



Implementation Case Study

Mangrove Sword Bean Food Bar as the Emergency Food Product for Children Under the Age of Five Due to Landslides

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Abstract It is essential to prioritize attention toward children aged five and below since they possess unique needs due to their limited ability to appropriately prepare for and react to catastrophic events. There exists a need for easily accessible and appealing food choices that are capable of satisfying the unique micronutrient needs of specific groups. This study aimed to assess the effects of a meal bar containing a combination of api-api mangrove (*Avicennia marina*) and sword bean (*Canavalia ensiformis*) on the body weight and Weight-for-Age Z (WAZ) score of persons afflicted by a landslide disaster. A non-randomized pre-post intervention study was undertaken on a sample of 34 children under five who were affected by a landslide disaster. The participants were divided into two groups: the intervention group, who were provided the api-api mangrove-sword bean meal bars, and the control group, who were given sword bean food bars. Both groups were served with snack bars for 15 days. The study included disseminating educational materials on well-rounded nutrition for mothers with children aged five and below. The research results suggest that most women with children below the age of five had a positive inclination towards the mangrove-sword bean meal bar, as shown by their evaluation of its aroma, flavor, consistency, and appearance during the hedonic test. The experimental group had a more significant rise in weight (0.32 kg) and WAZ score (0.73) compared to the control group. Significant discrepancies were seen in the weight changes and Weight-for-Age Z-score (WAZ) among children under five. These inequalities were observed concurrently with a considerable surge in mother awareness of the need to provide well-rounded nutrition for children in this age bracket and an upturn in the consumption of food bars generally. There were no statistically significant differences in macronutrient consumption, except fat intake, between the pre and post-study periods. The investigation of the api-api mangrove-sword bean meal bar as a viable alternative emergency food source for vulnerable communities in the face of disasters is a subject of considerable

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scholarly attention. Additional research endeavors might be undertaken to delve deeper into this issue, with a particular emphasis on pregnant females as the focal population for the study.

Keywords: Under-five children, Landslide, Weight, WAZ score, Mangrove-sword bean-food bar

1. INTRODUCTION

Indonesia is experiencing a persistent rise in hydrometeorological disasters, including earthquakes, tsunamis, floods, and landslides. This occurrence can be attributed, in part, to the geographical positioning of the country, which lies between two vast oceans and intersects with the convergence zones of three significant tectonic plates: the Indo-Australian, Eurasian, and Pacific plates. The susceptibility to catastrophes in this nation is further influenced by the varied topographical features of its land surface. As of December 2022, Indonesia has had 3,318 catastrophes, with floods being the most prevalent disaster, accounting for 42.8% (Annur, 2022). According to recent data, West Java Province, the most populous province in Indonesia, has emerged as the leading province regarding the frequency of natural catastrophes occurring within the country from January to November of 2022 (Annur, 2022). In 2021, Sumedang District, a constituent district within this province, saw 85 instances of landslides (Aprilana & Putra, 2021). In January 2022, a landslide event transpired after prolonged, intense precipitation for two hours inside the vicinity. According to the cited source, the landslide mentioned above resulted in the unfortunate loss of 40 human lives, in addition to causing significant structural damage to several structures. One of the primary challenges encountered in natural disaster management is the provision of adequate nutrition, particularly for vulnerable populations such as children under the age of five. However, it is essential to note that young children under five often encounter malnutrition in the aftermath of a catastrophe due to inadequate consumption of macronutrients. Children under the age of five need a balanced diet for their developmental stage to meet their nutritional needs. To address this challenge, it is recommended that Emergency Food Products (EFP) containing comprehensive nutrition be made available for direct consumption as the primary energy source for 15 days, starting from the onset of the crisis management period or the moment of evacuation (Ekafitri & Faradilla, 2011; Mariam, 2019).

Various emergency food formulations have been created in Indonesia, including food bars derived from brand and corn flours (Kusumastuty et al., 2015), cookies produced from Moringa leaf flour (Fitri et al., 2012). cookies manufactured from sweet potato flour, banana flour, and mung bean flour (Anggraeni 2014), as well as a food bar composed of soybean, broccoli, and mangrove fruit (Fatmah et al., 2021). Nevertheless, although api-api mangrove (*Avicennia marina*) is recognized as a viable alternative to rice and wheat flour in the production of biscuits, its use in creating food bars has yet to be explored. According to a study conducted by

(Fauziyana, 2021), it has been shown that the api-api mangrove has a more significant energy content in comparison to rice and maize. Nevertheless, it is vital to enhance the fat, carbohydrate, protein, zinc, and vitamin C levels in the snack bars composed of this particular flour. As a result, sword bean (*Canavalia ensiformis*) flour has been selected to enhance the nutritional results for children under the age of five. The food bar is a suitable form of emergency sustenance for displaced individuals in times of crisis due to its capacity to be derived from many indigenous food sources, and its solid and condensed composition facilitates efficient distribution among the affected population.

The api-api mangrove is more energy-dense (371 kcal) than wheat flour (365 kcal) (Mulyatun, 2018), rice (360 kcal), and corn (307 kcal) (Fauziyana, 2021; Anandito et al., 2016). To increase the protein content of nutritional food bars for older people, *Canavalia ensiformis* (sword bean) flour has been selected. *Canavalia ensiformis* contains 27.4 grams of protein per 100 grams of flour (Anandito et al., 2016; Nursalma et al., 2021). The food bar is convenient to distribute to catastrophe victims because of its solid, compact size, and the fact that it can be manufactured with a wide variety of locally available ingredients (Elnovrizza et al., 2019; Pinto et al., 2019). Furthermore, it can be ingested directly, with minimal or no preparation et al., and has a high concentration of carbs and proteins. In addition, unlike cookies or pastries, food bars can withstand more pressure because they are only partially dry (Fauziyana, 2021). Food bars provide a vital advantage in emergencies, whether arising from natural disasters or war conditions. As an Emergency Food Product (EFP), they reduce morbidity and mortality rates among those affected by natural disasters or human incidents by adequately satisfying human nutritional needs for up to 15 days following the event's onset (Sheibani et al., 2018; Ferris et al., 1999; Sphere, 2000).

In contrast to its potential as a substitute for rice and wheat flour, api-api mangrove (*Avicennia marina*) has never been used to produce food bars, except lindur fruit (*Bruguiera gymnorhiza*). These two mangrove species share advantages in energy, carbohydrate, and protein content. However, the development of mangrove api-api food bars with subsequent efficacy studies on humans has not been conducted in Indonesia. Additionally, it is noteworthy that this substance is rich in carbs and proteins, making it suitable for immediate consumption without processing. Furthermore, it has been shown that food bars exhibit more excellent pressure resistance than biscuits or cookies due to their semi-wet consistency (Anandito et al., 2016). In 2020, a research investigation was undertaken to examine the composition and properties of food bars formulated using lindur fruit (*Bruguiera gymnorhiza*) flour, broccoli flour, and soybean flour. Thirty-three older people refugees impacted by a flood in Depok City ingested food bars for 15 days. According to the study conducted by (Fatmah et al., 2021), it was observed that the weight of older people saw a mean rise of 0.2 kg throughout the specified time frame.

The present research investigated using an environmentally friendly product (EFP) in the form of snack bars composed of a blend of api-api mangrove flour and sword bean. The selection of Api-api mangrove was based on limited research compared to the more extensively

researched Lindur mangrove. This particular mangrove species also has carbohydrate, but in a significantly less quantity (Rosulva, 2021). According to a study (Wibowo et al., 2009), the api-api mangrove has been shown to have 21.43% carbohydrate, 10.4% protein, 0.04% fat, and 22.24/mL of vitamin C in every 100 grams. In a 100 g serving of sword bean beans, the composition consists of 55 g of carbohydrates, 24 g of protein, and 3 g of fat, resulting in an energy yield of 332 kcal [15]. According to a study (Fauziyana, 2021), it has been shown that api-api mangrove flour has the potential to serve as a viable alternative to wheat flour in the production of biscuits. Nevertheless, the use of api-api mangrove flour as a primary ingredient in culinary items, such as biscuits and cookies, remains rare. According to the study referenced (The Indonesian MOH, 2018), children under five could meet their daily calorie requirements by ingesting food bars three times per day.

2. MATERIAL AND METHODS

The study used a non-randomized pre-post intervention design and focused on 34 children under five impacted by a landslide catastrophe (Sastroasmoro & Ismael, 2014). The intervention group comprised individuals residing in three distinct neighborhoods (Annur, 2012; Annur, 2012), whereas the control group consisted of individuals living in three separate areas (Nida, 2021; Ekafitri & Faradilla, 2011; Mariam, 2022). The researchers acquired ethical permission from the Ethics Commission for Health Research and Development (KEPPK) of the Sint Carolus, College of Health Sciences, Jakarta (No.089/KEPPKSTIKSC/VII/2022). In early August 2022, the research participants consisted of recruited moms with children under the age of five. Before completing the study, these mothers provided their informed consent by signing a written consent form. The signing ceremony was placed as part of the first activities of this study, with the presence of the integrated health post of under-five children (*posyandu*) cadres and the research team as witnesses. The research sample included children under five affected by the landslide incident in Cihanjuang Village, located in the Cimanggung Sub-district of Sumedang District, inside the West Java Province of Indonesia.

The compilation of individuals under the age of five who were affected by the landslide catastrophe has been sourced from the Village Chief of Cihanjuang. The inclusion criteria for children under the age of five included the following: being between 12 and 59 months old, being of any gender, residing in Cihanjuang Village of Sumedang District, being affected by the landslide disaster, having malnutrition, having normal nutrition, or overnutrition status, not having any infectious diseases, and expressing a willingness to refrain from consuming any snacks other than food bars and plain water. The minimal sample size was determined using the method for hypothesis testing of paired mean difference, as outlined in the reference (Ariawan, 1998). The abovementioned observation pertains to the increase in weight of 0.4 kg in children under five, with a corresponding standard deviation of 1.9 (Fatmah et al., 2021).

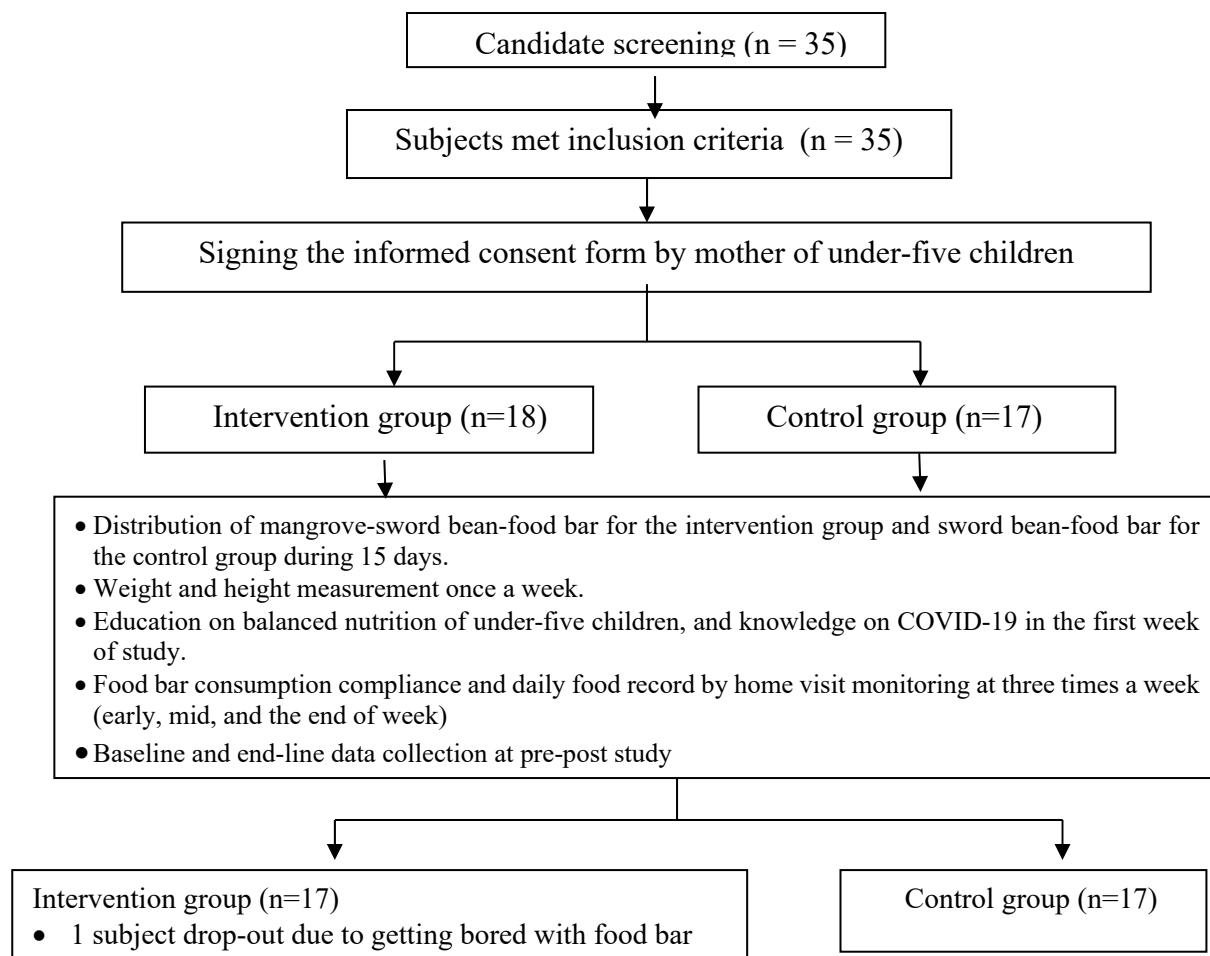


Figure 1. Research scheme source: *Author*, August 18, 2023

The present investigation used a two-sided significance threshold of 0.05. Therefore, to achieve a statistical power of 90%, a sample size of $n = 15$ was required. A total of 35 individuals, all under five, actively engaged in the research until its completion. At the commencement of the investigation, 35 individuals aged under five were included. These subjects were divided into two groups: an intervention group of 17 subjects and a control group of 17 subjects. Throughout the study, all youngsters in both groups participated until the study was completed. One participant was eliminated from the research due to their reported disinterest in food bars, leading to the cessation of consumption (Figure 1). The roster of individuals who perished in landslides. Namely, children under the age of five were acquired from the supervisor of the integrated health post for children under five, often referred to as *posyandu*. The anthropometric measurements were carried out at the *posyandu* sites to get the primary data on nutritional status. The potential participants were also invited to attend the dissemination event, which served as an introduction to the 15-day research. The intervention group's children under the age of five were provided with a snack bar made from mangrove-sword beans for 15 days. The calculation of this duration began on the day of evacuation, as stated by the United Nations High Commissioner for Refugees (UNHCR, UNICEF, WFP, WHO, 2022). Each participant in every group is expected to consume a snack bar weighing 50 grams at one meal time regularly for 15 days. Table 1 displays the nutritional composition of a

meal bar, revealing that each 50 g serving includes 234.2 kcal of energy, 24.7 g of carbs, 5.8 g of protein, and 12.5 g of fat.

Table 1. Nutrient content per 50 g of food bar

Type of food bar	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
Mangrove sword bean	234.2	24.7	5.8	12.5
Sword bean	230.4	26.5	3.9	12.1

Source: Saraswanti Laboratory Bogor, 2022

Enumerators interviewed all mothers of under-five children using the baseline questionnaire to obtain an overview of the socio-demographic characteristics of mothers of under-five children (age, marital status, highest formal education, occupation, and cohabitation status at home), as well as the characteristics of the under-five children (age and sex). In addition, the questionnaire assessed knowledge of balanced nutrition (healthy food menu; benefits of carbohydrates, proteins, vitamins, and minerals; definition of healthy food; definition of balanced nutrition; the need to measure weight; definition of stable or reduced weight with its causal factors and effects; and efforts to increase weight). Before, during, and after the study, anthropometric data collection was conducted. Using a digital scale and microtoise, respectively, the weight and height were measured. The research team has created a brochure and flipchart regarding balanced nutrition and landslide disaster mitigation. In the first week, mothers of infants under the age of five in the intervention group received nutritional education. The mothers of infants under the age of five were educated in Indonesian. After education was provided, after the study, endpoint data were collected to assess the extent of changes in balanced nutrition and macronutrient intake.

A hedonic test was conducted before the use of the mangrove-sword bean food bar as the experimental food product (EFP) for children under the age of five. The experiment aimed to ascertain the food bar choice among participants for blends, including *api-api* mangrove and sword beans. The research included a sample of twenty women with children under the age of five who were chosen from various locations. These mothers were designated as untrained panelists for the organoleptic test conducted at the study sites. When dealing with unskilled panelists, it is recommended to have a group size ranging from 10 to 20 individuals (Szabo). To mitigate potential bias, the inclusion criteria for study participants excluded any panelists with just partial training. The individuals acknowledged the significance of several sensory attributes of the food bar, such as its color, scent, taste, and texture, as factors that might potentially impact their inclination to adhere to and appreciate the food bar. The aroma, texture, color, and taste of the snack bar were evaluated using a four-point hedonic scale, with ratings ranging from 1 (strong hate), 2 (dislike), 3 (like), and 4 (strong like) (Lawless & Heymann, 2010).

The research included monitoring the individuals' food bar intake via three weekly home visits and measuring their anthropometric data once a week at the *posyandu*. During each

household visit, data about food intake, distribution of cookies, the quantity of cookies left, and the subsequent consumption of cookies were documented. Initially, a certain individual had difficulty comprehending the concept of cookies. Nevertheless, after the enumerators provided the mother with an explanation about the adverse effects that manifested as a means of early adaptation, her children continued to engage in the behavior. The degree of compliance with the consumption of food bars among children under the age of five was notably high. Trained enumerators gathered data on food intake records during house visits, which were scheduled three times a week, coinciding with the distribution of meal bars. The compliance of food bar intake was monitored by collecting anthropometric data from individuals throughout the first and second weeks of the study. Additionally, 24-hour meal recalls were recorded three days each week.

The food bar is composed of *api-api* mangrove flour, melted butter, chicken eggs, refined white sugar, a small quantity of wheat, and chocolate, strawberry, or orange pasta. The equipment used in the production of the food bar included a digital oven, mixer, aluminum brownie mold measuring 20 cm x 15 cm, digital scale, food bar dough cutting tool, and dough grinder. The procedure for creating food bars is as follows: Firstly, proceed to melt the butter and thereafter combine it with refined white sugar. The dough was mixed using a mixer for 5 minutes until it achieved homogeneity. Gradually incorporate the *api-api* mangrove flour into the mixture, followed by the addition of sword bean flour, egg yolks, and pasta. Gently agitate the dough with a large wooden spatula until it achieves a uniform and consistent texture. The dough should be poured into a brownie shape and thereafter cooked in a digital oven for 30 minutes, maintaining a temperature of 180°C.

Univariate analyses were conducted using SPSS version 22 software to determine the mean values of the food bar organoleptic test, as well as the socio-demographic factors, nutritional status, and awareness of balanced nutrition and landslide catastrophes among mothers of children under the age of five. The data on food intake over two weeks was examined using the Nutri Survey Program (Nutrition Survey and Calculation). The objective of the food consumption data analysis was to assess the variations in macronutrient intake (namely energy, carbohydrate, fat, and protein) before and after the research. The study used bivariate analysis, specifically using a statistical paired t-test, to evaluate the alterations in average weight, Weight for Age Z-score (WAZ), macronutrient consumption (energy, carbohydrate, protein, and fat), and comprehensive understanding of balanced nutrition among children under the age of five.

3. RESULTS

The research evaluated the preference for mangrove-sword bean food bars, considering four parameters: color, scent, taste, and texture. The study's results indicate that mothers with children under five expressed a greater preference for the mangrove-sword bean meal bar in terms of its color, scent, taste, and texture compared to the sword bean food bar (Table 2).

Table 2. Organoleptic test of mangrove-sword bean and sword-bean food bars by mothers of under-five children

Parameter	The mean value of food bar	
	Mangrove -sword bean food bar	Sword bean food bar
Color	3.10 ± 0.60 (like)	3.10 ± 0.60 (like)
Aroma	3.05 ± 0.45 (like)	2.15 ± 0.14 (dislike)
Taste	3.04 ± 0.32 (like)	2.20 ± 0.45 (dislike)
Texture	3.14 ± 0.23 (like)	2.10 ± 0.12 (dislike)

1=very dislike; 2=dislike; 3= likes; 4 = very like

The study examined the socio-demographic characteristics of children under the age of five. These characteristics were categorized into two groups: maternal factors, including marital status, age, level of education, employment status, and cohabitation status at home, and under-five children characteristics, including sex and age. These characteristics were analyzed separately for the intervention and control groups, as shown in Table 3. Most mothers in both categories with children under five were married and fell within the age range of 20 to 29. A significant proportion of moms with children under five have completed their education up to the junior high school level and are now unemployed. Most participants resided in nuclear family units characterized by a father, mother, and son/daughter cohabiting in the same household. More female participants were included in this research than their male counterparts. The average age of children under five in both groups was 36 months, with the intervention group having a somewhat lower average age than the control group.

Table 4 presents the anthropometric data, namely the WAZ-score of children under the age of five before and after the implementation of the intervention. Upon conclusion of the present study, it was observed that the intervention group had a marginally more significant increase in weight among children under the age of five compared to the control group. There was a statistically significant difference in the weight of children under the age of five between the first and final stages of the research ($p < 0.001$). Nevertheless, no significant difference was seen in the weight comparison between the groups ($p > 0.05$). The intervention group is expected to have a higher WAZ score due to the food bar supplementation intervention than the control group. There was a statistically significant difference in the mean change in WAZ scores between the intervention and control groups ($p=0.023$).

Table 5 presents the average disparity in macronutrient consumption, knowledge scores related to balanced nutrition for children under five, and the overall consumption of food bars. Upon completion of the trial, individuals in the intervention group exhibited a statistically significant increase in fat intake and widespread consumption of food bars. Effective results were seen regarding the knowledge of mothers of children under five on balanced nutrition for under-five children in both groups after the research.

Table 3. Socio-demographic characteristics of under-five children subjects

Variable		Control		Intervention		Total	
		n	%	n	%	n	%
Characteristic of family							
Marital status							
	Married	16	94.1	17	100.0	33	97.1
	Widow/widower	1	5.9	0	0.0	1	2.9
Age of mother (years old)							
	Mean $\pm$ SD	30.7 $\pm$ 6.8		30.6 $\pm$ 7.5		30.6 $\pm$ 7.0	
	20–29	8	47.1	9	52.9	17	50.0
	30–39	7	41.2	7	41.2	14	41.2
	40–50	2	11.8	1	5.9	3	8.8
Mothers' education							
	Graduated from junior high school or less	11	64.7	8	47.3	19	55.9
	Graduated from senior high school	5	29.4	8	47.1	13	38.2
	Academy/bachelor	1	5.9	1	5.9	2	5.9
Working status of the mother							
	No	11	64.7	11	64.7	22	64.7
	Yes	6	35.3	6	35.3	12	35.3
Living arrangement							
	Family (father, mother, children)	15	88.2	17	100.0	32	94.1
	Join with another family	2	11.8	0	0.0	2	5.9
Characteristics of under-five children							
Sex							
	Female	12	70.6	8	47.1	20	58.8
	Male	5	29.4	9	52.9	14	41.2
Age (month)							
	Mean $\pm$ SD	38.4 $\pm$ 12.1		33.9 $\pm$ 14.3		36.1 $\pm$ 13.2	

Table 4. The mean difference of weight and WAZ score of under-five children in pre-post

Indicator		Control		Intervention		Different	<i>p</i>
		Mean	SD	Mean	SD		
Weight (kg)							
	At pre/before	13.18	2.83	12.01	2.17	1.17	0.186
	At post/after	13.42	2.82	12.34	2.14	1.09	0.215
	Different	0.24	0.17	0.32	0.14	0.08	0.138
	95% CI of different	(0.13 – 0.33)		(0.25 – 0.39)			
	<i>p</i> *	**<0.001		**<0.001			
WAZ score (Weight for Age)							
	at pre/before	-0.68	1.27	- 0.32	1.04	-0.36	0.373
	at post/after	-0.88	1.19	-0.01	0.91	-0.87	**0.023
	Different	-0.19	0.82	0.31	0.73	0.51	0.067
	95% CI of different	(-0.18 – 0.57)		(-0.11 – 0.74)			
	<i>p</i> *	0.288		0.137			

#*p*: independent *t*-test

*p**: dependent *t*-test

***p* < 0.05 at significant level

CI : Confidence Interval

Table 5. The mean macronutrient intake of children and the balanced nutrition knowledge of mothers

Indicator	Control	Intervention	<i>p</i>
	Mean $\pm$ SD	Mean $\pm$ SD	
Energy (kcal)			
At 1 st week	1106.9 $\pm$ 253.2	977.3 $\pm$ 223.5	0.124
At 2 nd week	1156.5 $\pm$ 310.7	1106.9 $\pm$ 253.2	0.193
<i>p</i> *	0.293	0.338	
Carbohydrate (g)			
At 1 st week	149.9 $\pm$ 43.9	130.9 $\pm$ 34.4	0.171
At 2 nd week	162.5 $\pm$ 57.5	134.5 $\pm$ 32.7	0.093
<i>p</i> *	0.252	0.643	
Protein (g)			
At 1 st week	34.3 $\pm$ 9.9	30.1 $\pm$ 11.1	0.253
At 2 nd week	37.9 $\pm$ 15.1	32.0 $\pm$ 8.9	0.180
<i>p</i> *	0.187	0.496	
Fat (g)			
At 1 st week	39.9 $\pm$ 11.7	33.7 $\pm$ 10.6	0.107
At 2 nd week	45.7 $\pm$ 21.8	55.6 $\pm$ 9.4	**0.04
<i>p</i> *	0.601	0.111	
Total consumption of food bar (g)	588.2 $\pm$ 158.6	650.5 $\pm$ 100.9	**0.045
Balanced nutrition knowledge of mothers			
Pre-study	42.2 $\pm$ 6.9	43.5 $\pm$ 16.1	**< 0.001
Post-study	62.2 $\pm$ 13.3	65.7 $\pm$ 19.4	**< 0.001

#*p*: independent *t*-test

*p**: dependent *t*-test

***p* < 0.05 at significant level

4. DISCUSSIONS

The objective of nutrition management interventions during and post-disaster rebuilding and rehabilitation phases is to enhance and sustain the nutritional well-being of individuals affected by natural calamities (MOH, 2012). The management of dietary needs for children under five during and after a catastrophe has yet to be well addressed, and there is a lack of dedicated food resources for this age group. Furthermore, it should be noted that the current quantity and composition of food provisions allocated to individuals affected by disasters need to be revised and adequately address the nutritional requirements of children under five (Haniarti & Syarifuddin, 2020).

Children under the age of five are particularly susceptible to the adverse impacts of catastrophes. In such circumstances, an emergency food supply is crucial for addressing nutritional feasibility and fulfilling their dietary requirements. Implementing interventions that include providing nourishing food and teaching nutrition has been shown to have favorable outcomes in preventing malnutrition among children under the age of five after natural catastrophes while simultaneously enhancing food security. The enhancement and preservation

of the nutritional and health condition of individuals affected by a disaster can be achieved through the implementation of surveillance measures, such as anthropometric evaluation of children under the age of five, as well as nutrition awareness initiatives, which encompass nutrition education and the provision of food bars. These activities serve as a means to respond to the data gathered from public health service endeavors, ultimately leading to the amelioration of nutrition management in post-disaster scenarios (Darwis et al., 2018).

Following a natural calamity, there is a notable surge in the prevalence of undernourishment and stunted growth in children below the age of five, hence underscoring the imperative nature of nutrition and education interventions. The implementation of integrated nutritional treatments in conjunction with local health services, such as *posyandu* programs targeting children under the age of five, has the potential to provide optimal outcomes. The propensity of people and organizations to cultivate a local safety culture has the potential to enhance resilience in the aftermath of a catastrophe. Including food security in post-disaster recovery operations is crucial for preserving the nutritional and health well-being of vulnerable populations, particularly under-five children. The Sendai Framework has emphasized the reduction of catastrophe risk for the demographic of children under the age of five (Hafid et al., 2021).

The post-disaster recovery process is influenced by heightened active community engagement facilitated by adherence to emergency food consumption guidelines. The research observed a rise in the weight of children under five by 0.2 kg, aligning with the conclusions drawn from other studies examined by Pradhan et al. in 2016. Providing nutritional supplements to children under five after a catastrophe can enhance the healthy well-being of children suffering from undernutrition, stunted growth, and underweight (Pradhan et al., 2015). The practice of breastfeeding for up to two years among children under the age of five after the Palu earthquake has been shown to have a mitigating effect on the prevalence of stunting (Hafid et al., 2021). The present investigation reported an observed rise in weight and WAZ score within 15 days. However, no statistically significant disparities were established in the nutritional status of children under five, as determined by maternal socio-demographic factors, understanding of balanced nutrition, and macronutrient consumption, except for fat intake. The potential factors contributing to the observed outcomes include:

- The relatively brief duration of the intervention.
- The limited sample size was 18 children under five.
- The average nutritional status (WAZ) of the under-five children.
- The use of food bars as a snack.

The current research examined the impact of total consumption of food bars and fat intake on changes in weight and WAZ in children under five. This analysis was conducted by comparing the data obtained before and after the study. The daily intake of macronutrients for children under five after a catastrophe met 50% of the Recommended Daily Allowance (RDA). This was achieved by consuming 50 g of mangrove food bars, which provided 234.2 kcal of

energy, 24.7 g of carbohydrates, 12.5 g of fat, and 5.8 g of protein daily. The present research's findings oppose the results presented in a prior study, which indicated a reduction in the occurrence of underweight and stunted children under the age of five after a catastrophe (Balhara et al., 2017). Nutritional care for children under five after a disaster should include integrating nutrition interventions with public health promotion efforts, such as nutrition counseling campaigns or educational initiatives (Laili et al., 2022). There was a significant difference in the level of knowledge on balanced nutrition among mothers of children under five after the research. The results above align with three studies that have shown the positive impact of nutrition education on the nutritional condition of malnourished children who are thin, short, and under the age of five and also suffer from anemia (Puspasari & Andriani, 2017; Shalaby, 2016; Prasetyo et al., 2023).

Conversely, an insufficient mother's understanding of optimal nutrition impacts the feeding behaviors and endeavors to fulfill the nutritional needs of children under five (Widiyanto & Laia, 2021). The implementation of nutrition education is productive in enhancing the healthy understanding of individuals, particularly in the context of under-five children, which subsequently leads to improvements in their overall nutritional status. The current investigation is subject to some constraints. The study's limited sample size was derived only from a single sub-village, precluding generalizability to the broader Sumedang District. Furthermore, the relatively short two-week length could impact the ideal change in weight and WAZ. For future research, it is advisable to do a comparable study that assesses the height and weight-for-height z-score (WHZ) of children under the age of five, using a large sample size (e.g., 40 subjects) and an extended period (e.g., three months). Additionally, it is advised to include nutrition counseling as an intervention while employing a control group for comparative purposes.

The study had some limitations. First, the 15-day study duration resulted in slight increases in weight and changes in WAZ. Second, the small sample size might affect the weight gain and WAZ changes are not as large as they would be for a large sample size. Third, removing tannin and HCN content from the food bar impacted its astringent and slightly bitter aftertaste. The participant's acceptance of food bars for the next 15 days is affected by dizziness and difficulty defecating experienced within the first three days of consumption. Additionally, the diverse nutritional status of the participants (normal, overweight, and obese) led to a suboptimal increase in mean weight and WAZ, as they were not initially grouped according to nutritional status before the study.

5. CONCLUSIONS

The present research does not provide a statistically significant elevation in the WAZ score. However, it reveals a statistically significant disparity in the weight of children under five after consuming the *api-api* mangrove and sword bean meal bar. Therefore, this meal bar remains a viable option for emergency sustenance in both immediate and post-disaster scenarios, owing to its nutritional composition and physical characteristics. Nourishment education plays a

crucial role in the supply of nourishment to displaced individuals affected by disasters, with particular emphasis on vulnerable populations, including children under the age of five. Additional investigation using a larger cohort and an extended duration is imperative to generate substantiated findings about the effects of emergency sustenance, such as meal bars, on the nutritional well-being of displaced individuals in the aftermath of catastrophic events. This is particularly crucial when considering the susceptibility of some populations, such as the elderly and expectant mothers. These subsequent investigations must include diverse nutritional statuses, including underweight, stunted under-five youngsters, and underweight older people.

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