



Digitizing Student Nutritional Status Monitoring through the Development of Anthropometric Applications: Longitudinal Studies of BMI and Abdominal Circumference

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Abstract

Student nutritional status is an important indicator in determining the health quality of young adults. Changes in lifestyle during the education period can affect students' anthropometric conditions, particularly body mass index (BMI) and abdominal circumference. This study aimed to analyze changes in BMI and abdominal circumference among students of the Department of Nutrition over a one-year period without intervention and to develop an Android-based anthropometric application as a tool for monitoring nutritional status. The study used a longitudinal observational design with a paired-sample approach involving 106 students from the Department of Nutrition, consisting of the Diploma III Nutrition Program and the Bachelor of Applied Nutrition and Dietetics Program. Measurements were conducted in 2025 and repeated one year later, including body weight, height, abdominal circumference, and BMI. Data were analyzed using a paired sample test with a 95% confidence level.

INTRODUCTION

Nutritional status is an important indicator in determining individuals' health conditions and the overall quality of human resources. In student populations, changes in lifestyle, academic demands, and eating habits often lead to significant shifts in nutritional status. Students tend to experience changes in dietary patterns, physical activity, and sleep quality during their studies, which may affect their anthropometric conditions. This situation makes nutritional status monitoring an essential component of health promotion and preventive efforts in young adulthood (Pengpid et al., 2015).

Body Mass Index (BMI) is the most commonly used anthropometric parameter for assessing nutritional status because it is easy to apply and has good sensitivity in detecting the risk of undernutrition and overnutrition (Wang et al., 2021). In addition to BMI, abdominal circumference is also an important indicator of central obesity, which is closely associated with the risk of metabolic diseases such as hypertension, diabetes mellitus, and cardiovascular disease. Simultaneous measurement of BMI and abdominal circumference provides a more comprehensive assessment of an individual's nutritional status (World Health Organization, 2022).

Students of the Department of Nutrition have different activity characteristics compared to general students because they are engaged in laboratory practice, fieldwork, and intensive academic reporting. These activities have the potential to influence dietary intake and physical

activity patterns, thereby affecting anthropometric outcomes during the educational period (Neta et al., 2021). Longitudinal research is needed to examine changes in students' anthropometric conditions over time, particularly in the absence of specific interventions that may influence measurement results (Brindley et al., 2024).

Most research on student nutritional status still uses cross-sectional designs, which do not adequately capture temporal anthropometric changes (Fonseca-Pérez et al., 2026; Kamruzzaman et al., 2021; Maria et al., 2026). A longitudinal approach is considered more effective in evaluating dynamic changes in weight, BMI, and abdominal circumference over a defined period (Chen et al., 2024; Ler et al., 2025; Masoumi et al., 2026). Long-term monitoring is also important for identifying trends toward obesity beginning in young adulthood (Waluyo & Syarifuddin, 2022).

Although various studies have assessed student nutritional status, most remain cross-sectional in nature, limiting their ability to describe changes over time. In addition, longitudinal studies examining changes in BMI and abdominal circumference among Indonesian students remain limited, particularly among nutrition students who are expected to have better knowledge of healthy dietary and lifestyle practices (BRIN, 2023). This creates a research gap regarding whether nutritional knowledge is translated into sustained behaviors that support healthy nutritional status throughout the study period.

On the other hand, nutritional status monitoring systems in higher education institutions are still largely based on manual, periodic recording and are not yet integrated with digital technologies (Setiawan & Gazali, 2025). As a result, anthropometric data are often not continuously documented, difficult to track over time, and insufficiently support data-driven decision-making in health promotion and prevention programs. In contrast, the development of mobile health (mHealth) technology provides opportunities for faster, more accurate, and more sustainable nutritional monitoring (Nabilah, 2025).

Based on these conditions, there is a need for research that not only evaluates changes in student nutritional status through a longitudinal approach but also integrates the findings into an Android-based anthropometric application as a digital monitoring tool. This approach is expected to produce systematically documented anthropometric data while supporting digital transformation in student nutritional monitoring.

The development of digital technology in the health sector has driven a shift toward more practical and efficient health monitoring systems. The use of Android-based health applications has grown due to their ability to improve data recording speed, reduce manual calculation errors, and facilitate real-time health monitoring (Fathoni et al., 2025). Digitization of nutritional status monitoring through anthropometric applications is considered to enhance the effectiveness of nutritional assessment, particularly among student populations with high mobility and strong familiarity with digital technologies (Nugraha et al., 2025).

Digital anthropometric applications provide ease of data storage, visualization of nutritional status trends, and automatic interpretation of measurement results. The use of Android-based applications in anthropometric monitoring can assist healthcare providers and educational institutions in conducting regular nutritional assessments. The integration of digital technology in nutrition also supports the development of digital health concepts, which are rapidly advancing in modern healthcare systems (Ting et al., 2020).

Based on this background, this study aimed to analyze changes in Body Mass Index (BMI) and abdominal circumference among students of the Department of Nutrition over a one-year period using a longitudinal approach and to develop an Android-based anthropometric application as a tool for digitizing student nutritional status monitoring.

METHOD

This study used a longitudinal observational design with a paired-sample approach. The research was conducted on laboratory practice students of the Department of Nutrition, consisting of the Diploma III Nutrition Program and the Bachelor of Applied Nutrition and Dietetics Program. Initial data collection was carried out in 2025 and repeated one year later without any intervention.

A total of 106 respondents were included in the study using a total sampling technique. The sample consisted of 10 male students and 96 female students. Based on the study programs, 58 respondents were from the Diploma III Nutrition Program and 48 respondents were from the Bachelor of Applied Nutrition and Dietetics Program.

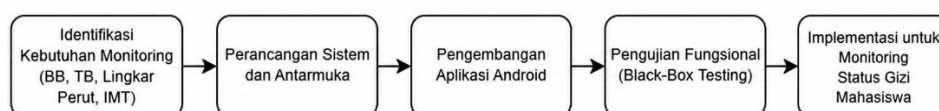
The variables measured included body weight, height, abdominal circumference, and Body Mass Index (BMI). Body weight was measured using a digital scale, height was measured using a microtoise, and abdominal circumference was measured using an anthropometric measuring tape. BMI was calculated using the standard formula:

$$\text{BMI} = \frac{\text{Body Weight (kg)}}{\text{Height (m)}^2}$$

Description:

- BMI = Body Mass Index
- Weight measured in kilograms (kg)
- Height measured in meters (m)

In addition to conducting longitudinal anthropometric monitoring, this study also developed an Android-based anthropometric application as a medium for digitizing student nutritional status monitoring. Application development is carried out simply using a prototyping approach that includes identifying user needs, designing systems, developing applications, and testing application functions. The application needs were arranged based on the anthropometric parameters used in the study, namely weight, height, abdominal circumference, and Body Mass Index (BMI). The application is designed to perform BMI calculations automatically, display nutritional status classifications, store measurement data, and provide student anthropometric monitoring history. Testing is done functionally (black-box testing) to ensure that all features can run according to development goals.



Picture 1. Anthropometry Application Development Flowchart

Data normality tests were performed using Kolmogorov-Smirnov and Shapiro-Wilk. Analysis of differences before and after one year was carried out using a *paired t-test* with a

significance level of 95% ($\alpha=0.05$). The entire data analysis process was carried out using the SPSS 26 application. This research also produced outputs in the form of an Android-based anthropometric application that is used to help record and monitor students' nutritional status digitally.

RESULTS AND DISCUSSION

1. Characteristics of Respondents

Based on the results of the study, most of the respondents were female as many as 96 people (90.6%), while men were 10 people (9.4%). Based on the study program, respondents came from Diploma III Nutrition as many as 58 students and Bachelor of Applied Nutrition and Dietetics as many as 48 students.

Table 1. Distribution of Respondents by Gender and Study Program

Characteristics	Quantity
Male	10
Women	96
Diploma III Nutrition	58
Master of Applied Nutrition and Dietetics	48

The dominance of female respondents in this study is in line with the general characteristics of students of the Department of Nutrition who are mostly female. This condition was also found in several previous studies related to health and nutrition education.

2. Anthropometric Measurement Results

Table 2. Student Anthropometric Measurement Results

Variable	During Practicum (Mean \pm Elementary)	After 1 Year (Mean \pm Elementary School)	Average Difference	p-value
Body Weight (kg)	52.33 \pm 11.83	53.12 \pm 12.62	+0,79	0,001*
Height (cm)	151.75 \pm 5.90	152.42 \pm 5.93	+0,67	<0.001*
Abdominal Circumference (cm)	76.12 \pm 9.73	76.21 \pm 9.73	+0,09	0,808
BMI (kg/m ²)	22.66 \pm 4.64	22.79 \pm 4.89	+0,13	0,207

The results of the paired sample t-test showed that there was a significant difference in the weight ($p=0.001$) and height ($p<0.001$) of students after one year of observation. However, abdominal circumference ($p=0.808$) and Body Mass Index (BMI) ($p=0.207$) did not show statistically significant changes. These findings indicate that despite the increase in weight, the change is still relatively proportional, so it does not have a meaningful impact on the BMI value or abdominal fat distribution of students.

Significant weight gain after one year of observation is consistent with various longitudinal studies in college students that show a tendency to increase weight during higher education. This condition is generally influenced by lifestyle changes, increased consumption of high-energy foods, reduced structured physical activity, and high academic demands that

can affect students' eating behavior and sleep quality (Torano & Fitrianita, 2025). Although the average weight gain in this study was relatively small, the change still needs attention because the gradual accumulation of weight gain during young adulthood can increase the risk of overweight and obesity at a later age (Banjarnahor et al., 2022).

The study also found a significant difference in student height after one year of observation. Physiologically, most of the respondents are in the late teens to young adult age ranges, so height growth is generally close to the maturation phase. Therefore, the changes in height found may not fully reflect biological growth, but can be influenced by variations in measurement techniques, differences in body position during measurement, and the accuracy of the measuring instruments used. These findings need to be interpreted carefully and are one of the limitations of the study.

Although weight gained significantly, BMI values did not show statistically significant changes. These results show that the weight gain that occurred was not large enough to affect the overall nutritional status of the respondents. Most students are still able to maintain a balance between weight and height during the observation period. This finding is different from the research of Reny Rahmawati et al. (2025) which reported a significant increase in BMI during the lecture period due to changes in consumption patterns and decreased physical activity. The difference in results may be influenced by the characteristics of respondents who come from the Department of Nutrition, so that they have a better knowledge of the principles of balanced nutrition and the importance of maintaining nutritional status.

In addition, the absence of significant changes in abdominal circumference showed that the distribution of abdominal fat was relatively stable during the observation period. Abdominal circumference is an important indicator in assessing the risk of central obesity which is closely related to metabolic syndrome, type 2 diabetes mellitus, and cardiovascular disease (Luthfiya et al., 2024). The stability of the abdominal circumference found in this study indicates that the weight gain that occurred has not been accompanied by a significant increase in visceral fat accumulation. Laboratory practice activities, academic activities, and student involvement in various field activities are suspected to contribute to maintaining the balance of student body composition. These findings are supported by previous research that states that physical activity plays an important role in maintaining body composition stability and preventing the increase in central obesity in young adult age groups.

Overall, the results showed that despite anthropometric changes in the form of weight gain, the nutritional status of students tended to be stable during one year of observation. These findings indicate that students of the Department of Nutrition are still able to maintain a relatively good nutritional status, although periodic monitoring is still needed to detect anthropometric changes that have the potential to increase the risk of future health problems.

3. Student Nutritional Status

Table 4. Distribution of Student Nutritional Status

Nutritional Status	During the Practicum	After 1 Year
Normal	61	53
Advantages of Light Level BB	9	16
Advantages of Heavy Weight BB	17	14
Skinny	11	15

Nutritional Status	During the Practicum	After 1 Year
Very Thin	8	8

Based on Table 4, most students are in the category of normal nutritional status both at the initial measurement and after one year of observation. These findings show that in general, students of the Department of Nutrition are able to maintain their nutritional status in the normal range during their education. However, there has been an increase in the number of students who are included in the category of being overweight at the light level. Although these changes have not had a significant impact on the average BMI of the population, this condition still needs attention because it can reflect a tendency to change lifestyles that have the potential to increase the risk of nutritional problems in the future.

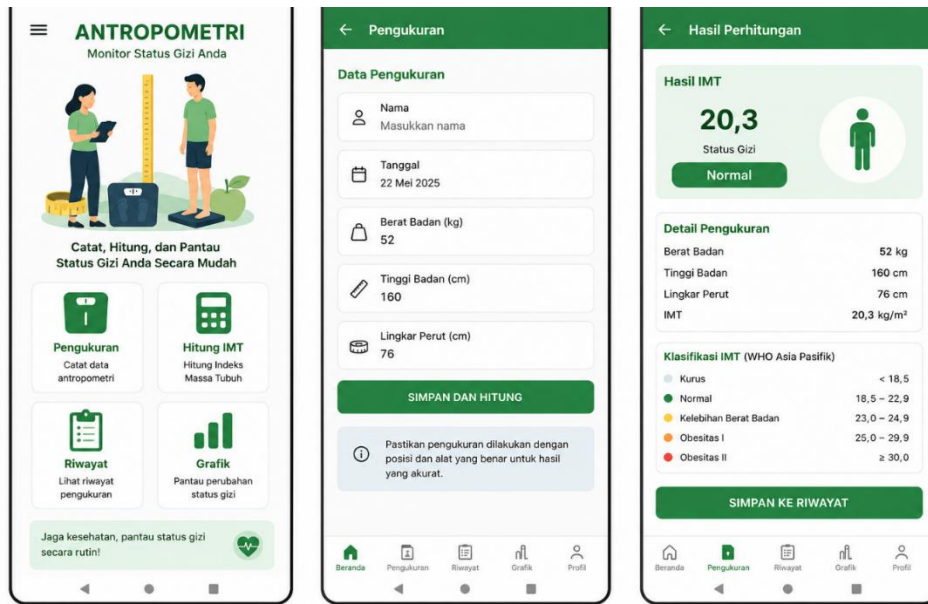
An increase in the proportion of college students who are overweight has also been reported in various previous studies. The transition period from adolescence to adulthood is known to be a period of vulnerability to changes in health behaviors, including an unbalanced diet, increased consumption of high-energy foods and fast food, reduced physical activity, and increased sedentary behavior. These factors can contribute to gradual weight gain if not balanced with healthy living behaviors (Tao et al., 2024). Therefore, it is necessary to monitor nutritional status regularly and continuously in the university environment to detect changes in nutritional status early and support the implementation of promotive and preventive programs in maintaining student health.

4. Development of Anthropometric Applications

One of the outputs of this research is the development of an Android-based anthropometric application as a medium for monitoring student nutritional status. Application development was carried out in response to the need for digitization of anthropometric data recording, which has been largely done manually. The manual recording system has various limitations, including the risk of data loss, difficulties in tracking measurement history, and limitations in producing information quickly for evaluation needs (Sentagi Sesotya Utami et al., 2024).

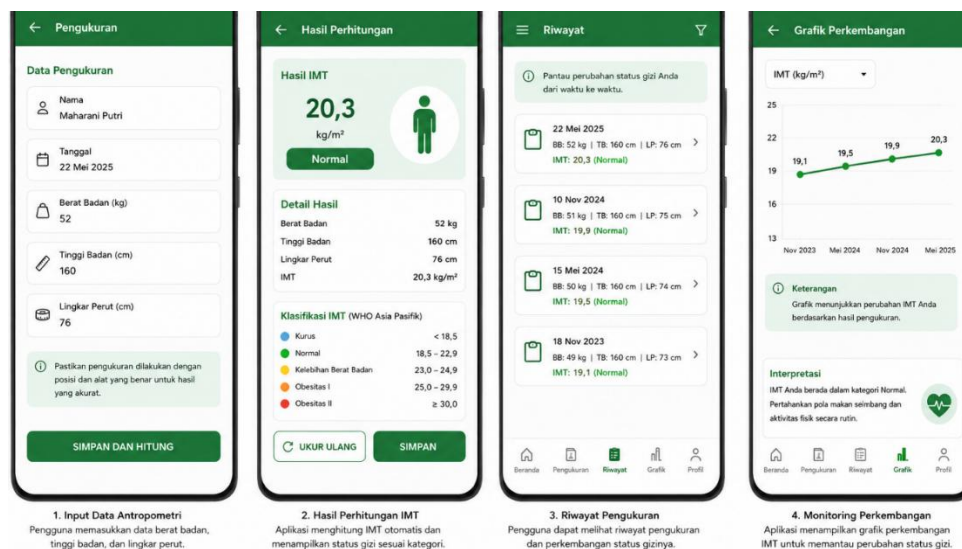
The developed application is capable of automatically calculating BMI, storing user anthropometric data, displaying nutritional status classifications, and providing measurement history that can be used for long-term monitoring. These features allow the process of monitoring nutritional status to be carried out more systematically than conventional recording. In addition, the digitization of anthropometric data also supports more efficient data management and makes it easier for educational institutions to evaluate the nutritional status of students on a regular basis.

The development of anthropometric applications in this study is in line with the development of the concept of digital health and mobile health (mHealth) which is increasingly applied in the field of public health and nutrition (Hasanah et al., 2025). The use of smartphone-based technology provides opportunities to improve accessibility, data processing speed, and health monitoring efficiency, especially in young age groups who have a high level of digital device use (Dobosz, 2025). Thus, the anthropometric application developed has the potential to become one of the supporting innovations in the continuous monitoring system of student nutritional status.



Picture 1. Anthropometry App Home Page View

Figure 1 shows the appearance of an Android-based anthropometry application consisting of the main page, an anthropometric measurement form, and BMI calculation results. The application allows users to record weight, height, and abdominal circumference, as well as obtain automatic nutritional status classification as a means of digital monitoring of nutritional status.



Picture 2. BMI Calculation and Nutrition Status Monitoring Features

Figure 2 shows the features of anthropometric applications which include anthropometric data input, automatic BMI calculation, measurement history storage, and visualization of nutritional status development in the form of graphs. This feature allows users to monitor nutritional status periodically through Android devices with a faster recording and interpretation process than manual methods.

CONCLUSION

The study showed a significant difference in students' body weight and height in the Department of Nutrition laboratory after one year of observation without intervention. However, changes in abdominal circumference and Body Mass Index (BMI) were not statistically significant. Most students were classified as having normal nutritional status, although there was a slight upward trend in the proportion of students with mild overweight.

This study also produced an Android-based anthropometric application that can be used as a tool for digitizing student nutritional status monitoring. The application is expected to improve the effectiveness of recording, monitoring, and evaluating students' nutritional status on a regular basis, thereby supporting promotive and preventive health efforts in educational settings.

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