. Since this is a Chi-Square with a 3x2 table, the odds ratio (OR) calculation was performed manually as follows:

OR_1 (Excess Carbohydrate Adequacy Level) : $\frac{1\,x\,60}{1\,x\,41} = 1{,}4$

OR_2 (Adequate Carbohydrate Adequacy Level) : $\frac{1\,x\,60}{7\,x\,41} = 0{,}2$

The odds ratio results indicate that female students with a higher carbohydrate adequacy level had a 1.4 times higher risk of obesity than those with a deficit carbohydrate adequacy level. Female students with an adequate carbohydrate adequacy level had a 0.2 times higher risk of obesity than those with a deficit carbohydrate adequacy level.

The statistical analysis of Table 4 resulted in a p-value of 0.316, showing no significant relationship between carbohydrate adequacy level and body fat percentage, thus accepting the null hypothesis (H0), indicating no relationship between carbohydrate adequacy level and body fat percentage. This finding aligns with studies by Sari et al. (2018), which also showed no relationship between carbohydrate adequacy and body fat percentage, with a p-value of 0.38. Another study by Nuraida et al. (2017) found no relationship between carbohydrate adequacy and body fat percentage, with a p-value of 0.288. However, this finding differs from the study by Jannati et al. (2024), which indicated a relationship between carbohydrate adequacy and body fat percentage, with a p-value of 0.009. Another study by Rayahu et al. (2017) also showed a relationship between carbohydrate

adequacy and body fat percentage, with a p-value of 0.012. The differences in results between this study and those by Jannati et al. (2024) and Rayahu et al. (2017) could be attributed to the different research methods using SQ-FFQ and Food Recall to determine carbohydrate intake.

The relationship between physical activity level and body fat percentage was examined using the IPAQ-Short Form questionnaire, administered as a self-administered questionnaire. The relationship between physical activity level and body fat percentage is shown in Table 5 below:

Table 5
Relationship Between Physical Activity Level and Body Fat Percentage

			Body Fat Percentage			p-value	Odds ratio
			Obesity	Non-Obesity	Total		
Physical Activity Level	Inactive	N	10	30	40	0.028	2.3
		(%)	9	27	36		
	Active	N	33	38	71		
		(%)	29.7	34.2	64		
	Total	N	43	68	111		
		(%)	38.7	61.2	100		

Note: "N" indicates the number of individuals in each category, while "%" indicates the percentage of individuals in each category based on the total population.

Table 5 presents the results of the Chi-Square analysis and odds ratio. The table is presented in a cross-tabulation, with the p-value and the number of respondents. This analysis obtained a p-value of 0.026 ($p < 0.05$), indicating a relationship between physical activity levels and body fat percentage. The odds ratio from this analysis is 2.3, meaning that respondents with low physical activity levels have a 2.3 times higher chance of experiencing obesity than those with high physical activity levels.

The results of the statistical test in Table 5 showed a p-value of 0.028 ($p < 0.05$), indicating a significant relationship between physical activity levels and body fat percentage, thus accepting the alternative hypothesis (Ha). This means a relationship exists between physical activity levels and body fat percentage. This finding is consistent with the study by Gifari et al. (2022), which found a relationship between physical activity and body fat percentage with a p-value of 0.005. Another study by Miftachurochmah et al. (2024) also found a relationship between the level of physical activity and the percentage of body fat. However, the results differ from the study by Suryana and Fitri (2017), which found no relationship between physical activity levels and body fat percentage with a p-value of 0.650. Schultchen et al. (2019) study also stated no relationship between physical activity levels and body fat percentage. The difference in results with Suryana and Fitri (2017) is due to the measurement method, which used a 2x24-hour physical activity recall and skinfold caliper. The difference with Atika and Nur (2024) is also in the measurement method, which used a 2x24-hour physical activity recall.

Thus, this study found a significant relationship between energy and fat adequacy levels and body fat percentage among Nutrition students at the State University of Surabaya. Students with higher energy and fat adequacy levels have a higher risk of obesity. Energy adequacy levels pose a 4.4 times higher risk, and fat adequacy levels pose a six times higher risk of obesity. Conversely, carbohydrate adequacy levels did not significantly correlate with body fat percentage. Additionally, physical activity levels are significantly related to body fat percentage, with inactive students having a 2.3 times higher risk of obesity than active ones.

This study provides more specific insights into the factors affecting body fat percentage among Nutrition students. The results are consistent with studies by Jagim et al. (2021) and Gallo et al. (2021), which show a relationship between nutritional intake and body fat percentage, indicating a significant relationship between energy and fat adequacy levels and body fat percentage. Higher energy and fat adequacy levels are associated with a higher risk of obesity, supporting the findings of Jagim et al. (2021), which show a relationship between sports nutrition knowledge and body fat percentage, and study Gallo et al. (2021), which finds a relationship between dietary patterns and body composition. However, these findings are inconsistent with Priyono et al. (2023), which focused on the nutritional status of physical education teachers without finding a specific relationship between nutritional intake and body composition. Limitations of this study include not analyzing other factors such as genetics and hormones and only using a sample from one university. Future research should consider genetic and hormonal variables affecting body fat percentage. Moreover, future studies should use more diverse samples from several universities to enhance the generalizability of the results.

Nevertheless, the findings of this study have important implications for the development of nutrition and physical activity intervention programs in academic settings, highlighting the importance of maintaining a

balance in energy and fat intake and increasing physical activity to control body fat percentage and prevent obesity. These programs can be specifically designed for female students, considering their needs and habits, making them more effective in achieving optimal body health. Additionally, this study can serve as a basis for university health policies to support a healthy lifestyle among students.

CONCLUSION

This study shows a significant relationship between the levels of energy and fat adequacy and physical activity with body fat percentage among nutrition students at Universitas Negeri Surabaya. However, the relationship between carbohydrate adequacy and body fat percentage was insignificant. This study supports the notion that dietary patterns and physical activity levels affect body fat composition, with higher energy and fat intake and lower physical activity correlating with increased body fat percentage.

RECOMMENDATIONS

Future research should also analyze genetic and hormonal variables that affect body fat percentage to provide a more comprehensive understanding. Additionally, sampling should include several universities to enhance the generalizability of the results. Operational and technical suggestions for those involved in the research include the importance of designing nutrition and physical activity intervention programs tailored to the needs of female students. These programs should encompass comprehensive nutrition education, individual nutrition counseling sessions, and structured routine physical activities. Furthermore, regular monitoring and evaluation are necessary to assess the program's effectiveness and make adjustments to achieve optimal student health.

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