

## Does School Gardening and Nutrition Education Improve Knowledge and Fruit-Vegetable Consumption Among Elementary School Students?

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### ABSTRACT

**Background:** Although scientific evidence has revealed the benefits of fruits and vegetable consumption (FVC) for children, 96.8% of age school children in Indonesia and 70.6% of primary school students in Jakarta did not have FVC as recommended. **Aims:** to assess how Muhammadiyah Elementary School Students' knowledge and FVC were affected by school gardening and nutrition education. **Methods:** Following 6 months program, knowledge and FVC were assessed by using Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) and knowledge questionnaire. **Results:** 1) There is a significant increase in students' knowledge scores from  $43.24 \pm 14.24$  to  $70.31 \pm 18.92$  ( $P$ -value 0.000). 4); 2) Mean of FCV was elevated from  $211.45 \pm 12.33$  to  $289.76 \pm 19.64$ , however, it was not statistically significant ( $P$ -Value of 0.058). **Conclusion:** Although knowledge has been improved following 6 months program, the FVC level was not dramatically enhanced. Future similar activities need to be done in a non-pandemic situation and should be lengthened into more than 6 months to portray a significant increase in FVC.

**Keywords:** Fruit and Vegetable, Health Promotion, Nutrition Education, School.

### INTRODUCTION

Scientific evidence has shown the relationship between inadequate fruit and vegetable consumption (FVC) and overweight and obesity among elementary school children. In Germany, a cohort study showed that adequate FVC suppressed the increases in students' body mass index (Bayer et al., 2014). In East Java, Indonesia, a study found that FVC below the recommended level is associated with a higher risk of obesity among elementary school students (Anggraeni et al., 2017). Moreover, FVC is also associated with food choices, where children who have more FVC are more likely to eat a greater variety of foods with healthier food choices (Korinek et al., 2015).

However, globally, most school-age children do not have FVC as recommended today (5 servings a day). A study in the United Kingdom found that two-thirds of students did not eat fruit at all at lunch and only 3% consumed 1 serving of what was provided (Upton et al., 2012). In

Thailand, more than half of children consume less than the recommended amount of fruit and vegetables ( $\leq 2$  servings a day) (Hong & Piaseu, 2017). In Indonesia, the results of basic health research in 2010 - 2018 show that most (>95%) primary school-age children have an inadequate FVC including in DKI Jakarta province, the capital city of Indonesia (Ministry of Health Republic of Indonesia, 2010,2013,2018).

Various factors have been detected as the cause of the low FVC among school children. The direct causes are poor access and lack of nutritional knowledge. Lack of access is indicated by the lack of vegetables and fruit that are marketed in the neighbourhood and at school. Only a few elementary schools in DKI Jakarta have fruit and vegetable gardens to be consumed. The nutritional knowledge that should be improved is mainly about how much fruit and vegetable to be consumed a day and how to avoid nutrient loss during fruit and vegetable cooking/processing.

A systematic review by (Yang et al., 2020) showed that poor access to

vegetables and fruits in the children's surroundings is the main cause of the lack of FVC. In Australia, higher access to sales of high-calorie foods such as fast food and minimarkets is associated with lower FVC (Timperio et al., 2008). The living environment that lacks vegetable and fruit marketing and the absence of vegetable gardens in schools are the causes of low FVC for school children in Korea (Park et al., 2013). A similar result was also reported by a study in Brazil, where a living environment that provides vegetables and fruit within a radius of fewer than 500 meters increases the FVC among students (Nogueira et al., 2018). Whereas in DKI Jakarta, poor access to vegetables and fruit in the neighbourhood and at school is one of the causes of the low FVC (Sudiarti, 2018).

Lack of nutritional knowledge and skill (cooking and measuring portions) is related to the level of intake of vegetables and fruit. Research in the Texas United States shows that children who are involved in cooking have a higher intake of vegetables and fruits (Asigbee et al., 2020). The community empowerment program conducted in Auckland, New Zealand has also succeeded in increasing the behaviour of eating vegetables and fruit by involving children in cooking (Gerritsen et al., 2019).

Lack of knowledge about nutrition is also associated with low FVC among school children. Research in the Netherlands shows that knowledge regarding the daily portion of vegetables and fruit is related to the level of intake (Fischer et al., 2011). In line with that finding, research in Bogor, Indonesia, also found a similar finding, in which nutritional knowledge is related to FVC (Mohammad & Madanijah, 2015). Generally, Indonesian primary school children's knowledge is poor, especially regarding the recommended number of fruit and vegetable servings (Priasmoro et al., 2017).

Muhammadiyah 4 elementary school, located in Cawang, East Jakarta, is a typical elementary school in the midst of a crowded capital city, Jakarta, that has complex health problems, including the problem of FVC. The results of the preliminary survey found that 70.6% of the school's students did not consume vegetables and fruit as recommended. The main cause includes poor access to vegetables and fruit, such as the absence of school gardens and the lack of fruit and

vegetable-based food outlet. In terms of nutritional knowledge, it was found that 93.5% of Muhammadiyah elementary school students have poor knowledge, especially regarding the recommended portion of vegetables and fruit to be consumed a day. Therefore, this study aimed to evaluate the effect of school gardening and nutrition education on knowledge and FVC among Muhammadiyah Elementary School Students Jakarta. We hypothesized that student's knowledge and FVC will be improved following the program.

## METHODS

### Study Design

This is a multicomponent school-based intervention program that occupied one group pre-test and post-test design to investigate the effect of the program on students' knowledge and FCV. On the whole, this study lasted for 6 months and was conducted by using a protocol as described by figure 1. This study has been registered for ethic approval from Medicine and Health Research Ethic Committee University of Muhammadiyah Prof.Dr.Hamka number 03/22.10/02079.

### Participants

Out of 149 student-parent pairs, 126 pairs from grades 4, 5 and 6 in Muhammadiyah 4 Elementary School, East Jakarta, Indonesia participated in this promotion program (a total of 23 pairs dropped out due to unfinished activities, incomplete questionnaire, sick and or abstain during the program). Students and parents were participated in a webinar and their knowledge improvement was assessed. The parents, on behalf of their children, have agreed and filled out the informed consent form prior to the program. Half of the participants will be assigned to the intervention group, and control group for the remaining subjects.

### Intake Measurement

A Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) interview will be conducted. Due to the pandemic situation in DKI Jakarta, both offline and online interaction (hybrid) data collection were occupied. Offline interview and online meeting platform were used so that the interviewer and interviewee could meet and see each other in a real-time situation. Household portions of fruit and vegetables were shared on the video conference so

that the interviewees could see and recall how much fruit and vegetables they consumed during the last 1 months.

#### **Intervention components**

##### **a) School gardening**

This activity aimed to provide fruit and vegetables accessibility at school. A self-watering hydroponic system was built to provide fruit and vegetable for student consumption prior to intervention period. About 4 hydroponic structures was built to accommodate vegetables such as spinach, Chinese kailan, cucumber, green bean, green onion, and lettuce. The vegetable seeds were planted on the growing medium in each hydroponic bucket. Whereas fruits such as strawberry, rambutan, guava, avocado, banana, tomato and mango were planted directly on the ground. We planted the fruit in the form of sapling rather than seed to get a faster result. These crops were grown for 3 months until they were ready to be harvested. After 3 months, all of the vegetables were ready to be picked. Only strawberry and tomatoes from the fruit section that were ready to be consumed at that time. All of these fruits and vegetables were then used for cooking demonstration and consumption.

##### **b) Nutrition Education**

###### **1. Webinar for Students and Parents**

This activity aimed to enhance student's and parent's knowledge of FVC. The webinar "let's plant your crops and eat them!" was held for students to educate them on how to simply grow fruit and vegetable by themselves in their homes. Meanwhile, webinar "fruit and vegetable in my plate" was delivered to the parents to improve their knowledge about the importance of, portion and management of fruit-vegetable servings in household environment.

###### **2. Emotional demonstration (Emo-demo)**

A video was made to demonstrate a step-by-step science experiment by using balance scale, marbles, and cottons. This experiment aimed to

show how a large volume of cotton made the weight pan rose as they lighter than marbles. Cotton that is weighed in larger volume will be much lighter compared to the marbles in smaller volume. Marbles, on the other hand, push the weight pan down because they are much heavier than cotton even in a small amount. Cotton represents fruit and vegetables that contain limited calories although being consumed in a large volume compared to the high energy junk-food that symbolised as marbles. This demonstration was intended to evoke students' emotion toward FVC and junk food. As they saw that consumption of a large volume of fruits and vegetables make they satisfy without obtain a significant amount of calories compared to the junk food, their perception towards FVC may be improved. It will subsequently motivate them to eat more fruits and vegetables.

###### **3. Cooking demonstration**

We conducted a cooking demonstration to educate students and parents on how to make simple dishes made from fruits and vegetables. We used the fruits and vegetables picked from hydroponic garden, including lettuce, Chinese kailan, spinach, tomatoes and strawberry. The dishes such as mixed-vegetable rice, vegetable pancake, chicken with mixed-fruit sauce, and creamy fruit sandwich was made in front of the students to enrich their skill in preparing fruit-vegetable based dishes at home. This will subsequently encourage them to eat more fruit and vegetables.

###### **4. Nutrition-based education in class**

Teachers grades 4, 5 and 6 participated in a workshop aimed to train them on how embedding nutrition science, particularly regarding FVC, into learning materials. Elementary school subjects including natural sciences, sport and health sciences, Islamic religion and Bahasa Indonesia were involved as the target of nutrition science

integration. In natural science, for example, a topic about the gastrointestinal process was enriched by nutrition science regarding the importance of fibre from fruit and vegetable to help defecation. Storytelling in Bahasa Indonesia were also embedded with balance nutrition topics. Micronutrient in fruit and vegetable was briefly explained in the sport and health sciences module for their benefit in supporting physical activity and exercise. Suggestion of consuming fruits and vegetables as halal and fine food that comes from Islamic values was taught in the Islamic religion class.

### Media

We created 3 health education modules: 1) hydroponic module, 2) FVC pocket book, and 3) nutrition-based education module. The hydroponic module provides a practical guide for schools and students to grow fruit and vegetable using various hydroponic systems. The FVC pocket book was delivered to the teachers, parents and students. This book describes the benefits, types, content, recommended portion and suggested processing method of fruit and vegetable that is described theoretically and practically. Nutrition-based education module was used by the teacher to help them integrate nutrition principles into learning plan of related school subjects such as natural sciences, sport and health sciences, Islamic religion and Bahasa Indonesia. The class learning plan or Rencana Pelaksanaan Pembelajaran (RPP) was the main document that used to evaluate the integration of nutrition principles into learning materials.

In addition, we created emotional demonstration video entitled “Banyak Tapi Ringan, Sedikit Tapi Berat” (“much but light, little but heavy”). This 4-minute video is a science experiment that tells the students about the comparison of energy yielded from fruits-vegetables versus fatty, oily, high-sugar food. They could learn about how to conduct the experiment with their friends. After do the experiment, students were expected to have an insight that eat fruits and vegetables could make them satisfy without gain a lot of calories.

### Statistical Analysis

The difference of knowledge score and FVC level between pre and post intervention was examined by using dependent t-test. The analysis was performed by using SPSS Statistic v. 23.0 (IBM SPSS Statistic for Windows, Version 23.0. Armonk, NY, USA).

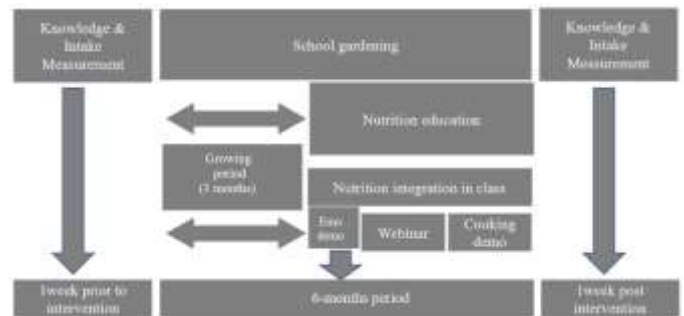


Figure 1. Intervention Protocol Summary

## RESULTS AND DISCUSSION

### Participant's characteristics

From a total of 149 students and parents of Muhammadiyah 4 Elementary School participated at baseline, only 126 pairs of them that completed this 6-months school-based intervention program (23 pairs were dropout due to sick absence, unfilled post-test, and other unspecified reasons). Table 1 shows that students were equally took from grade 4, 5 and 6. Boys and girls were proportionally participated in this study. Half of parents were 36-45 years old, graduated from middle school and unemployed. Mostly they live about less than 1.6 km from grocery store. In DKI Jakarta, fruit and vegetable were sold by street vendor, traditional market, supermarket, convenience store, and online store.

Table 1. Participant's Characteristics

Characteristics	Percent
<b>Children's grade</b>	
Grade 4	34.6
Grade 5	33.3
Grade 6	32.1
<b>Children's gender</b>	
Boys	44.4
Girls	55.6
<b>Parent's age</b>	
26-35 y	35.9
36-45 y	52.4

46-55 y	11.7
<b>Parent's Gender</b>	
Male	15.2
Female	84.8
<b>Parent's educational level</b>	
Primary education graduate	6.2
Middle school graduate	51.7
Higher education graduate	42.1
<b>Parent's employment status</b>	
Employed	36.6
Self-employed	8.3
Unemployed	55.2
<b>Distance to grocery store</b>	
<800 m	9.8
800 m - <1.6 km	36.4
1.6-2.4 km	20.4
2.4-<4.8 km	11.2
>4.8 km	22.2

**Baseline surveys**

At baseline, students were asked about their habit and amount of FVC in the last 1 month by using semi-quantitative food frequency questionnaire. The result reveals that the mean of FVC was 211.45 gram per day (table 3). This amount is lower than recommended by Indonesian Ministry of Health. It is suggested that Indonesian children need to consume at least 300 grams of a combination of fruit and vegetable a day (MOHRI, 2017).

As nutrition literacy theoretically linked to the food consumption (McEachern et al., 2022), student's and parent's knowledge was assessed at baseline. The same questionnaire consists of 10 general

questions about balance nutrition and fruit-vegetable consumption (benefit, portion, meal example) was delivered to the students and their parents. As shown in table 2, the baseline knowledge score was 53.08 and 43.13 for students and parents respectively. In general, there are three main questions that were incorrectly answered by the students and parents including fruit and vegetable portion, number of recommended servings of fruit and vegetable a day, and the correct meal time.

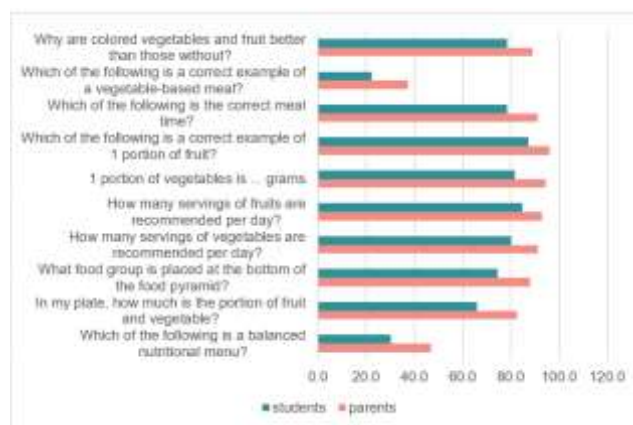


Figure 2. Proportion of participants who incorrectly answered the questions (%)

**Post-intervention surveys**

Statistical analysis shows a significant increase in knowledge scores post-intervention both among students and parents. Before the intervention, only 2.12% of parents and 17.3% of students have good knowledge about FVC. After the intervention, 51.06% of parents and 51.92% of students have good knowledge of FVC.

Table 2. Comparison between Pre-test and Post-test of Knowledge

	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	p-value
Parents	43.13±14.24	70.31±18.92	<0.001
Students	53.08±1.74	77.36±1.48	<0.001

Our analysis shows that the proportion of respondent who incorrectly answered the questions at post-test are lower than pre-test for all questions. The three questions that have a sharpest decrease of wrong answer from pre-test to post-test are about the correct meal time, example of 1 portion of fruit and serving of fruit a day. We believe that nutrition

education that integrated with learning material in the class, along with other intervention components (webinar and cooking demonstration) support student's knowledge improvement. In the class, teacher shows taught about balanced nutrition and food pyramid (type, portion, serving/day), meanwhile in webinar, students got the information about the

benefit of colourful fruit and vegetable, portion, serving and mealtime. During cooking demonstration, students saw how much exactly the amount of fruit and vegetable were served in the plate. All of these activities repeated the same information about FVC so that the students can absorbed and memorize that information very well. It has been shown in previous research that continuing information delivery will retain information until 1 year post-intervention (Wu et al., 2019).

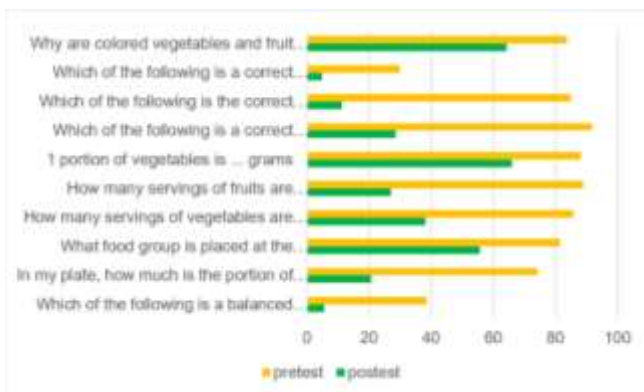


Figure 3. Proportion of participants (combination of students and parents) who incorrectly answered the questions at pre-test and post-test (%)

This increase in knowledge indicates that the information conveyed by the resource persons was well received by the participants. Various factors influence this, such as educational background, atmosphere during delivery and the quality of the media itself (Bratianu, 2015). Most of the respondents have a moderate education background. This makes it easier to absorb the information presented. The

discussion also went very well and was interesting because the questions asked were very critical so as to build a more complete concept of thinking about children's fruit and vegetable consumption. The calm atmosphere of the online counselling where participants' voices can be stopped while the resource person is speaking greatly helps in absorbing information. Lastly is the media factor. The media delivered is not only in the form of written presentations but also videos. It is known that video is more effective in increasing knowledge than writing (Wahyuni et al., 2019).

It has been proposed that understanding food could be the secret to advancement (McEachern et al., 2022). The topic of food literacy, which includes food knowledge, has received increased attention in other studies (Vaitkeviciute et al., 2015). The results of treatments to increase food literacy were assessed in a systematic review measuring food literacy among children. Overall, this review found that higher levels of food literacy were associated with favourable effects on young people's dietary behaviours. However, many of the included studies had methodological flaws, such as inconsistent dietary intake surveys or instruments used to assess nutrition literacy (Vaitkeviciute et al., 2015).

An SQ-FFQ interview was again conducted to measure the change of FVC after the program. Analysis shows that students' FVC increased following 6 months intervention period. However, this increase was not statistically significant.

Table 3. Pre-program and Post-program of Student's FVC

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	p-value
FVC (g/day)	211.45±12.33	289.76±19.64	0.058

Although we found a significant increase of student's and parent's knowledge, there is no significant improvement on student's FVC. This finding is reasonable since the change of behaviour can be seen after 1-2 year intervention program. This program lasted

much shorter compared to the other similar study. A study in Southwestern Ontario, Canada, found a relationship between knowledge improvement and FCV after 2 year intervention program. In addition, a study in Zegreb, Croatia, found a significant increase of FVC level among

the intervention group following a three-year intervention period (Ilić et al., 2022). Fruit and vegetable consumption belongs to a complex health behaviour that need a long term follow up since numerous biological and social factors may affect children's intake of fruits and vegetables, including accessibility (Phillips & More, 2022). This study record that more than half of the participants live in  $\geq 1.6$  km from the nearest grocery store. It could be a barrier of FVC.

A possible lower impact of the intervention could be due to the COVID-19 pandemic, where the adequacy of the implementation of the whole intervention was reduced. We intended to enhance the availability of fruit and vegetables on school lunches, but the COVID-19 pandemic prevented us from completing this task. The COVID-19 epidemic may have had an impact on students' eating patterns as well. The kids were frequently secluded at home with their parents during the intervention's implementation. The COVID-19 pandemic's effects were most noticeable in the fact that parents and kids ate more home-cooked meals; nonetheless, kids consumed more snacks on a daily basis (Ilić et al., 2022).

However, although statistically not significant, we can see that the mean of fruit and vegetable intake was increased. The results of this study add to the body of knowledge regarding how different intervention designs and strategies can influence primary school students' FVC. The notion that intervention with several components is more successful than interventions with only one component served as our guide in creating the intervention (Evans et al., 2012). We also considered the results of previous studies suggesting that fruit and vegetable consumption can be increased through education of children and parents, peer and teacher influence, reinforcement, video-peer modelling, sensory exposure, and increasing the availability of fruits and vegetables through school menus (Appleton et al., 2016). Nevertheless, it was challenging to determine which part of this multi-component intervention changed how much fruit and vegetables were consumed. Future studies need to assess separate effect of each intervention component on program outcome.

## CONCLUSION

This multicomponent 6-month gardening and nutrition education program successfully increase student's and parent's knowledge about FVC recommendation. However, there is no significant improvement was observed on fruit and vegetable consumption. A longer intervention period in non-pandemic situation is needed to see a significant improvement of FVC level.

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