

**FRUIT AND VEGETABLE-RELATED KNOWLEDGE AND PRACTICES AMONG  
MALNOURISHED ADOLESCENT GIRLS ON SMALL ISLANDS: A QUASI-  
EXPERIMENTAL STUDY IN INDONESIAN.**

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**Abstract**

**Background:**

Adolescent girls often do not adhere to dietary recommendations, leading to a high prevalence of malnutrition due to low fruit and vegetable consumption. This study aims to examine the effects of nutrition education interventions on nutritional knowledge and fruit and vegetable consumption among malnourished adolescent girls in the small islands of Indonesia.

**Materials and Methods:**

This study used a quasi-experimental, non-randomized pre-post test with a control group design involving a purposive sample of 92 adolescent girls (intervention group (IG) = 46, control group (CG) = 46). The IG received nutrition education based on social cognitive theory (SCT), including a module and education for the mother. In contrast, the delayed CG only received leaflet education. Educational interventions include 90 minutes of SCT-based nutrition education and 45 minutes of leaflet education every week for 12 weeks.

**Results:**

After nutrition education, there was a significant increase ( $p < 0.05$ ) in the variables of knowledge ( $6.64 \pm 2.67$ ), fruit portions ( $1.90 \pm 1.09$ ), vegetable portions ( $1.90 \pm 1.09$ ), fruit intake and fruit diversity ( $10.95 \pm 5.36$ ). However, there was no significant increase in the variables of diversity of vegetables ( $p = 0.885$ ). The bivariate test of mean differences showed significant differences ( $p < 0.05$ ), including knowledge ( $2.69 \pm 2.95$ ), fruit portion ( $1.65 \pm 1.47$ ), and fruit diversity ( $4.74 \pm 5.84$ ). The variables vegetable portions ( $p = 0.218$ ) and vegetable diversity ( $p = 0.654$ ) did not show significant differences.

**Conclusions:**

Implementing SCT-based nutritional education demonstrates a significant enhancement in knowledge levels, as well as an increase in both consumption rates and diversity of fruit types, even in small island regions characterized by food insecurity.

**Keywords:** Adolescent girls, Dietary Diversity, Fruits, Nutrition Education, Vegetables

**Introduction:**

The small island group has been extensively researched for its complex historical issues, including malnutrition, economic inequality, and environmental vulnerability, posing a general health crisis threat [1]. Previous research has emphasized the significant gaps in understanding the nutritional requirements of high-risk groups, such as adolescent girls in remote areas, who are affected by malnutrition [2]. To address malnutrition among adolescents, the UN introduced the "Zero Hunger" program, which strives to eradicate hunger, ensure food security, and promote good nutrition worldwide, including in Indonesia [3].

Malnutrition, characterized by insufficient intake of energy, protein, or essential micronutrients, will lead adolescents to slower growth, delayed sexual maturation, lower micronutrient reserves, and inadequate bone mass [4]. Adolescents, particularly girls, are a highly vulnerable group due to increased nutritional requirements during puberty and the possibility of pregnancy [5]. Several research studies indicate adolescents fail to meet dietary guidelines, often consuming too few fruits and vegetables, leading to malnutrition [6]. An adequate diet is crucial for adolescents' growth and development, as they require high amounts of essential nutrients like vitamins and minerals found in a variety of fruits and vegetables [7].

According to Indonesia Basic Health Research data [8] (2018) revealed that 95.5% of the population over five years old in Indonesia still failed to consume at least five portions of fruits and vegetables daily. Darfour-Oduro et al. [9] conducted a study across 49 developing and low-income countries, including Indonesia, and found that  $> 50\%$  of adolescents did not consume recommended

portions of fruit and vegetables. The study of fruit and vegetable consumption among adolescents in South Sulawesi Province revealed that only 4.46% met the recommended daily intake [10].

The Indonesian Ministry of Health introduced the “GERMAS” (Gerakan Masyarakat Hidup Sehat) guidelines campaign, including a recommendation for sufficient fruit and vegetable intake on a national scale [11]. The campaigns that lack nutrition education may raise public awareness about the health benefits of fruits and vegetables, but often fail to increase consumption [12]. Lack of knowledge about nutrition in adolescent is the primary cause of the high prevalence of malnutrition and micronutrient deficiencies, as it influences eating attitudes and behavior [13]. Because health-related habits adopted in adolescence tend to persist into adulthood, it is recommended that public health interventions aimed at preventing or stopping adolescent risk behavior should be implemented [14].

Nutrition education has the potential to increase knowledge and positively influence food preferences, health, and academic performance, making them healthier [15]. A systematic review has shown that interventions based on behavior change theory, particularly Social Cognitive Theory (SCT), are more effective in improving population health outcomes [16]. Additionally, SCT interventions are most effective in school-based educational interventions [17]. SCT focuses on an individual's ability to learn through personal experience or by observing and imitating models or examples they encounter in the media or through other people [18–20]. SCT explains that education is an agentic cognitive process that exists and is understood in a social context, such as the family at home, peers at school, or others [21]. Education, with support from family and peers, aims to ensure an adequate diet [22].

To the best of the author's knowledge, a notable gap exists in the literature regarding the provision of nutritional education specifically tailored to address the needs of malnourished adolescent girls residing in remote Indonesian islands. Consequently, this discrepancy warrants significant attention in formulating strategies to enhance fruits and vegetables intake among adolescent populations in these isolated locales. It is imperative to research to bridge this knowledge gap and develop interventions contextually appropriate for small island communities. This study aims to investigate the impact of nutrition education interventions on nutritional knowledge, and fruit and vegetable consumption among malnourished adolescent girls in the small islands of Indonesia.

#### **Subjects and Methods:**

#### **Ethical Consideration:**

This study adhered to the Declaration of Helsinki's guidelines. The Research Ethics Commission of the Faculty of Public Health at Hasanuddin University granted ethical clearance (Approval Number: 5906/UN4.14.1/TP.01.02/2023). We ensured that all participants and their guardians were fully informed about the study's nature and obtained their informed consent.

### **Study design and setting**

This study applied a quasi-experimental, non-randomized pre-post test with control group design. The intervention group received nutrition education based on social cognitive theory, including a module developed by Hidayanty et al. and education for the mother. In contrast, the delayed the control group received a leaflet plus education. Pre- and post-tests were conducted in both groups.

### **Study participant and sampling**

The research was conducted from August 1 to December 11, 2023, in the Tanakeke Islands District, Takalar Regency, South Sulawesi Province (coordinates 5°30'25.207"S, 119°17'4.469"E). The initial preparatory step involved securing research permits from the provincial government of South Sulawesi. The licensing process was executed at the Education Office in Takalar Regency to obtain authorization for conducting research among Junior High School students and at the Jeneponto-Takalar Region VII Education Office to undertake research on Senior High School students. After acquiring research permissions from these two educational authorizations, discussions were initiated with nine principals out of 15 schools within the Tanakeke Islands sub-district.

The research used a purposive sampling methodology and had specific inclusion and exclusion criteria. The inclusion criteria were: 1) participants needed to provide informed consent and be willing to participate, 2) the target group was female students aged 10-19 suffering from malnutrition, based on anthropometric measurements and food consumption. Malnutrition identified if they suffered one or more of the following issues: Mid-Upper Arm Circumference (MUAC) measurement <23.5 cm, Z-Score calculation from the WHOantroplus software within BMI-for-age Z-score (BAZ), Height-for-age Z-score (HAZ) falling within -3 SD to 2 SD, and macronutrient intake <80% based on the 24-hour recall, 3) participants had to be registered students in junior high or high school within the Tanakeke Islands District of Takalar Regency, South Sulawesi Province in 2023, and 4) participants should not be following any special dietary regimen during the study. The exclusion criteria were: 1) participants with less than 80% attendance during the intervention phase, and 2) participants who withdrew from the study before completion.

The sample size was calculated based on the malnourished female student population of Tanakeke Islands, with a 5% margin of error at a 95% confidence level, and accounting for a 15% dropout rate. According to this calculation, each group education interventions should include at least 46 female students.

### **Nutrition education curriculum**

The nutrition education curriculum presented in this study is grounded in the SCT framework (Table 1). The program is systematically implemented weekly, specifically on Wednesdays, within the

school timetable. This curriculum emphasizes education on malnutrition. It primarily targets adolescent girls, providing them with dedicated educational sessions. The curriculum divides adolescents into smaller groups (max 15 students) to provide personalized attention and a more focused educational experience. Additionally, it actively involves parents through monthly interactive sessions. Mother education through direct face-to-face interactions and WhatsApp group meetings to create a home environment that encourages healthier dietary practices, to increase the consumption of fruits and vegetables.

The Intervention groups (IG) consists of Junior High School 4 Mappakasunggu and Senior High School 10 Takalar, provides a comprehensive educational experience for adolescent girls through a program of 12 weekly sessions for three months. SCT educational sessions are divided into six stages: 1) Previous Session Review (15 minutes): Starting the second week, we dedicate time to reviewing and reinforcing previous learning. 2) Education Session (15 minutes) Core teaching segment where new information is introduced. 3) Ice Breaking and Consumption (Times vary): We offer snacks and drinks to create a relaxed environment. Icebreaking activities can be conducted 2-3 times to prevent boredom. 4) Discussion/Role Play/Simulation/Practice (30 minutes): These segments vary according to the theme of the session, ensuring dynamic and interactive learning 5) Q&A and Summary (15 minutes): We end the session by answering questions and summarizing the essential points. 6) Goal Setting (15 minutes): Participants are guided to set personal goals for healthy living behavior that must be achieved until the next meeting.

The study involved Kalukuang and Tompotana Junior High Schools as control groups (CG) located on satellite islands away from the main island where the IG took place. The intervention consisted of nutrition education through 12 infographic leaflets provided by the Indonesian Ministry of Health, distributed weekly. The CG received leaflet education, which involved 45-minute sessions using lectures, discussions, and ice-breakers and was conducted in large groups. Mothers of CG were not included in the education, which was solely conducted at schools.

#### **Data collection and tool**

This study utilized an informed consent form, demographic questionnaire, fruit and vegetable knowledge questionnaire, SCT construction questionnaire, and Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The knowledge questionnaire, adapted from Farisa (2012), included 15 multiple-choice. Each correct = 1, incorrect = 0. The SCT construction questionnaire utilized in this study underwent rigorous expert validation by esteemed lecturers at Hasanuddin University, Makassar. The internal consistency coefficients for validity ranged from  $\alpha=0.415$  to 0.826, while reliability coefficients ranged from  $\alpha=0.731$  to 0.865 (data on the SCT construction questionnaire not included here).

This study aims to assess fruit and vegetable consumption in the last month (30 days) using the SQ-FFQ and determine the status of fruit and vegetable consumption according to WHO definition [23]. This questionnaire includes questions regarding the consumption of 18 types of vegetables and 19 types of fruit, which can be added to the types of fruit and vegetables that still need to be listed. The SQ-FFQ questionnaire involved one teacher from Senior High School 10 Takalar and two parents from each group. To ensure that researchers and adolescent girls have consistent perceptions, we used portions of fruits and vegetables with the "Buku Foto Makanan; Measuring Guides - Food Model Booklet" (KEMENKES, 2014) during the interviews. Furthermore, educational media in modules with IPR 000232421 by Dr. Healthy Hidayanty, SKM, M.Kes, increased fruit and vegetable consumption.

Anthropometric tools, such as the Seca body scales (Model 770) and the Seca stadiometer (Model 206) from Germany, have an accuracy of 0.1 cm. Additionally, the MUAC tape from the Indonesian Ministry of Health has an accuracy of 0.1 cm. All research instruments have been validated by experts, including dietitians and nutrition science lecturers. Additionally, this instrument was utilized for a pilot test with 30 school-aged girls to review the questionnaires and ensure the adolescent girls comprehension.

#### ***Statistical data analysis***

The statistical analysis in this study used IBM SPSS Version 28 for Windows (IBM Corp., Armonk, N.Y., USA). Descriptive statistics calculated percentages, means, and standard deviations. The data normality using the Shapiro-Wilk test before conducting bivariate analysis. Depending on the data distribution, the Independent Sample t-test, or Mann-Whitney test for independent data, paired data, the Paired Sample t-test, or Wilcoxon Signed-Rank test. A 5% significance level (two-sided) was applied.

#### **Results:**

A total of 88 adolescent girls were chosen to participate in nutrition education classes. However, four adolescent girls were excluded because they did not meet the 80% attendance requirement in IG. This resulted in a post-intervention response rate of 95.6%. Table 1 reveals that 56 (52.7%) of participants are girls aged 13 -15. Most of their parents, 45 (52.3%) of fathers and (48) 52.2% of mothers, have elementary-level education. Most fathers 66 (75%) work in fishing, while most mothers 76 (84.6%) are housewives. Additionally, 84 (95.5%) of these families fall into the lower socio-economic (monthly income < IDR 1,500,000).

Figure 1 illustrates the alterations in fruit and vegetable knowledge scores during the pre and post collection phases. The intervention group mean ( $\pm$  standard deviation) knowledge score significantly increased ( $p < 0.01$ ) from a pre of  $4 \pm 2.14$  to a post score of  $6.64 \pm 2.76$ . Similarly, the control group mean knowledge score also significantly enhanced ( $p < 0.01$ ), rising from a pre of  $3.22 \pm$

2.05 to a post  $4.70 \pm 2.38$ . The differential in the mean change in knowledge scores between IG and CG was statistically significant ( $P= 0.38$ ), with the IG achieving mean increase of  $2.69 \pm 2.95$ , which was higher than the CG mean increase of  $1.48 \pm 2.43$ .

The study found significant ( $p<0.01$ ) pre and post intervention increased fruit and vegetable consumption among IG and CG, but the IG saw a more significant increase. Fruit intake in the IG went from 0.65 to 2.30 portions daily, a higher increase than that of the CG, which was 0.58 to 0.65. The mean increase in fruit intake was significantly higher ( $p<0.01$ ) in the IG compared to the CG. The IG also saw a larger increase in vegetable consumption, from 0.76 to 1.90 portions daily, compared to the CG increase from 0.61 to 1.41. While vegetable consumption also significantly increased ( $p<0.01$ ) in both groups, the difference between the IG and CG was not statistically significant ( $p=0.218$ ), though the IG had a slightly higher increase (Table 3).

Table 3 also shows the changes in the diversity of fruits and vegetables consumed pre-post education intervention. The diversity of fruit consumed by both groups increased significantly ( $p<0.01$ ) from 6.21 to 10.95 on GI and 6.11 to 16.15. The mean difference between groups is also significant ( $p<0.01$ ). The IG experienced an average increase of 4.74, while the CG had a higher increase of 9.78. The diversity of vegetables consumed by the two groups was not significantly different ( $p > 0.05$ ), with an increase from 6.88 to 7 in IG and 6.37 to 6.91 in CG. The mean difference between the groups was not significant ( $p = 0.654$ ), with the IG seeing a mean increase of 0.12 and the CG a higher increase of 0.54.

### **Discussion:**

The results of fruit and vegetable knowledge scores in this study increased significantly between the two groups after the intervention. Overall fruit and vegetable knowledge scores ranged from 0–15. The post-intervention results showed that the average score was  $6.64 \pm 2.67$  (min-max; 1–12) or adolescent girls could only answer 44% of the questions. Student performance issues in some Indonesian areas might be linked to high teacher absenteeism, which affects schools in impoverished and remote regions. A 2014 survey found that about 20% of teachers in these areas are regularly absent. Research shows that teacher absenteeism negatively impacts student attendance, dropout rates, and learning outcomes [24]. In South Sulawesi, the education quality is notably low, with only 29% of children reaching satisfactory literacy and 18% achieving adequate numeracy levels, highlighting the need for educational improvements [25].

The study found that the average number of fruit portions consumed meets the recommended minimum of two portions per day. However, vegetable intake in this study falls short of the recommended minimum of three portions per day for vegetables, or a total of five combined portions of fruits and vegetables per day [23]. The study reported lower daily fruit and vegetable intake than a

cross-sectional study in Iran: 3.43 portions/day for fruit and 2.30 portions/day for vegetables [26]. The study discovered that fruit and vegetable consumption levels were higher than those in a previous SCT study in Iran; on average, participants consumed 1.45 and 1.47 portions/day [27]. These results were also higher than those of a previous SCT study by Trude et al. (2016)[28] involving low-income urban African American adolescents. In that study, adolescents consumed an average of 1.5 portions/day of fruit but had a higher vegetable intake, 1.8 portions/day.

The study observed increased fruit diversity among participants but no change in vegetable diversity, which remained stagnant. This trend may be because fruits are more commonly chosen as snacks by individuals, while vegetables are often eaten as part of family meals, influencing adolescents' consumption patterns. Family influence on food choices decreases as adolescents age [29]. Witarningsih and Khomsan (2019)[30] analyzed the differences in fruit and vegetable consumption between coastal and mountain communities in West Java. They found that vegetable consumption among Indonesian people is generally in the form of cooked soup as a moistening agent for staple foods. Additionally, vegetable consumption in coastal communities tends to be lower due to cultural habits, as people in these areas tend to consume more fish and mistakenly consider fish soup as a vegetable.

Diet diversity is vital for micronutrient adequacy, as no single food can supply all necessary nutrients. A varied diet contributes to adequate levels of vitamins A, D, E, folate, calcium, iron, and magnesium, enhancing overall nutritional status and health [31]. Despite the crucial significance of diversity within fruit and vegetable species and diets, nutrition research has focused on diversity among different food groups, neglecting this essential aspect [32]. It is essential to remember that the human body cannot adequately synthesize at least 30 micronutrients. Therefore, crucial to maintain a diverse intake to ensure we get all the essential nutrients [33].

Based on interview results, adolescent girls living in the Tanakeke Islands consume fruits such as coconut, mango, watermelon, banana, and gersen (*Muntingia calabur*) more often. On the other hand, they rarely consume sapodilla (*Manilkara zapota*) and pineapple. Sapodilla is a seasonal fruit that is not readily available, while pineapple is rarely consumed due to its difficulty in processing and the negative stigma surrounding its consumption by adolescent girls. Additionally, adolescents mentioned that they often consume vegetables like spinach water (*Ipomoea aquatica*), moringa leaves, eggplant, cucumbers, and tomatoes, while green beans and bitter melon (*Momordica charantia*) are the least consumed vegetables. They are unfamiliar with beans and dislike bitter melon because of its taste. In most cases, the unfamiliar taste of fruits or vegetables prevents teenagers from consuming them. School-age teenagers tend to refuse fruits and vegetables with unfamiliar tastes and natural bitterness [34].

The research highlights the benefits of SCT-based nutrition education for adolescent girls in secondary schools, emphasizing its role in shaping positive dietary behaviors. It calls for further targeted



research to enhance vegetable consumption among these girls, particularly in the socio-economically disadvantaged areas of the Tanakeke Islands. Addressing the local cultural context is crucial in combating malnutrition, a prevalent issue among adolescent girls in island and coastal communities who often marry and become mothers early without adequate nutritional knowledge. This research underlines the importance of educating adolescent girls on nutrition for their health and preventing the intergenerational transmission of malnutrition [35].

### **Conclusion**

The study conclusively demonstrates that nutrition education based on Social Cognitive Theory (SCT) are effective in increasing knowledge and consumption of fruits and vegetables among adolescent girls, especially in island areas. This reinforces the potential of SCT-based interventions to significantly impact dietary practices in low to middle income, geographically isolated communities. Further research is crucial to support the promotion of vegetable consumption among girls in the Tanakeke Islands in line with health recommendations.

### **Acknowledgment:**

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**Table 1 Nutritional Education Curriculum for Adolescent Girls**

<b>Sesion</b>	<b>Intervention group (SCT Education)</b>	<b>Control Group (Leaflet Education)</b>
<b>1st week</b>	Evaluating Adolescent Girls Malnutrition	Food Pyramid
<b>2nd week</b>	Assessment of Dietary Habits	Staple Food (Source of carbohydrates)
<b>3rd week</b>	Identifying Obstacles to Nutritional Eating	Anemia
<b>4th week</b>	Fostering Healthy Dietary Practices	Chronic Energy Deficiency
<b>5th week</b>	Promotion of Regular Physical Activity	Physical Activity
<b>6th week</b>	Fruit and Vegetable Intake Assessment	Source of Fruit
<b>7th week</b>	Barriers to Fruit and Vegetable Consumption	Vegetable Sources
<b>8th week</b>	Understanding the Nutritional Benefits of Fruits and Vegetables	Side Dishes (Animal & Vegetable Protein)
<b>9th week</b>	Processing Techniques for Fruits and Vegetables	Anemia
<b>10th week</b>	Preservation and Storage of Fruits and Vegetables	Drink eight glasses of water a day
<b>11th week</b>	Anticipating and Managing Behavioral Change Challenges	Wash Hands with Soap
<b>12th week</b>	Sustaining Healthy Lifestyle Habits	Healthy snacks

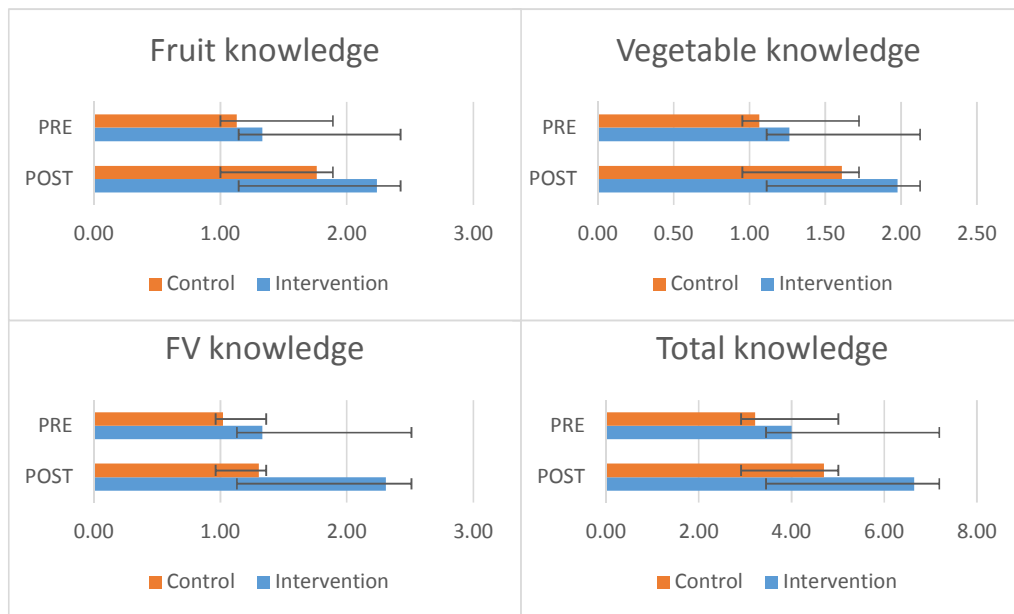
**Table 2. Demographic Characteristics of Adolescent Girls Before Nutrition Education**

<b>Variable</b>		<b>.n=88</b>	<b>%</b>
<b>Age</b>	11-12 Years	32	47.7
	13-15 Years	56	52.7
<b>Father's Education</b>	Uneducated	17	19.5
	Elementary school	45	51.8
	Junior high school	16	18.4
	Senior high school	6	6.9
	College	3	3.4
<b>Mother's Education</b>	Uneducated	24	28.4
	Elementary school	48	54.5
	Junior high school	9	10.3
	Senior high school	5	5.7
	College	1	1.1
<b>Father's Job</b>	Civil servants	3	3.4
	Entrepreneur/trader	1	1.1
	Fisherman	66	75
	Farmers	15	17.2
	Unemployed	3	3.4
<b>Mother's Job</b>	Civil servants	1	1.1
	Entrepreneur/trader	2	2.3
	Fisherman	2	2.3
	Farmers	7	8
	Housewife	76	86.4
<b>Socio-economic status</b>	Low	84	95.5
	Medium	2	2.3
	High	2	2.3

**Table 3: Bivariate Analysis of Fruit and Vegetable Consumption and Diversity Among Adolescent Girls**

Dependent Variable	Groups	Mean±SD		P value	Mean±SD
		Pretest	Posttest		
Fruit Consumption	Intervention	0.65 ± 0.75	2.30 ± 1.43	<b>0.000*</b>	1.65 ± 1.47
	Control	0.58 ± 0.52	0.88 ± 1.03	0.054*	0.29 ± 0.96
	P value	0.506**	<b>0.000**</b>		<b>0.000**</b>
Vegetable Consumption	Intervention	0.76 ± 0.55	1.90 ± 1.09	<b>0.000*</b>	1.13 ± 1.15
	Control	0.61 ± 0.49	1.41 ± 0.76	<b>0.000*</b>	0.81 ± 0.85
	P value	0.113**	<b>0.042**</b>		0.218**
Fruit Diversity	Intervention	6.21 ± 2.21	10.95 ± 5.36	<b>0.011*</b>	4.74 ± 5.84
	Control	6.11 ± 2.54	16.15 ± 4.71	<b>0.000*</b>	9.78 ± 5.50
	P value	0.420**	<b>0.000**</b>		<b>0.000**</b>
Vegetable Diversity	Intervention	6.88 ± 2.17	7.00 ± 3.38	<b>0.001*</b>	0.12 ± 3.72
	Control	6.37 ± 2.49	6.91 ± 3.58	<b>0.048<sup>a</sup></b>	0.54 ± 3.82
	P value	0.324**	0.671**		0.654**

Significantly different at a p < 0.05. \* Wilcoxon \*\* Mann Whitney <sup>a</sup> Paired t-test <sup>b</sup> Independent t-test



**Figure 1. Scores of Nutrition Knowledge Before and After Intervention.**

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**Conflict of Interest:**

There are no conflicts of interest.

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