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ORIGINAL ARTICLE

# The Effectiveness of Training Anthropometry using Cards to Increase Adolescents' Knowledge and Skill

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## ABSTRACT

**Background**: Adolescents in Indonesia face the triple burden of malnutrition due to low nutritional literacy. This study evaluates the impact of Learning Cards (in bahasa: Kartu Belajar or Kejar) in improving anthropometric knowledge and skills among adolescents. **Methods**: This was a pre-experimental, single-group pre-test post-test design was conducted in Giripanggung Village, Tepus, Gunung Kidul, Yogyakarta, Indonesia in 2023. Fifty adolescents, aged 11-19 years, participated in a three-day offline training covering weight, height, and mid-upper arm circumference measurements. Data were collected at three points (pre-test, post-test 1, and post-test 2) and analyzed using tests. **Results**: Adolescents' knowledge significantly improved from a pre-test mean score of 54.7 ± 11.8 to 79.7 ± 11.9 in post-test 1 ($p < 0.05$). While post-test 2 showed a slight decline (77.6 ± 12.5), knowledge remained significantly higher than baseline ($p < 0.05$). Anthropometric skills also increased substantially, with weight measurement scores rising from 51.3 ± 21.5 (pre-test) to 85.3 ± 13.7 (post-test 1, $p < 0.05$). Although post-test 2 showed a decline (75.2 ± 15.4), the scores remained higher than the pre-test ($p < 0.05$). **Conclusions**: Training using Kejar effectively enhances adolescents' knowledge and skills in anthropometry. These findings suggest that expanding the use of Kejar media to other communities could Improve adolescent nutrition literacy at a national level.

**Keywords:** Adolescents, Anthropometry, Training, Nutritional Literacy, Visual Media

## INTRODUCTION

Adolescents represent a critical stage of rapid physical, psychological, and emotional development, often referred to as the second golden age after early childhood. During this period, optimal nutritional intake is vital to support both physical growth and cognitive development. This period is known as the second golden age after toddlers, where optimal nutritional needs are essential to support physical growth and cognitive development (Bundy et al., 2018). Unfortunately, adolescents in Indonesia face challenges in the form of three burdens of malnutrition including undernutrition, overweight, and micronutrient deficiencies (Rah et al., 2021). This situation is further exacerbated by lifestyle changes influenced by globalization, such as increased consumption of high-calorie, nutrient-poor foods and reduced physical activity. These challenges have negatively impacted adolescents' quality of life and increased the risk of non-communicable diseases in adulthood (Norris et al., 2022).

The increased nutritional needs in adolescents are often not fulfilled with adequate dietary intake. The habit of consuming fast food high in fat, salt, and sugar has become a common trend among teenagers, increasing the risk of obesity and non-communicable diseases in

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adulthood (Mititelu et al., 2024; Mizia et al., 2021). The lack of knowledge regarding healthy eating exacerbates this situation, potentially affected their future (Thakur & Mathur, 2022; Veronika et al., 2021). Therefore, early intervention is needed through education and increasing nutritional literacy. To address these issues, early interventions focusing on nutrition education and literacy are crucial. Posyandu Remaja, a community-based health initiative, has been developed to empower adolescents by improving their access to health services and equipping them with essential health knowledge. A key component of this program is anthropometric training, which teaches adolescents to measure body weight, height, and mid-upper arm circumference. These skills are critical for monitoring nutritional status, detecting risks of malnutrition, and designing targeted interventions. Despite the potential benefits of such training programs, several challenges were: first, the effectiveness of visual education tools designed specifically for adolescents has not been thoroughly explored. Second, most studies focus on short-term outcomes, such as immediate gains in knowledge and skills, without assessing long-term retention. Third, individual and environmental factors, including motivation, peer support, and community engagement, play a pivotal role in sustaining learning and applying skills in daily life (Bakhtiar et al., 2021; Siswati et al., 2022).

Kejar media were developed as a visual educational tool to address these gaps. Designed with the characteristics of adolescents in mind, the cards use images, diagrams, and concise texts to simplify complex information and make it more engaging**.** This study aims to evaluate the effectiveness of training using Kejar media in improving adolescent knowledge and skills related to anthropometry. The findings are expected to serve as a reference for enhancing educational strategies and supporting the sustainability of Posyandu Remaja programs.

## METHODS

### Study design

This study employed a pre-experimental design with a single-group pre-test post-test approach. Participants underwent a pre-test to assess baseline knowledge and skills, followed by a three-day offline training intervention and two post-tests to evaluate immediate and sustained impacts. The intervention flow is illustrated in Figure 1.

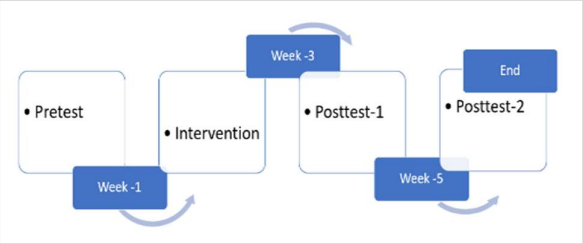


**Figure 1.** Intervention stage

### Setting and time

The research was conducted in Giripanggung Village, Tepus, Gunung Kidul, Yogyakarta, Indonesia. Giripanggung village has significant adolescent health challenges. As a rural area located in a hilly area, access to health facilities is often an obstacle. The distance to the center of Wonosari, the capital of Gunung Kidul Regency, takes about 45 minutes to an hour by private vehicle, while public transportation is not always adequately available. This condition results in limited access for adolescents to adequate health services, including nutrition and health education programs. In addition, the lifestyle of adolescents in Giripanggung Village which tends to be influenced by limited information about healthy eating and physical activity increases the risk of malnutrition, both in the form of deficiencies and excess nutrition. The research was carried out in April-June 2023.

### Population and sample

The sample was taken from the adolescent population who had participated in peer

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counselor training as many as 50 people with a purposive sampling technique based on inclusion criteria including the age of respondents 11-20 years old and present at each meeting. The sample selection procedure can be seen in Figure 2.

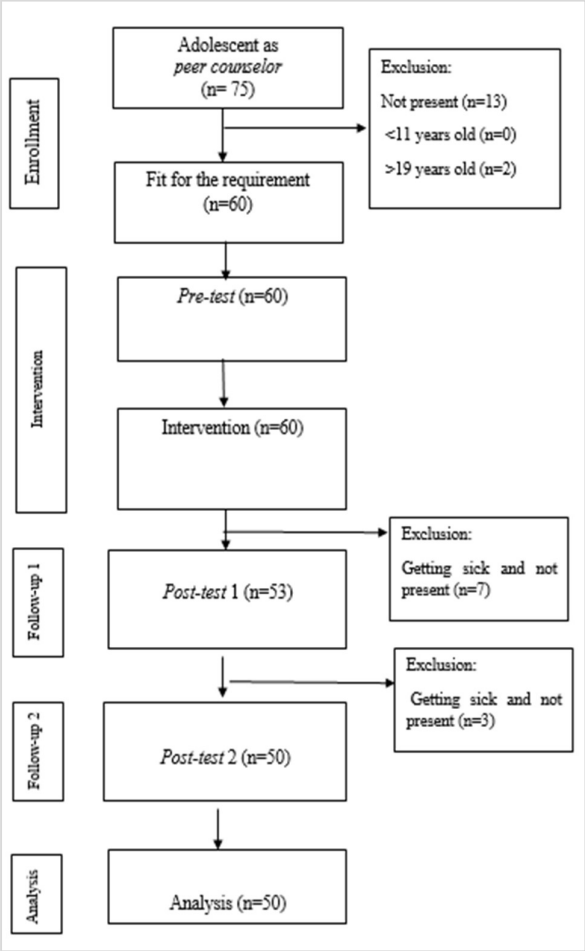


**Figure 2.** Consort diagram

### Kejar Card Media

Kejar media is multiple cards contains practical and visual guides designed to help adolescents understand and practice anthropometric measurements correctly. The material in this card includes systematic steps for measuring weight, height, and upper arm circumference, as well as additional information on the importance of anthropometric data to assess nutritional status.


**Figure 3.** The simple illustration of Kejar Card media

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Each card comes with illustrative images, infographics, and short instructions that are easy for teens to understand, even without direct assistance. The contents of the Kejar media include: 1) body weight, 2) body height, 3) upper arm circumference, 4) nutrition education and the importance of anthropometric data, and 5) case study examples in the form of simulation of nutritional status calculation based on measurement results and data interpretation. In detailed, the Kejar media in Figure 3.

### Research instruments and measurement

The research instrument used to measure respondents' knowledge was structured questionnaire containing 15 questions. The result of the correct respondent's answer is divided by 15 and then multiplied by 100 so that the maximum value is 100.

In the term of skills measurement, we used an anthropometric SOP checklist for measuring weight, height, and upper arm circumference. Each step taken by the respondent will get a score of 1 and if the step is missed, it will be given a value of 0.

### Data analysis

This study used univariate and bivariate analysis to process data, including gender variables, age, pre-test and post-test scores of anthropometric skills, as well as adolescents' knowledge of anthropometry. The normality test was carried out using the Shapiro-Wilk method, according to the sample size of 50 respondents, to determine whether the data was normally distributed or not. In the bivariate analysis, a paired *t-test* was used to evaluate the difference in pre-test and post-test scores.

### Ethical consideration

The research was approved by MHREC Poltekkes Kemenkes Yogyakarta, number DP.04.03/e-KEPK.1/604/2023 dated May 31, 2023.

## RESULTS AND DISCUSSION

### Adolescent's characteristics

Most of the adolescents participating in the study were males, aged 14-17 years, and senior high school (Table 1). This age group is in a phase of rapid growth, where nutritional needs increase significantly to support physical, cognitive, and emotional development. However, at this age, unhealthy lifestyle habits, such as the consumption of fast food that is high in fat, salt, and sugar, as well as low physical activity, can increase the risk of malnutrition, both in the form of malnutrition and overweight.

**Table 1.** Characteristics of respondents

| Characteristics | n | % |
|---|---|---|
| **Gender** | | |
| Male | 12 | 24 |
| Female | 38 | 76 |
| **Age (years)** | | |
| 11 - 13 | 10 | 20 |
| 14 - 17 | 39 | 78 |
| 18 - 20 | 1 | 2 |
| **Education** | | |
| Junior high school | 10 | 20 |
| Senior high school | 29 | 58 |
| University | 11 | 22 |
| **Total** | **50** | **100** |

### Analysis of knowledge differences before and after intervention

The study showed that there was a significant increase in the knowledge and skills of the respondents after participating in the training using Kejar media. In the terms of knowledge, the average pre-test score of 54.7±11.8 increased to 79.7±11.9 in post-test 1 and decreased slightly to 77.6±12.5 in post-test 2. Statistical analysis showed significant differences between pre-test and post-test 1 ($p<0.05$) and pre-test and post-test 2 ($p<0.05$).

While, in terms of skills, the average score of weighing skills increased from 51.3±21.5 in the

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pre-test to 85.3±13.7 in post-test 1, and decreased slightly to 75.2±15.4 in post-test 2. Height measurement skills also increased from 41.6 ± 8.4 in the pre-test to 77.8 ± 9.7 in post-test 1, although it decreased to 70.5±11.2 in post-test 2. This difference was significant at all measurement times ($p<0.05$).

However, the results on the skill of measuring the upper arm circumference show a different trend. The average score increased from 38.3±12.9 in the pre-test to 80.9±15.2 in the post-test 1, but the decrease in the post-test 2 to 74.6±18.3 did not show a significant difference compared to the post-test 1 ($p>0.05$). This increase in knowledge and skills indicates that visual Kejar media are effective in improving the understanding of trainees.

**Table 2.** Analyze differences in knowledge and skills between measurement

| Variable | Measurement | Value | | Mean | p-value |
|---|---|---|---|---|---|
| | | Min | Max | | |
| Knowledge | *Pre-test* | 33 | 80 | 54.7±11.8 | 0.000* |
| | *Post-test* 1 | 53 | 100 | 79.7±11.9 | |
| | *Pre-test* | 33 | 80 | 54.7±11.8 | 0.000* |
| | *Post-test* 2 | 53 | 100 | 77.6±12.5 | |
| | *Post-test* 1 | 53 | 100 | 79.7±11.9 | 0.092 |
| | *Post-test* 2 | 53 | 100 | 77.6±12.5 | |
| Weight measurement skills | *Pre-test* | 17 | 100 | 51.3±21.5 | 0.000** |
| | *Post-test* 1 | 50 | 100 | 85.3±13.7 | |
| | *Pre-test* | 17 | 100 | 51.3±21.5 | 0.000** |
| | *Post-test* 2 | 33 | 100 | 75.2±15.4 | |
| | *Post-test* 1 | 50 | 100 | 85.3±13.7 | 0.001** |
| | *Post-test* 2 | 33 | 100 | 75.2±15.4 | |
| Height measurement skills | *Pre-test* | 25 | 63 | 41.6±8.4 | 0.000** |
| | *Post-test* 1 | 50 | 88 | 77.8±9.7 | |
| | *Pre-test* | 25 | 63 | 41.6±8.4 | 0.000** |
| | *Post-test* 2 | 38 | 88 | 70.5±11.2 | |
| | *Post-test* 1 | 50 | 88 | 77.8±9.7 | 0.003** |
| | *Post-test* 2 | 38 | 88 | 70.5±11.2 | |
| Upper arm circumference measurement skills | *Pre-test* | 13 | 63 | 38.3±12.9 | 0.000** |
| | *Post-test* 1 | 38 | 100 | 80.9±15.2 | |
| | *Pre-test* | 13 | 63 | 38.3±12.9 | 0.000** |
| | *Post-test* 2 | 13 | 100 | 74.6±18.3 | |
| | *Post-test* 1 | 38 | 100 | 80.9±15.2 | 0.115 |
| | *Post-test* 2 | 13 | 100 | 74.6±18.3 | |

*significant ($p<0.05$)

A significant increase in participants' knowledge and skills showed the effectiveness of training with the Kejar media. This fact strengthens the theory that visual education media is more effective than conventional lecture methods (Spencer, 1991) because visualization simplifies the learning process and improves information retention. For example, study on the use of e-pocket books to improve knowledge and skills of anemia in adolescents in Yogyakarta (Wijaya et al., 2024), the use of snakes and ladders to increase knowledge of fruit and vegetable consumption in adolescents in Jakarta (Wijayanti et al., 2021), and explosion box media that have

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proven to be effective in increasing elementary school students' knowledge about balanced nutrition(Siswati et al., 2023). Visual media also fosters active involvement in the learning process, boosting interest and enthusiasm among participants during training (Park, S., Bekemeier, B., Flaxman, A., & Schultz, 2021). The respondents trained in this study are expected to be able to become reliable adolescent health cadres. The skills they have will be crucial to detect the nutritional status of adolescents in their respective regions more accurately. However, repeated training is required to ensure that training results last in the long term (Franiatte et al., 2024). In addition, the development of more durable and inclusive training media can be a priority to improve the sustainability of the program (Boidin A, Tam R, Mitchell L, Cox GR, 2021; Franiatte et al., 2024). Community support is also an important factor driving the success of training, under the theory that reinforcing factors can strengthen behavior change efforts (Boonyathee et al., 2021).

The respondents in this study are expected to develop into competent adolescent health cadres who can significantly improve the health of their peers and communities. Their ability to measure anthropometric parameters such as weight, height, and upper arm circumference accurately is critical for early detection of malnutrition, obesity, or micronutrient deficiencies among adolescents (Sufyan et al., 2024). These skills will not only help identify health issues but also contribute to designing targeted interventions at the community level (Mintarsih et al., 2024; Suyatno et al., 2024). However, training outcomes must be maintained over the long term, as the observed decline in post-test 2 results indicates that periodic reinforcement is necessary. Without follow-up training, the knowledge and skills acquired are at risk of degradation over time, which can undermine the program's effectiveness. Therefore, the development of a sustainable training framework that includes regular refresher sessions, advanced modules, and community support mechanisms is crucial for ensuring the long-term success of the program (Bang et al., 2016).

Research indicates that knowledge and skills acquired through training programs tend to decline over time without proper follow-up, particularly in healthcare settings. For example, studies have shown a significant fall in neonatal resuscitation skills without follow-up training among birth attendants (Reisman et al., 2016) and lower motivational interviewing skills among treatment providers (Schwalbe et al., 2014). Similarly, community health cadres experienced a decrease in knowledge scores four years after care for child development training (Tri Kurniasih et al., 2023). So that, to maintain effectiveness, training programs should incorporate regular refresher sessions, with three to four feedback/coaching sessions over six months to sustain motivational officer (Schwalbe et al., 2014). These findings emphasize the importance of developing sustainable training frameworks with ongoing support mechanisms to ensure long-term program success.

In addition, the use of Kejar media specifically designed for adolescents' needs shows that the media's adjustment to the audience's characteristics plays an important role. Recent studies highlight the effectiveness of innovative educational media in engaging adolescents and improving learning outcomes. Interactive digital tools like animated videos and mobile games have shown greater efficacy compared to traditional methods (Surr et al., 2017). Thus, Fun Learning Cards significantly increased student participation and understanding in high school settings (Baswara, 2024), while flash cards proved effective in enhancing primary school students' motivation and learning outcomes (Subhan et al., 2024). These findings align with research indicating that visual aids tailored to the target age group can

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boost active participation and interest (Balbale et al., 2014; Nurwahidin & Pratama, 2024). These studies collectively encourage the importance of age-appropriate, interactive, and visually appealing educational media in fostering adolescent learning and engagement.

However, the observed decline in post-test 2 scores highlights challenges in maintaining long-term skill retention among participants. This phenomenon can be explained by memory decay theory, which states that knowledge not reinforced periodically tends to remain in short-term memory and gradually fades. Research consistently demonstrates that skills decay over time without practice, with significant loss occurring after extended periods of non-use (Balbale et al., 2014). Factors influencing skill retention include task characteristics, training methods, and individual differences(Klostermann et al., 2022). Physical and speed-based tasks are generally more resistant to decay than cognitive and accuracy-based tasks (Balbale et al., 2014).

Refresher interventions can effectively mitigate skill decay, with even minor interventions showing positive effects (Klostermann et al., 2022). Studies have explored various refresher methods, including practice, skill demonstration, symbolic rehearsal, and procedural knowledge tests, each affecting skill and knowledge retention differently (Kluge & Frank, 2014). Other studied showed that in the context of neonatal resuscitation training, both in-person and video-based refresher courses have shown promise in maintaining skills, though decay is still evident within 2-4 months post-training (McCaw et al., 2023). These findings underscore the importance of regular, tailored refresher interventions to maintain critical skills in high-risk industries and healthcare settings.

Based on these findings, strategies to enhance the effectiveness of long-term training are essential. One practical approach is to conduct regular refresher sessions, delivered through relearning a combination of face-to-face meetings and digital platforms (Franiatte et al., 2024; Kluge & Frank, 2014; McCaw et al., 2023). Additionally, the development of durable training materials equipped with interactive guides represents a promising innovation. For instance, integrating video tutorials with Kejar can create an effective and engaging learning experience. Incorporating these technological elements enables participants to review the material anytime, catering to their individual needs.

Overall, this study highlights the importance of an adaptive and sustainable educational approach in improving the skills of adolescent volunteers. With the support of the community and continuous media development, the Posyandu Remaja program can be an effective intervention model to improve the health status of adolescents. These initiatives is also expected to reduce the burden of malnutrition on adolescents in the future, as well as improve their overall quality of life.

### Study limitation

This study has several limitations. First, the pre-experimental design with a single group pre-test and post-test approach limits the ability to establish causality and control for external factors influencing the outcomes. Second, the relatively short follow-up period (three weeks after training) may not adequately capture the long-term retention of knowledge and skills. Third, the study was conducted in a single village with a specific demographic profile, which may limit the generalizability of the findings to other settings. Future research should consider a more rigorous design, such as a randomized controlled trial, and extend the follow-up period significantly to better assess the sustainability of training outcomes over time.

## CONCLUSIONS

Training using Kejar media proved effective in improving adolescents' knowledge and skills

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related to anthropometric measurements, although there was a slight decrease was observed in the second post-test results. This program shows great potential as an educational model that can be widely adopted to improve the health status of adolescents. To increase effectiveness, it is recommended to have regular re-learning sessions, develop more interactive training media, expand the intervention area to various regions, and evaluate long-term impacts. In addition, the government is expected to integrate this program into national adolescent health policies, allocate a special budget for continuous training, and encourage multi-stakeholder collaboration to expand the scope of training to support national nutrition literacy and create a healthier and more productive young generation.

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