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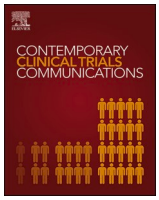

# The combination of nutrition education at school and home visits to improve adolescents' nutritional literacy and diet quality in food-insecure households in post-disaster area (De-Nulit study): A study protocol of cluster randomized controlled trial (CRCT)

Nikmah Utami Dewi [a,*], Ali Khomsan [b], Cesilia Meti Dwiriani [b], Hadi Riyadi [b], Ikeu Ekayanti [b], Diah Ayu Hartini [c], Bohari Bohari [d], Ummu Aiman [a], Nurulfuadi [a], Rasyika Nurul Fadjriyah [e]

[a] Department of Nutrition, Faculty of Public Health, University of Tadulako, Indonesia
[b] Department of Community Nutrition, Faculty of Human Ecology, IPB University, Indonesia
[c] Department of Nutrition, Health Polytechnic of Palu, Palu, Indonesia
[d] Department of Nutrition, Faculty of Medicine, Sultan Ageng Tirtayasa University, City of Serang, Indonesia
[e] Department of Public Health, Faculty of Public Health, University of Tadulako, Indonesia

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ABSTRACT

Nutrition education is selected as a method which often used to change eating behaviour, yet, the effectiveness of this method in adolescents who live in household with food insecurity status is rarely investigated. The purpose of this study was to assess the impact of a combination of nutritional education held at school and home visits for increasing the nutritional literacy and its effect on the quality of adolescent diet, so that the result can be used as a strategy to improve nutritional literacy dan diet quality in those adolescents who live in food-insecure households in post-disaster areas. The De-Nulit Study is a Cluster Randomized Controlled Trial (CRCT) with an intervention from a combination of nutritional education given at school and home visits conducted for three months for adolescents who live in food-insecure households with ages ranging from 15 to 17 years old. A randomization sampling was carried out at four schools located the nearest locations which were affected heavily by the major natural disasters in 2018. The nutritional education intervention groups in schools were given in eight sessions, whereas home visits with an interview approach for students with a motivational interview approach were carried out four times. The control group will receive leaflets three times a month for three months, and each group will receive a food stamp $ 7.6 per month for three months. The trial research has been recorded in Thai Clinical Trials Registry (TCTR) with identification number of TCTR 20220203003 issued on 03 February 2022.

## 1. Background

Nutritional education is a common way to do for changing eating behavior [1–3]. In the post-disaster areas, nutritional education becomes one crucial thing to do during the rehabilitation and construction period. Within these periods, economic activity began to start again, and make households could choose their own food choices although their dependence on the fund/aid distribution from the government kept high [4]. A failure in recognizing the nutritional problems and also a low level of nutritional awareness in the post-disaster period can increase morbidity and mortality [4].

Globally, nutrition education for adolescents has been carried out widely with varying degrees of success in changing their eating behavior [1–3]. Nutrition education aimed at adolescents who live in food insecurity status has already been conducted in several places with varying degrees of success. Most studies assessed the components of knowledge [5–9] and the eating behavior [5,7,9–13]. There was one study conducted in Lebanon on Syrian refugees [9], whereas some other studies were conducted in the United States with a sample size ranging from 15 [7] to 1136 adolescents [10].

Nutritional education interventions for adolescents are mostly implemented in the form of School-based interventions with different

* Corresponding author.
*E-mail address:* nikmah@untad.ac.id (N.U. Dewi).

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effectiveness [2,14–16]. The nutritional education in schools is very important for building peer group supports through group interactions to be able to increase the individual subjective norms [17] but adolescents often find difficulties in setting priorities, goals, and action plans for changing their nutritional behavior. In addition, transformation in nutritional information obtained from school will be difficult to implement at home without the help of a mentor or someone who has more knowledgeable in the related area [18]. Increasing the adolescents' self-confidence and strengthening the motivation of the related individual through individual and family approaches will be an important matter in evaluating the nutrition education interventions until the adolescent is able to make decisions upon nutritional knowledge that they have acquired [19].

A combination of nutritional education in the community with an individual approach through home visits has been successfully applied to groups of mothers and children for improving their knowledge, attitude, and self-confidence in carrying out the good nutritional behavior and nutritional status [20,21]. For adolescents, interventions for nutritional education that involved parents were effective in increasing the vegetable and fruit intake [22], meanwhile for the adolescent who has an intervention with the help of the university students in the form of a motivational interview had a significant effect on changing the snack consumption behavior from adolescents in low socioeconomic status [23].

The concept of the home visit was initiated and applied in community-based interventions in the mother and children group [20]. The purpose of this program is to improve the existing health services, closing the gap by volunteer services targeted to the family where children categorized as the food insecurity group are able to live their lives with good parenting support in the caring communities and families [24]. Home visit also becomes an approach to do in the community scope aimed at families with food insecurity status [25]. Home visits provide support to families by fulfilling the basic family needs, sharing prenatal and childcare knowledge also linking them to available health services [24]. Most of the home visits were carried out by the community who already received the training related to the program being implemented [20].

Adoption of concept home visits for adolescents is the potential to close the gap in nutritional education given at school and its implementation at home. Adolescents are expected to increase their nutritional literacy and be able to change their behavior so they can meet their nutritional needs with the support of families and caring communities [23] In vulnerable groups such as adolescents who live in food-insecure households, home visits provide support to adolescents and families against the obstacles faced when changing their eating behavior. The apparent problems especially occurred in the application of nutritious eating with the minimum resources which related to the eating pattern in adolescents [26].

The strategies to improve nutritional literacy and diet quality through a nutritional education approach aimed at food-insecure adolescent groups will be provided through this research. Efforts to improve nutrition and health need to be carried out, especially for groups that receive less attention and are more vulnerable to experiencing worse nutritional and health conditions. The study's outcome will answer the difference between the average nutritional literacy score and the diet quality among adolescents in food-insecure households in post-disaster areas who received nutrition education at school and home visits with adolescents in the control group who only received nutrition information leaflets.

### 1.1. Methods/design

This study aims to assess the effect of a combination of nutrition education at school and home visits on increasing nutritional literacy and its impact on the diet quality of adolescents who live in food-insecure households in post-disaster areas by taking a case study in Palu city, Indonesia. Nutrition education is carried out based on behavioral change mediators in the theory of planned behavior.

The selected design of this study was a Cluster Randomized Controlled Trial (CRT) with random allocation based on school to search the effect of a combination of nutritional education at school and home visits on adolescents' nutritional literacy and adolescents' diet quality in food-insecure households. This study is called the De-Nulit Study which means Diet and Nutrition Literacy.

In this study, nutrition education at school and at home was carried out to improve the nutritional literacy and diet quality of adolescents in food-insecure households in the post-disaster areas in Palu City. This city was the area hit by major disasters of a powerful earthquake, tsunami, and land liquefaction in September 2018 with the death toll of more than 3600 people and 40,738 refugees [27]. The catastrophic event not only bring causalities but also impacted socio-economic conditions. The record of material loss was 17293 houses having light damage, 12717 houses were moderately damaged, 9181 houses were heavily damaged and 3673 houses were brought down to ashes [27].

The main hypothesis of this study is a combination of nutrition education at school and home visits for three months is effective in improving the nutritional literacy and dietary quality of adolescents who live in food-insecure households. In addition, the eating habit of mothers also increased compared to the control group.

### 1.2. The sample size, inclusion, and exclusion criteria

The adolescents are involved in the study if they are in food-insecure households, living with their mother, the age are ranging from 15 to 17 years old, grade X or XI at school, have never been absent from school for more than two days in the last semester, do not have allergies and chronic diseases, are not on a special diet, willing to participate in the study, and the adolescents and their mothers are signing informed accent and informed consent. Informed accents and informed consents were collected by research staff.

The total sample for the nutritional education intervention and home visits was determined by using the formula of Armitage and Berry (1987) [28]. Determination of the main outcome power calculation according to the previous study in Mumbay India in the form of a nutritional education intervention for adolescents carried out for two months was able to increase the diet quality score by 7.6 [29]. There were four schools located closest to the disaster site that was willing to participate. Cluster randomization implemented in school was considered the effect design as a correction factor in determining the sample. Intra-cluster correlation determination based on intervention studies in school was found as 0.014 [30]. The number of samples with an anticipated dropout of 10% was 27 adolescents in each cluster whereas the total sample was 108 adolescents consisting of 54 people in the intervention group and 54 people in the control group. The stage of the study is shown in Fig. 1.

## 2. Randomization

The randomization were done based on the clusters (schools). School allocation randomization were conducted by computer program randomization. Each of two selected schools were randomly assigned as the intervention group and the control group. Each school consisted of 27 subjects thus made up of 54 subjects in the intervention group (De-Nulit) and 54 subjects in the control group. The nature of the intervention made blinding impossible for both participants and researchers. However, the assessors were blind to the baseline conditions as well as the evaluation of the final data collection and follow-up. However, blindness cannot be ascertained as this can be disclosed by adolescents or their mothers. The statistician who performed the data analysis was blinded to the study group, using the intervention numerical code only.

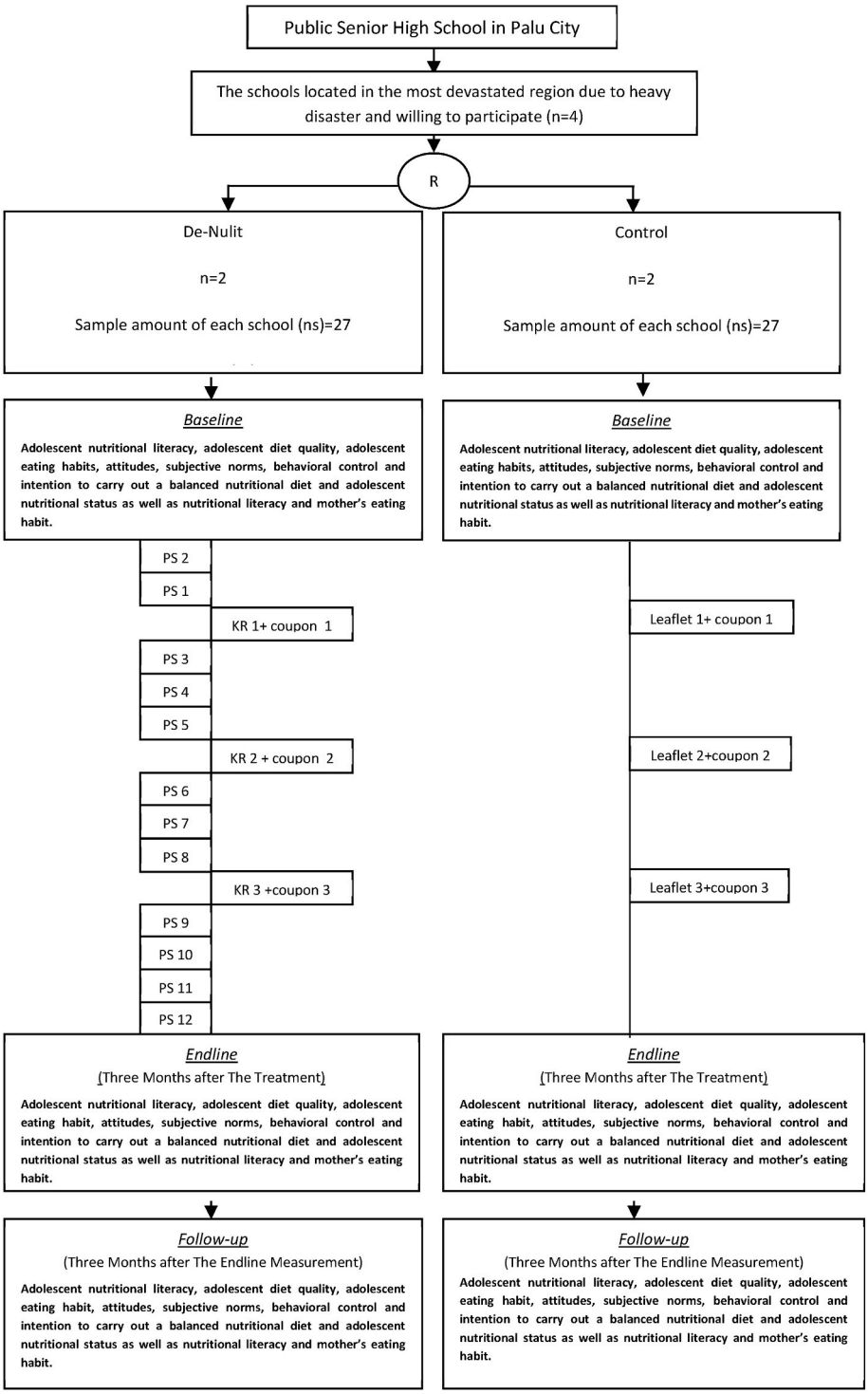


**Fig. 1.** Stages of the study.

### 2.1. Primary outcome

The main outcome in this study are nutritional literacy and diet quality which will be measured at baseline, end line, and follow-up, and the final measurement will be carried out after the nutrition education intervention process is done for three months. Afterward, the follow-up measurement will be carried out after three months the intervention is finished. Follow-up measurement targeted at looking at the retention of nutritional literacy and improving diet quality after the intervention ended.

Nutritional literacy is assessed with a validated *Nutrition Literacy Questionnaire* (Nulit) [31]. The scoring is based on a Likert scale consisting of five choices, namely "strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. The range of scores for each statement is starting from one as the lowest score and five as the highest score. The higher the total score of the functional nutrition literacy, interactive nutrition literacy, and critical nutrition literacy components, the higher the nutritional literacy.

The modified IGS3-60 will be employed to measure the diet quality in adolescents in this study. The modified IGS3-60 is a Healthy Eating

Index (HEI) that was tailored and developed for adolescents in Indonesia [31] by adding an iron component. The types of food consumed by the subjects are categorized into the groups of carbohydrates, sources of animal protein, vegetables, fruits, vegetables, milk, and iron. The average number of food portions based on food-recall 2 × 24 h then will be counted and the score will be calculated.

### 2.2. Secondary outcome

The secondary outcomes in this study are the mother's eating habits, mother's nutritional literacy also the habitual food intake and nutritional status of adolescents measured at baseline, end line, and follow-up.

Mother eating habits were determined based on the median score for eating vegetables, fruit, protein sources, salty-sweet and fatty foods as measured by a food frequency questionnaire with a response scale of 'Never', 'less than three times per month', 1–2 times per week', 3–6 times per week', 1 time per day and 'more than 1 time per day [32].

The mother's nutritional literacy was determined based on the total score of functional literacy, interactive literacy, and critical literacy components. The higher the score, the higher the nutritional literacy of the mother.

Adolescents' habitual food variables are the habit of eating vegetables, fruit, sources of animal protein, and vegetable protein as well as eating salty, sweet, and fatty foods and nutritional intake will be measured by applying the food frequency questionnaire. Eating habits were determined based on the median eating habits score. Answer scores are >1 time per day (score 5), 1 time per day (score 4), 3–6 times per week (score 3), 1–2 times per week (score 2), <3 times per month (score 1) and never (score 0) [32]. The nutrient intakes including energy (kcal), carbohydrates (grams), fat (grams), protein (grams), iron (mg), and calcium (mg) were identified using a 2 × 24-h food recall. The information on the type and amount of food intake was collected in household size and then converted into grams with the help of a food picture [33]. Intake data is converted into a nutritional value using the Indonesian Food Composition Table also with the information on the nutritional value of packaged foods.

The nutritional status of adolescents in this study was assessed by variables of adolescents' weight, height, body mass index (BMI) according to adolescents'age, upper arm circumference, percent body fat, and hemoglobin. BMI is calculated by comparing weight (kilograms) with the square of height (meters). BMI classification based on age which categorized into severe malnutrition (<- 3 SD), thin (- 3 SD to < - 2 SD), normal (- 2 SD up to + 1 SD), overweight (+1 SD to +2 SD) and obese (+2 SD) [34]. The percent body fat was measured by employing the Bioelectrical Impedance Analysis (BIA) Omron Karada Scan Body Composition. As the classification of percent body fat, for men is categorized into athletic (5–10%), good (11–14%), acceptable (15–20%), overweight (31–36%), and obese (>37%) [35]. Hemoglobin status observed by hemoglobin measurement using the Hemocue method to male adolescents with the status classification of non-anemic (13 g/dl), mild anemia (11–12,9 g/dl), moderate anemia (8–10.9 g/dl), and severe anemia (<8 g/dl). In the meantime, the classification of hemoglobin status in women categorized by a) non-anemic:12 g/dl, b) mild: 11–11.9 g/dl, c) moderate: 8–10 g/dl, and d) severe: <8 g/dl [36].

### 2.3. Socio-economic data and adolescents' characteristic

The socio-economic families of adolescents in this study were measured based on family income, parent education, household size, family type, food norms, and mother food consumption habits. The income aspect is categorized into quartiles while parents education is divided into non-school education, basic education, secondary education, and higher education [37]. The household size aspect is divided into small households, medium households, and large households [38]. The type of family aspect is divided into the electron family, nuclear family, atomic family, molecular family, and joint family [39]. The mother's food norm aspect was determined based on the median value of the Healthy Eating Norm [40]. Food allocation in the households was assessed by Likert scale questions. The mothers were asked to rank each household member according to food allocation by order of more diverse, fairly diverse, undecided, less diverse, and least diverse [41]. Food allocation consists of carbohydrate sources, protein sources, vegetables, and fruits, and according to the median value of the total food group, the food allocation for each member of the household will be found.

### 2.4. The food security

The household food security level was measured by employing the Household Food Insecurity Access Scale (HFIAS) questionnaire consisting of nine questions [42]. Adolescents are categorized as food insecure when they have score of 2 [42].

### 2.5. Psychological components

The construction of the Theory of Planned Behavior consists of variables of attitudes, subjective norms, behavioral control, and intentions to have a healthy diet. Whereas for the attitude assessment consists of 16 statements in which 12 statements about the subjective norms, 20 statements of behavior control, and 9 statements of intention. The scoring is based on five answer choices for each statement starting from 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. Responses to each positive statement were scored from 5 to 1 (strongly agree to strongly disagree) and for negative statements also scored from 1 to 5 (strongly agree to strongly disagree) [43]. Attitudes, subjective norms, behavioral control and intentions are determined based on the median score. The assessment of the Theory of Planned Behavior construct on a healthy diet uses a questionnaire that has been validated and assessed for reliability [44].

### 2.6. Interventions and control group

The intervention group will receive a combination of nutrition education at school and home visits. The nutrition education conducted in school will be provided in eight sessions, while home visits with a motivational interview approach are carried out four times.

The nutrition education in schools and home visit are carried out in a span of three months. The duration of nutrition education varies from 60 to 120 min per week and home visits of 60 min which will be held from one to two times per month. Details in weekly activity times are shown in Table 1.

The nutrition education activities in school are after-school activities that are held every Saturday. The activity will be guided by two facilitators in each class. The facilitators of nutrition education in school in this study were nutritionists with at least a bachelor's degree in health nutrition who understood how to conduct participatory education to adolescents.

The nutrition education activities in school include games, role play, practicum, discussions, brainstorming, group work, presentation and assignments. The material is given with a participatory approach like an interactive method in a fun way. The nutrition education session at school consists of the following materials: The importance of nutrition of adolescents; Consequences of malnutrition and excess nutrition in adolescents; Balanced nutrition for teenagers; My dinner plate; Food exchange material; Vegetable and fruit; Food source of protein; Food and Beverage labels; Sugar, Salt and Fat; Nutrition facts and hoaxes".

The adolescents will be given assignments to deepen their knowledge and skills, especially those relating to their ability in promoting healthy food to friends and family. In addition to the material that has been delivered in a participatory manner at school, the adolescents will also receive videos related to the material that has been studied. They will be

**Table 1**
Strategies of nutrition education in schools and home visits.

| Week | Session | Description of Activities | Time | Method | Media |
|---|---|---|---|---|---|
| I. | Nutrition of Adolescents | • Introduce The Learning System and Series of Nutrition Activities<br>• Creates a cheering expression (yel-yel)<br>• Makes an agreement<br>• Matching Pictures Game | 30 min | Play and Discussion | Modules for Facilitator and Adolescents |
| | | | 30 min | Play and Discussion | |
| | Malnutrition | • Calculate BMI according to age<br>• Discussion about the BMI calculation according the age, nutrition consequences and over nutrition, follow up procedure which must be done and some obstacles that might be met<br>• Video and worksheets | 60 min | Practicum, brainstorming and discussion | Modules for Facilitator, modules for Adolescents, and videos |
| | | | 30 min | | |
| II. | Balanced Nutrition and My Dining Plate (My Plate Content) | • A group game of "My Healthy Pillars"<br>• Discussion about Balanced Nutrition Pillar<br>• Puzzle Game "My Dining Plate"<br>• Discussion about the content of my plate, its implementation in their daily lives, problems that they faced, and the alternative solutions.<br>• Video and worksheets | 120 min | Game and discussion. | Modules for Facilitator, modules for Adolescents, and videos |
| | | | 30 min | | |
| III. | First (1st) Home Visit | • Discussion about obstacles, the alternative solutions, and follow up steps in BMI for age measurement<br>• Motivate adolescents for able to overcome obstacles and implement follow up steps as stated in prior time. | 60 min | Interview about Motivation | Modules for Facilitator and Participants |
| IV. | Exchange Material to Food Ingredients | • A group game of "Exchange Food"<br>• Discussion about the importance of variety food ingredients<br>• Practicum of Exchange Food<br>• Practicum of preparing food according to My Plate Content.<br>• Video and worksheets | 30 min<br>45 min<br>100 min<br>30 min | Games, discussion and practicum | Modules for Facilitator, modules for Adolescents, and videos |

| **Week** | **Session** | **Description of Activities** | **Time** | **Method** | **Media** |
|---|---|---|---|---|---|
| V. | Vegetables, Fruits, and Protein Sources | • A game of "Chain of Whispers"<br>• Discussion of the benefit of vegetables and fruits also its impact when the consumption is below the requirement level, and the reason why the vegetable and fruit consumption level is low in adolesecents and the alternative solutions | 60 min | Games, discussion, practicum | Modules for Facilitator and Adolescents |
| | | • A game of "Protein Catch"<br>• Discussion about the benefit of protein for adolescents and know type of rich protein foods (animal-based protein food and vegetable-based protein food) | 60 min | | |
| | | • Video and worksheets | 60 min | Assignment | |
| VI. | Second (2nd) Home Visit | • Discussion of obstacles, alternative solutions in an effort to practice eating according to the concept of My Dining Plate<br>• Solve the problem in preparing meal according to the concept of My Dining Plate (My plate content)<br>• Determine the target must be achieved in the next home visit related to eating practice according to the concept of My Dining Plate | 60 min | Interview about Motivation, Practical Aid, Recall | Modules for Facilitator and Adolescents |
| VII. | Labels in Food and Beverages Packages, and sugar, salt and fat contents in food and drinks | • "Healthy Scientist" game with the important task of finding the secret formula in drinks and food<br>• Group work sorts of food based on sugar, salt and fat content.<br>• Discussion of consumption limits, due to excessive consumption of sugar, salt and fat as well as the habit of consuming sugar, salt and oil in the surrounding environment.<br>• Video and worksheets | 120 min<br>30 min | Games, group assignment, discussion | Modules for Facilitator, modules for Adolescents, and videos |
| VIII. | Third (3rd) Home Visit | • Discussion about the achievement of eating practice according to the concept "My Dining Plate"<br>• Adolescents able to assess their intake of vegetables, fruit and protein sources.<br>• Adolescent able to assess sugar, salt, and fat intake.<br>• Discussion of the obstacles that still arise in the consumption of vegetables, fruit and protein sources<br>• Discussion of the obstacles that still arise in reducing the consumption of sugar, salt and excess fat<br>• Determine targets to be achieved in the next visit related to consumption of vegetables, fruit and protein sources as well as reducing sugar, salt and fat intake. | 60 min | Interview about Motivation Recall | Modules for Facilitator and Adolescents |

(*continued on next page*)

**Table 1** (*continued*)

| Week | Session | Description of Activities | Time | Method | Media |
|---|---|---|---|---|---|
| IX. | Facts and Hoaxes about Nutrition | • A game of "Chain Motion" for depicting the spread of hoax news<br>• Practicum for searching nutritional information to sort out fake news and accurate nutrition facts | 60 min<br>60 min | Game and practicum | Modules for Facilitator and Adolescents |
| X. | Teenagers' Nutrition Educators | • Educate their peers to present the result in the next session | 60 min | Assignment | Modules for Participant |
| | | • Presentation about the adolescent experiences and feelings during their role as nutrition educators<br>• Discussion of obstacles encountered during education in their environment<br>• Discussion of the alternative solutions so their environment can apply eating habits according to the concept of balanced nutrition and reduce sugar, salt and fat intake. | 120 min | Presentation and discussion | Modules for Facilitators and Participants |
| XI. | Fourth (4th) Home Visit | • Discussion on the achievements of the practice of eating vegetables, fruit and protein as well as reducing the sugar, salt and fat intake.<br>• Discussion of the benefits that have been obtained from the behavior changes made.<br>• Build a commitment to eat according to the concept of balanced nutrition and reduce the sugar, salt and fat intake. | 60 min | Interviews about Motivation, Recall | Modules for Motivators and Participants |
| XII. | Maintain the practice of Balanced Nutrition Concept | • Visualize the goals and expectations of the adolescents in the future<br>• Group discussion on how to achieve the goals and expectations of adolescents with the material in the sessions that have been finished<br>• Adolescents will choose behaviors that will be carried out simultaneously, declared and promised to remind each other about their commitment. | 120 min | Discussion and making commitments | Modules for Facilitators and Participants |

asked to convey what they have learned to their families, especially mothers, by asking several questions and providing answers that have been provided.

Home visit activities include motivational interviews, practical assistance and 24-h dietary recall. A 24-h dietary recall was carried out to determine changes in food consumption according to the nutritional education that had been obtained. The difficulties encountered while adopting a balanced diet were also identified. Adolescents are asked to convey solutions to nutrition problems that hampered them. Motivator provides motivation and practical assistance on matters related to a balanced diet such as determining single meal portions and reading food labels. If also for some reasons the adolescents do not take part in school activities such as being sick, the motivator is in charge of conducting a brief review of the material given at school. Home visits are not aimed directly to increase the family nutritional knowledge, especially mothers, but adolescents were asked to be able to communicate the information obtained to their families. The motivators should have a nutritional or public health education background and attended a minimum of two years of nutrition education.

Type of media applied in the nutrition education process are the adolescents' module, the Facilitator module, the Motivator module and video materials. The teenager module has a purpose as the source of nutritional information and to serve as a guide for the adolescents in nutrition education activities whether will be done at home or at school. For the module content consists of nutrition education material which will be delivered in the process of nutrition education given at school, assignment sheets, commitment sheets and plans for changes that they made every week. Adolescents were also given nutrition education media in the form of videos. These videos provide some reinforcement of the material given at school and the video is made in the form of illustrations.

The facilitators are also given a facilitator module aimed as a guide for facilitators in carrying out the process of facilitating nutrition education in schools. The facilitator module is also intended as a source of information for facilitators about the materials which need to be conveyed and must be understood by the adolescents. The module contains nutrition education materials as well as detailed technical steps for facilitation.

The modules also be given to motivators as a guide for them in conducting motivational interviews as well as become the guide in providing technical assistance to improve nutritional skills for the adolescents. The motivator module contains information on nutrition education materials and technical steps for conducting motivational interview as well as technical assistance for nutritional skills for adolescents.

The control group will receive leaflets which given three times for every month within three months. Leaflets are one of the most frequently used media to disseminate health information including adolescents. The first leaflet contains information about 10 balanced nutritional messages, the second leaflet contains My Plate Contents and the third leaflet about information on how to read food labels. The leaflets are issued by the Ministry of Health of the Republic of Indonesia.

Every adolescent group will receive a food stamp to ensure the adolescent households have sufficient access to groceries. The coupons can be exchanged for vegetables, fruit, fish, meat, eggs, and nuts and cannot be exchanged for other foodstuffs such as spices, sugar, oil, flour. The coupons can be exchanged at designated grocery stalls. Every subject in each group received a coupon of $7.6 for every month and will be received by the adolescent for three months.

### *2.7. A training for facilitator and motivator*

The training for facilitator has an aim to enable facilitators to carry out the nutritional education process in achieving certain competencies according to the stated goal of changing food behavior. Facilitator training is created based on the developed facilitator module whereas the motivator training also carried out after the motivator module was developed. Motivator training is held to ensure the motivators competent in carrying out the role of adolescent motivators by conducting appropriate motivational interviews and practical assistance needed by adolescents to achieve the goals which have been set. Facilitators and motivators can carry out the facilitation and motivation process when the standard score of minimum 80 on the post-test successfully achieved.

### 2.8. Statistical analysis

Data analysis was conducted by presenting the mean, median, standard deviation and presentation as descriptive data for each variable in this study. In order to observe whether the nutritional literacy is related to diet quality through attitudes, subjective norms, behavioral control and adolescent intention (TPB construct), a mediation analysis was carried out. The multivariate regression analysis was conducted to examine factors related to the quality of adolescent diet. Differences in the nutritional literacy, dietary quality and eating habits of adolescents were analyzed in before, after intervention and follow-up in the intervention and control group through ANOVA which involving variables apparent to be confounding variables. Then, a Post Hoc Test was applied as a follow-up analysis when it was found the effect of nutrition education at school and home visits based on the time of measurement. The p-value used to reject the hypothesis is $< 0.05$.

## 3. Discussion

This study observes the effectiveness of combination in nutrition education held at school and home visit that carried out together for 12 times in total for 3 months period compared to the provision of leaflets in improving the nutritional literacy and diet quality in adolescents in food insecure household in the post-disaster areas. As the study hypothesis is the combination of nutrition education at school and home visits is effective in increasing the nutritional literacy and diet quality of adolescents in food insecure households. In addition, there will be an increasing a good eating habit in mother of the related adolescents in the intervention group when compared to the control group.

A similar study was conducted in Lebanon on humanitarian conflict refugees with a younger age group (6–14 years) [9]. This research shows an increase in knowledge, attitude, and intake of nutrients to the nutritional status of body mass index for age. Several other studies have also been conducted on food-insecure adolescents with mixed results [5,45]. One study showed significant increases in knowledge, self-efficacy and vegetable and fruit intake scores [5]. However, a systematic review showed that adolescent behaviour change interventions had little effect on changing healthy eating habits [45].

This study provides an overview about efforts as solution to improve the nutritional behaviour and diet quality in vulnerable groups which are still rarely carried out. This study has a strong point, among others, about nutritional education in schools which able to reach large number of adolescents who are pursuing education. Furthermore, this research also involving the university students as motivators in the community as a form of community service which can be a role model for implementing a sustainable community service for the higher education scope. The study also provides information about the role of nutrition education in the implementation of food assistance program in post-disaster areas. Effort to increase the nutritional literacy are the prevailing components that must be included in the provision of any food assistance program from the government or other donor agencies.

Unfortunately, some limitations to the study are found such as the research was conducted after three years since the heavy natural disasters happened, thus, the result differences according to the time period of the occurrence unable to examine. In addition, there are several environmental factors like the availability of healthy food in the school canteen or the involvement of teachers in the nutrition education process were not become the focus of this study, therefore, the result of this study do not fully reflect the involvement of school elements. Furthermore, type of this study did not allow the blinding method to be applied to participants and the researchers, however, the baseline, the end line and follow-up measurement were performed by blinded assessors to reduce potential bias.

## 4. Conclusion

Efforts to improve the quality of adolescent diets need to be carried out for food-vulnerable groups, including in post-disaster areas prone to experiencing socio-economic changes that can exacerbate nutritional and health conditions. Nutrition education efforts and changes in eating behaviour are strategies that are often carried out among adolescent groups to improve nutrition and health. This study is a study in post-disaster areas which is rarely carried out. However, the results are very much needed to see the effect of nutrition education interventions on food-insecure adolescents in these vulnerable areas of socio-economic change.

## Trial status

Recruitment of subjects began in March 2022 while the intervention began in May 2022 and is currently ongoing. Final assessment will be conducted in August 2022 and follow-up assessment in December 2022.

## Ethics approval and consent to participate

The Ethical Committee of IPB University has approved the research with registration number of 464/IT3.KEPMSM-IPB/SK/2021. The intervention also has been recorded to Thai Clinical Trial Registry (TCTR) under identification number TCTR20220203003. Every subject has declared the willingness to participate in this study in a written form after received explanations before everyone sign the approval form.

## Consent for publication

Not Applicable.

## Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to failure to obtain agreement from all members of researchers team and the funding beneficiary. One of the causes lies in the likelihood of data misinterpretation.

## Funding

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## Authors' contributions

There are ten [10] authors participated in this study with their own duties as explained in the following paragraph [1]: NUD has responsibility to design the concept and study design, prepares the draft of the manuscripts, conducts revision, and ensures the field study run according to the stated objectives [2]. AK plays a role in supervise the study, provide constructive criticism and suggestions to the manuscripts, and creates the study design [3]. CMD has responsibility to prepare manuscripts, the research instruments, the validation processes, and revise the manuscript [4]. HR performs the data processing and statistical analysis, and then ensures the data accuracy followed by writing the manuscript [5]. IE makes the study design, supervises the facilitators and motivators also prepares the manuscript [6]. DAH has a role to prepare the data collection process and ensures the process going without any problems and take responsibility for revising the manuscripts [7]. BOH interprets data, prepares manuscripts and the educational materials to be used at school and home visits [8]. UA conducts

the facilitator and motivator training, data analysis and manuscript revision [9]. NF has responsibility to design and validate the educational materials as well as providing criticism on the manuscript draft [10]. As the last individual, RNF plays a role in funding acquisition, administration and revision of the manuscript.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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## Abbreviations:

| | |
|---|---|
| ANOVA | analysis of variance |
| BMI | body mass index |
| CRCT | Cluster Randomized Controlled Trial |
| HEI | Healthy Eating Index |
| TCTR | Thai Clinical Trials Registry |
| TPB | Theory of Planned Behaviour |

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