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Differences in knowledge and attitudes of adolescent girls regarding healthy eating in the highlands and coastal areas of Indonesia

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ABSTRACT

Introduction: Healthy eating behaviors during adolescence influence long-term health. Geographical disparities affect nutrition access, with coastal adolescents having better fish availability and upland areas facing protein limitations. This study evaluates a TTM-based education program to improve knowledge and attitudes toward healthy eating among adolescent girls in both regions.

Method: A quasi-experimental one-group pretest-posttest design was conducted without a control group. Although two different areas were compared highland and coastal, random assignment was not applied. Localities were purposively selected due to their distinct geographic and nutritional contexts. A total of 139 female adolescents aged 15–19 years were included (Cigedug: n = 94; Caringin: n = 45), all meeting criteria of anemia, chronic energy deficiency, and low nutrition knowledge. The intervention combining printed modules and simulation videos tailored to TTM stages. Data were collected through validated pre- and post-test questionnaires (30 items; Cronbach's α = 0.87) and qualitative interviews with 20 informants.

Result: Before the intervention, most adolescents were in the pre-contemplation stage (highlands: 90.38%, coastal: 32.37%). After the intervention, transitions occurred to contemplation (highlands: 64.89%, coastal: 48.89%) and preparation stages (highlands: 78.69%, coastal: 54.55%). Significant improvements in nutrition knowledge were observed in both areas: highlands (mean pre-test = 44.17, post-test = 50.15; $p < 0.001$) and coastal (pre-test = 41.91, post-test = 48.22; $p = 0.004$). Behavioral targets also improved, including daily breakfast (highlands: 93.75%, coastal: 75%), fruit and vegetable intake (highlands: 68.75%, coastal: 91.67%), and reduction in fast food consumption (75% in both). Statistically significant differences were found in one target, namely fruit and vegetable intake ($p = 0.042$).

Conclusion: A structured TTM-based intervention combining educational modules, simulation videos, and personal goal setting effectively improved knowledge and dietary behaviors among adolescent girls across highland and coastal contexts.

KEYWORDS

Adolescent Nutrition, Eating Habits, Educational Intervention, Nutritional Education, Transtheoretical Model.

INTRODUCTION

Healthy eating behaviors are very important for adolescents as they can affect physical growth, cognitive development and long-term health[1]. Adolescents aged 15 to 19 experience rapid growth, both physically and psychologically, which makes this period particularly important for the development of healthy eating habits[2]. However, many adolescents lack adequate knowledge about the importance of eating nutritious food, as well as attitudes that are less supportive of healthy eating patterns[3]. This can lead to various nutritional problems, such as chronic energy deficiency (CED), anemia, and other growth disorders, which negatively impact their quality of life[2].

Based on the results of basic health research, 36.6% of adolescents aged 15-19 years-experience chronic energy deficiency, followed by the 20-24 years age group with 23.3%.

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Chronic energy deficiency is a condition of calorie and protein deficiency (malnutrition) in individuals that can cause health problems[4]. Meanwhile, micronutrient deficiencies that are commonly found in the community are anemia. Anemia occurs because the hemoglobin level in the blood is below the standard based on age and gender[5]. Similar to Chronic Energy Deficiency (CED), anemia is more common among women, especially adolescents and pregnant women. The prevalence of anemia among adolescents (15-24 years old) in 2023 reached 15.5%. This indicates that 1-2 out of 10 adolescents suffer from anemia. In addition, based on gender, 18.0% of women experience anemia[6].

Nutrition knowledge is a factor that influences adolescents' eating habits. This knowledge includes an understanding of the importance of a balance between the consumption of carbohydrates, proteins, fats, and vitamins and minerals in the diet[7]. Attitudes towards healthy eating, which are influenced by social, cultural and psychological factors, also play a very important role. However, adolescents often face challenges in changing their attitudes towards healthy eating, especially amidst the influence of social environments and social media that often promote the consumption of fast food, processed foods and high-sugar snacks[8].

In addition to individual factors, geographical factors can also play a role in shaping adolescents' knowledge and attitudes towards healthy eating. Different geographical areas can influence the types of food available, as well as the diets commonly practiced by local communities[9]. In coastal areas, consumption of fish and marine products rich in protein and omega-3 fatty acids is often more accessible. This may contribute to better knowledge and attitudes of adolescents towards the consumption of healthy, nutritious food[10]. In contrast, in upland areas, despite easier access to vegetables and fruits, the main diet that relies on local carbohydrates is often not balanced with sufficient protein intake, which may affect knowledge and attitudes towards healthy eating[11].

In addition, unhealthy eating patterns in adolescents may also be associated with negative attitudes towards healthy food. Some adolescents tend to overlook the importance of consuming nutritious food even though they have basic knowledge about nutrition[12]. Adolescents often face challenges to change their eating habits due to lack of knowledge about nutrition and lack of motivation to adopt a healthier diet[13]. Therefore, it is important to conduct interventions that can improve adolescents' knowledge and attitudes regarding healthy eating.

One effective approach to addressing eating behavior problems in adolescents is the Transteoritikal Model (TTM). This model has been shown to be effective in helping individuals make behavioral changes in a more structured and gradual manner. TTM identifies five stages of behavior change that individuals go through to achieve lasting change: pre-contemplation, contemplation, preparation, action, and maintenance[14].

Previous research has shown that TTM-based interventions can increase individuals' knowledge and awareness of the importance of healthy eating and promote positive behavior change[14]. In addition, studies have indicated that TTM-based programs can result in significant increases in fruit and vegetable consumption among adolescents, as well as reductions in fat intake[15]. However, there are limited studies that combine TTM with a module-based nutrition counseling program to comprehensively evaluate changes in adolescent eating behavior.

Therefore, this study aims to identify differences in knowledge and attitudes of adolescent girls regarding healthy eating patterns in highland areas and in coastal areas and measure the effectiveness of education and counseling programs based on the Transtheoretical Model (TTM) in improving the knowledge and attitudes of adolescent girls regarding healthy eating patterns.

METHODS

Research Design

This study used a quasi-experimental design with a one-group pretest-posttest approach to improve the effectiveness of counseling and education programs based on the Transtheoretical Model (TTM). The main objective of this study was to identify differences in knowledge and attitudes of adolescent girls regarding healthy eating patterns in highland areas and in coastal areas before and after the intervention. This study did not include a control group. Although two different geographical areas were compared, the groups were non-randomized and may be subject to contextual differences that were not controlled, such as socioeconomic status, access to health services, or cultural practices. The use of a single-group design was justified because the study focused on assessing whether a behavior change intervention could be effective across differing geographical contexts. Rather than contrasting with a non-intervention group, the research aimed to evaluate variation in responses to the same educational treatment in highland and coastal environments.

Size, Setting, and Participants

$$n = \frac{2\delta^2 (Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

Description:

n = Minimum sample size.

σ = Standard deviation.

Z1-α/2 = z score at 1-α/2 with α=0.05.

Z1-β = z score at 1-β (80% power test) with β=0.2.

(μ1 – μ2) = Difference in mean change in the study.

Based on the sample formula above, the minimum number of samples required in this intervention stage is 21 people. Then, to avoid loss of participants, the sample was increased by 10% to 24 respondents multiplied by two, so that the total sample of each research location was 48 respondents.

This study was conducted in Garut Regency, which includes two sub-districts with different geographical conditions, namely Cigedug Sub-district located in the highland area and Caringin Sub-district located in the coastal area. The study was conducted for three months, from August to November 2024, focusing on adolescent girls aged 15 to 19 years. The study sample consisted of 94 adolescents from Cigedug Sub-district and 45 adolescents from Caringin Sub-district. Participant inclusion criteria included adolescent girls aged 15-19 years, anemia, chronic energy deficiency (CED), and low nutritional knowledge. The exclusion criteria were adolescents who were unwilling to be respondents.

Data Collection

Data collection was carried out using a mixed-method approach, combining quantitative surveys and qualitative interviews. The quantitative survey involved the administration of pre-test and post-test questionnaires to measure changes before and after the intervention. The questionnaire consisted of 30 items that assessed three main dimensions: knowledge about balanced nutrition, attitudes toward healthy eating, and self-reported eating behaviors. This instrument was developed based on the Transtheoretical Model (TTM) and had previously been validated in an adolescent population aged 15–19 years, ensuring its relevance and appropriateness for this study. Validity was determined through item-total correlation analysis, where all items showed r-values exceeding the r-table at a 0.05 significance level. Reliability testing using Cronbach's Alpha yielded a score of 0.87, indicating strong internal consistency.

In the qualitative component, interviews were conducted with 20 informants, 15 from highland areas and 5 from coastal areas, to explore their experiences, challenges, and motivations related to changes in healthy eating behaviors after the intervention. The number of interviews conducted was 20, not 20 sessions. Qualitative data were analyzed using thematic analysis, a systematic approach involving transcription, manual coding, theme generation, and categorization. Transcripts were reviewed and manually coded to extract recurring themes, which were then categorized into four main domains: breakfast habits, fruit and vegetable consumption, fast food consumption, and the practice of bringing healthy meals to school.

Data Analysis

All statistical analyses were conducted using SPSS version 26. First, the Shapiro-Wilk test was used to assess data normality. Since the knowledge data were normally distributed ($p > 0.05$), a paired t-test was employed to compare pre-test and post-test scores within both highland and coastal groups. This test was chosen to evaluate significant changes in nutrition knowledge following the intervention. For the contemplation stage, which involved ordinal data based on the Health Belief Model (HBM) components, the Wilcoxon signed-rank test was used to assess changes between pre- and post-intervention scores. Descriptive statistics were used to summarize behavioral targets during the preparation stage of the Transtheoretical Model (TTM). A significance level of $p < 0.05$ was considered statistically significant for all analyses.

Ethical Considerations

This study was approved by the Health Research Ethics Committee of Muhammadiyah University Jakarta (No. 181/PE/KE/FKK-UMJ/XI/2023). All participants, including parents or guardians for participants under 18 years of age, provided consent before participating in this study. The confidentiality of all participants was strictly maintained throughout the research process.

RESULTS

Table 1 shows the characteristics of respondents in the Highlands and Coastal areas. Most adolescents in the Highlands were 15 (31.9%) and 17 years old (21.3%), while those in the Coastal areas were 18 years old (33.3%) and 17 years old (22.2%). These age groups represent mid to late adolescence, a period where health behaviors start to solidify, making them ideal targets for nutrition education interventions.

The educational intervention was carried out over 7 sessions within 7 consecutive weeks. Each session lasted approximately 60–90 minutes and was conducted using a mixed modality approach, combining face-to-face meetings and virtual support via WhatsApp groups. The intervention content was structured according to the Transtheoretical Model (TTM), with key sessions covering: (1) balanced nutrition and food groups; (2) adolescent nutrition problems (e.g., anemia, undernutrition, obesity); (3) dietary behavior and physical activity; (4) interpretation of food labels and advertisements; (5) influence of social media and peer pressure; (6) overcoming barriers to healthy eating; and (7) setting personal dietary goals and behavior targets.

Pre-Contemplation

The pre-contemplation stage is the first stage in the Transtheoretical Model (TTM), where individuals are not yet aware of the problem or have no intention of making changes[16]. Most of them were unaware of the importance of a healthy diet and its adverse effects on health, both in the short and long term.

Table 1. Distribution of respondent characteristics in coastal and highland areas

Category	Highland		Coastal		Total	
	n	%	n	%	n	%
Age						
15	30	31.9	6	13.3	36	25.9
16	17	18.1	8	17.8	25	17.9
17	20	21.3	10	22.2	30	21.6
18	13	13.8	15	33.3	28	20.1
19	14	14.9	6	13.3	20	14.4

In the first meeting, the material presented related to the importance of maintaining a balanced diet to support optimal growth and development. In addition, the material also discussed various nutritional problems often faced by adolescents, such as anemia, chronic energy deficiency (CED), obesity, and the long-term risks that can arise if these nutritional problems are not addressed.

As shown in Table 2, the test results showed an increase in knowledge in both groups (Highlands and Coastal) after taking the test. In the Highlands group, the average pre-test score was 44.17 and post-test 50.15, with a statistically significant 5.98% increase ($p < 0.001$). While in the Coastal group, the average pre-test score was 41.91 and post-test 48.22 with a 6.31% increase which was also significant ($p = 0.004$). This indicates that the educational intervention using a module and simulation video effectively improved nutritional knowledge among adolescents in both regions.

After the post-test and learning through the module, an interview was conducted to dig deeper into the understanding and changes in eating behavior that occurred in adolescents. This interview focused on four important aspects related to healthy eating habits, namely breakfast habits, fruit and vegetable consumption, the influence of fast food, and the habit of bringing healthy lunches to school. Regarding breakfast habits, this breakfast can help them feel more refreshed and ready for school activities. Secondly, the consumption of fruits and vegetables every day is also a much-discussed topic. Fruits and vegetables contain important nutrients that support their health and strengthen their immune system. Third, regarding the consumption of fast food, fast food that is high in sugar, salt and fat (GGL) can have adverse effects on the body's health, such as increasing the risk of obesity and metabolic disorders. Fourth, regarding the habit of bringing healthy lunches to school, practical factors and peer influence often become obstacles in bringing healthy lunches. They prefer to buy food at school which is often less healthy.

Adolescents find it difficult to prepare healthy lunches for school due to busyness or time constraints, as well as lack of knowledge on how to prepare healthy food. At this stage, the interview results show that there has been no change in attitude and awareness about the importance of a healthy diet even after they have participated in the educational materials provided.

Qualitative interviews were conducted after the post-test to explore changes in behavior and perceptions. Four main themes emerged: breakfast habits, fruit and vegetable consumption, fast food intake, and the practice of bringing healthy lunchboxes to school. Adolescents generally acknowledged that breakfast made them feel more refreshed and

Table 2. Results of knowledge level analysis

Test	n	Pre-Test	Post-Test	Knowledge Increase (%)	Sig. (2-tailed)	Sig. (2-tailed)
		Mean (SD)	Mean (SD)			
Highland	94	44.17 (13.48)	50.15 (17.52)	5.98	<0.001*	<0.001*
Coastal	45	41.91 (12.41)	48.22 (12.18)	6.31	0.004*	

* Statistically significant at p=0.05.

ready for school, with one participant noting, "I noticed that on days I ate breakfast, I could focus more in class."

In terms of fruit and vegetable consumption, students admitted to gaining new awareness, although availability at home and school remained a barrier. "I didn't know that not eating enough vegetables could make me tired easily," said one adolescent.

Regarding fast food, many students understood its risks, but still preferred it due to convenience and peer norms. A coastal respondent stated, "Even though I know it's bad, I still buy fried snacks at school because it's quick and cheap."

For bringing lunch from home, adolescents cited time constraints and peer influence. A highland student explained, "I feel awkward bringing food from home when my friends are buying things outside." These findings reveal that although knowledge improved, behavioral change was still limited by environmental and social factors.

Contemplation

The contemplation stage is the second stage in the Transtheoretical Model (TTM), where individuals become aware of problems in their behavior and begin to consider making changes[16]. This stage is modified by the Health Belief model (HBM) theory, which is to measure a person's health behavior with six components, namely susceptibility, severity, benefits, barriers, cues to action and efficacy related to perceptions if implementing healthy eating behavior, the influence of peers on unhealthy eating habits, and their efforts to find information about healthy eating patterns on social media.

Table 3 presents the results of the analysis of perceived change using the modified Health Belief Model (HBM) approach. In the perception of vulnerability, both groups experienced an increase of 1.00 in the highlands and 0.50 in the coastal areas. The greater the sense of vulnerability to health problems, the greater the impetus to change eating habits. In terms of perceived severity, there was a similar increase in both groups of 0.50, indicating that the more serious the perceived impact, the greater the motivation to change eating patterns. On perceived benefits, there was an increase of 0.50 in the highlands and 1.75 in the coastal areas. Greater belief in the benefits of healthy eating increases motivation to change diet. These results are supported by research showing that nutrition education methods based on the Health Belief Model can improve knowledge and attitudes[17]. On perceived barriers, it shows an increase of 1.00 in the highlands and 0.50 in the coastal areas. The greater the perceived barriers, the more difficult it is to adopt a healthy diet. The cues to action component showed both groups had a statistically significant increase, with an increase of 1.00 in the highlands ($p = 0.018$) and 1.14 in the coastal areas ($p = 0.047$). This reflects encouragement or reminders that encourage dietary changes, such as support from others. Finally, self-efficacy had an increase of 1.00 in the highlands and 0.71 in the coasts, suggesting that the higher a person's self-efficacy, the more likely they are to consistently adopt a healthy diet. Although self-efficacy and benefits improved, they were not statistically significant in both groups, suggesting that confidence and perception of benefit need longer-term reinforcement to result in stable change.

Preparation

The preparation stage is the third stage in the Transtheoretical Model (TTM), where individuals begin to plan and take small steps to change their behavior[16]. At this stage, adoles-

Table 3. Perceived Consideration of Change with Health Belief Models Approach

No	Components of Health Belief Models	Highlands Group (n=61)			P	Coastal Group (n=22)			P
		Pre-test	Post-test	Δ		Pre-tets	Post-test	Δ	
		Mean	Mean			Mean	Mean		
1.	Perceived Vulnerability	2.00	3.00	1.00	0.500	2.00	2.50	0.50	0.500
2.	Perceived Severity	2.50	3.00	0.50	0.500	3.50	4.00	0.50	0.500
3.	Perceived Benefits	2.75	3.25	0.50	0.182	3.00	4.75	1.75	0.069
4.	Perceived Barriers	2.50	3.50	1.00	0.500	2.50	3.00	0.50	0.500
5.	Cues to Action	2.71	3.71	1.00	0.018*	2.71	3.85	1.14	0.047*
6.	Self-efficacy	3.14	4.14	1.00	0.062	3.57	4.28	0.71	0.182

Δ = change in posttest - pretest score. * = Significance Value $p<0.05$.

cents who were previously in the contemplation stage, now start to have targets to make changes in their eating patterns. One of the first steps is to fill out a questionnaire to assess confidence in dealing with situations that affect eating habits. The results showed that in the highlands, most adolescents (64.6%) felt confident eating healthy food despite being tired, while in the coastal areas, confidence levels were higher (66.7%) when in a relaxed situation. This difference is influenced by physical and social conditions that affect their readiness to change. Adolescents also set personal targets, such as eating breakfast every day, consuming vegetables and fruits, reducing junk food, and bringing healthy snacks to school.

Table 4 summarizes the target behavior changes. In the highlands, most adolescents (93.75%) set a target to have breakfast every day, 75% wanted to reduce fast food consumption to a maximum of one time per week, and 68.75% wanted to consume more fruits and vegetables. However, only 50% bring a healthy lunch to school. In coastal areas, 91.67% of adolescents want to consume fruits and vegetables, 75% want to eat breakfast every day, and reduce fast food consumption, and 75% also bring healthy lunches to school. These differences suggest that behavior priorities may differ by location due to cultural, environmental, or infrastructural factors. Adolescents in coastal areas seem more committed to bringing healthy lunches, while those in highlands place higher importance on daily breakfast.

DISCUSSION

The importance of nutrition education interventions for adolescents is particularly relevant in the context of their low levels of knowledge about nutrition, as emphasized by recent studies that show significant gaps in nutrition understanding based on this demographic[18,19]. Most adolescents, as seen from the data, show a limited understanding of the importance of a healthy diet, with 76.3% of respondents having knowledge levels below 60%, confirming the need for effective education programs[20]. This suggests that educational interventions based on the provision of comprehensive information on nutrition are needed, especially given the evidence supporting the effectiveness of structured nutrition education in improving eating habits[21]. In this discussion, it is important to consider how a comprehensive and structured education program can increase adolescents' awareness and knowledge of the importance of balanced nutrition, as has been evidenced by previous studies showing positive outcomes from such interventions[22].

One approach that can be taken is to focus on reproductive health and nutrition issues often experienced by adolescents, such as anemia, obesity, and other eating disorders, which are critical areas that require attention in adolescent health programs[23]. In addition, educational materials should emphasize the long-term effects of unhealthy eating patterns, providing deeper understanding for adolescents to make better decisions about their eating habits[24].

Adolescent eating habits that lead to the consumption of foods high in calories, sugar, salt and fat (GGL) are increasingly becoming a major concern in various countries, including Indonesia[25]. Adolescents often choose fast, processed, and practical foods due to convenience, affordable prices, and ease of access [26]. Foods such as fast food, sugary drinks, high-calorie snacks and light meals are very popular among adolescents[27]. This habit can be attributed to a variety of factors, including peer influence, advertisements on social media, and habits inherited in the family[28]. Foods that are high in calories, sugar, salt and fat tend to be high in energy but low in nutrients, thus not meeting the body's nutritional needs in a balanced way[29].

These high-calorie diets often contain more saturated fat and added sugar, which can increase the risk of obesity, type 2 diabetes and hypertension in adolescents[30]. Excessive consumption of sugar, for example through sugary drinks or snacks, can affect the energy balance in the body, causing a rapid spike in blood sugar, followed by a sharp decline[31]. This can lead to fatigue, unstable mood, and dependence on sug-

Table 4. Target Adolescent Healthy Behavior

Target	Highlands Group	Coastal Group	P
	%	%	
Eat fruits and vegetables	68.75	91.67	0.042*
Breakfast every day	93.75	75.00	0.054
Reduce fast food consumption to a maximum of 1 time per week	75.00	75.00	0.567
Bring healthy lunch to school	50.00	75.00	0.124

* = Significance Value p<0.05.

ary foods. In addition, excessive salt consumption can also increase the risk of hypertension and other health problems[32].

In highland areas, access to food sources is often limited. This is due to difficult geographical conditions and limited transportation. People in these areas tend to rely on local agricultural produce, which may not always meet their diverse nutritional needs. Research shows that people in the highlands tend to consume more plant-based protein sources, such as beans and vegetables, compared to animal protein sources. In contrast, coastal areas have better access to seafood sources, such as fish and other seafood, which are rich in protein and omega-3 fatty acids. This contributes to a more varied and nutritious diet. Research in coastal areas shows that most diets in these areas are of good quality, with sufficient intake of energy, protein and fat[33].

By emphasizing the importance of a healthy diet and providing easy-to-understand information, it is expected that adolescents will be more motivated to make changes in their eating behavior. Educational programs designed with an approach based on the Transtheoretical Model are expected to guide adolescents through various stages of behavior change, from awareness and consideration to more concrete actions to achieve healthier eating habits[34]. Therefore, although the majority of adolescents were still in the pre-contemplation stage, an early stage that usually indicates disinterest or unpreparedness to change, these results indicate a great opportunity to assist them in the change process.

In addition, the finding that adolescents in the Highland and Coastal regions show low awareness of healthy eating behaviors suggests that nutrition intervention programs still have a lot of room to grow[18]. For example, the pretest results in this study showed that the majority of adolescents did not actively seek information on healthy eating from social media or advertisements. They were also more likely to be influenced by peers in choosing unhealthy foods, which is in line with findings from the literature highlighting the heavy influence of peers and media on dietary choices among adolescents[23]. This opens up opportunities to explore how external factors such as social media and peers can be utilized to deliver more effective messages on healthy eating.

The influence of peers and social media on adolescents' eating habits needs to be a focus in the development of more targeted intervention programs. This could lead to the development of educational strategies that focus not only on knowledge, but also on attitude change driven by these social factors [24]. For example, utilizing influencers or public figures who are respected by adolescents can be an effective way to communicate the importance of good nutrition through channels they are already familiar with. Intervention programs that focus on the use of social media and communication strategies involving peers can have a positive impact on raising awareness of healthy nutrition among adolescents[23].

Furthermore, the importance of nutrition education in raising adolescents' awareness is not only related to increasing their knowledge, but also to preparing them for the challenges of changing their eating habits. Given that adolescents are in a pivotal phase of development, they need practical knowledge that is easily applied in their daily lives[22]. In this case, educational materials on balanced nutrition guidelines such as the concept of "Fill My Plate" or how to read nutrition labels can be effective tools to help adolescents make better decisions regarding their diet. Programs that provide practical and applicable information are more likely to have a real impact on changing adolescents' eating behaviors[21].

However, despite this information, the biggest challenge remains in the implementation of healthy eating habits, especially when it comes to external factors that influence their eating behavior. This is clearly reflected in the interview results which show that many adolescents still face barriers in accessing or preparing healthy food, as well as social pressure from their peers who opt for fast food[20]. These barriers reflect the need to design intervention programs that not only educate, but also take into account the social and environmental context of the adolescent[24]. For example, difficulties in preparing a healthy breakfast in the morning due to time constraints or a lack of practical knowledge in preparing healthy food points to the importance of providing more concrete and applicable support to adolescents.

After the intervention, post-test results showed a significant increase in adolescents' awareness of healthy eating, as well as a reduction in negative peer influences on their eating choices. These improvements suggest that the Transtheoretical Model-based approach has great potential to support changes in eating behavior among adolescents[34]. This reinforces the view that structured and sustained interventions, focusing on self-understanding and strengthening individual targets, can bring about significant changes in adolescents' eating habits.

However, despite the visible progress, the barriers that adolescents face in adopting healthy eating patterns cannot be ignored. External factors such as social pressure from peers, as well as limited time and resources to prepare healthy meals, remain challenges that must be overcome[24]. In this regard, it is important to understand that behavior change is not easy, and requires a more holistic approach that considers social and economic factors, as well as family and neighborhood habits.

As a next step, this study highlights the importance of providing more integrated support from various parties, including family, school and peers. Strong social support is needed to help adolescents overcome the barriers they face on the road to healthy eating[20]. Therefore, nutrition education programs should consider the social and environmental factors that influence adolescents' eating habits and suggest practical solutions

that can be implemented in their daily lives. Further research is also needed to explore new methods in nutrition education that are more adaptive to technological developments and social changes that can be more effective in increasing adolescents' awareness and motivation to maintain a healthy diet[22].

Overall, the discussion emphasized that while adolescents show readiness for change, challenges in implementing healthy eating habits remain. Educational programs that incorporate knowledge, confidence, and strong social support from the surrounding environment can help adolescents achieve better and sustainable changes in their diets. With a more holistic and contextualized approach, these interventions can bring a broader positive impact in public health, especially among the younger generation who will be our future successors[21].

CONCLUSION

This study showed that most adolescents in the Highlands and Coastal areas were in the pre-contemplation stage at the beginning of the study, unaware of the importance of a healthy diet. After the Transtheoretical Model (TTM)-based educational intervention, there was a significant increase in nutrition knowledge in both groups, with some adolescents entering the contemplation and preparation stages. Adolescents have targets to change their diet, including breakfast habits, fruit and vegetable consumption, and reduction of fast food consumption. Interventions utilizing the TTM approach can have a positive impact on knowledge and attitudes about healthy eating in both areas.

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