



Local Snacks and Virtual Nutrition Counseling Services Increasing Growth of Stunting Children

Nadimin Nadimin^{1*}, K. B. Theresia Dewi¹, Abdul Salam², Adriyani Adam¹

¹Department of Nutrition, Health Polytechnic of Makassar, South Sulawesi, Indonesia; ²Nutrition Science Study Program, Faculty of Public Health, Hasanuddin University, Indonesia

Abstract

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*Correspondence: Nadimin, Department of Nutrition, Health Polytechnic of Makassar, South Sulawesi, Indonesia. Email: nadiminzizi66@gmail.com

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BACKGROUND: The conducive factor of stunting is the deficiency in nutrient intake due to the lack of quantity and quality of food consumed by the children. Children's food consumption is strongly influenced by the mother's nutritional knowledge and children's feeding practices.

AIM: The aims of this study were to determine the effect of providing local snacks in South Sulawesi with a substitute of snakehead fish flour (Tibus) and virtual nutrition counseling on the growth of stunting children.

METHODS: The design of this study used a randomized pretest-posttest control design. The sample was divided in two groups using systematic random sampling. The first group was given local Tibus snacks and nutritional counseling virtually and the second group was only given virtual nutrition counseling. The intervention was carried out every day until 1 month. The sample of this research was mothers who have stunting children under five of age.

RESULTS: Nutrition knowledge of mothers in group one increased significantly before and after intervention (63.78 ± 1.68 vs. 73.70 ± 1.35 points), but this was not the case in group two. The increase in maternal nutritional knowledge was higher in group one than in group two, although it was not significant ($p = 0.91$). The comparison of the weight gain of children in group one versus group two was 0.37 ± 0.49 kg versus 0.07 ± 0.39 kg ($p = 0.021$). The increase in the height of the children in group one before and after was 84.15 ± 7.79 cm versus 85.97 ± 7.95 cm ($p = 0.000$). The ratio of the increase in the height of the children in group one and group two was 1.82 ± 0.94 cm versus 1.53 ± 0.68 cm ($p = 0.402$).

CONCLUSIONS: Nutrition counseling virtual can increase nutrition knowledge. The providing of local snacks (Tibus) accompanied by virtual nutrition counseling can increase growth in body length and weight of stunting children. The efforts to accelerate prevention stunting in children under five can be done with utilization of local snacks.

Background

The results of Basic Health Research (Riskesdas) on 2018 show that the prevalence of children under five suffering malnutrition in South Sulawesi is still high compared the national figure and WHO target. The number of toddlers who are underweight is 23%, wasting 10%, and stunting 35.6% [1]. Even though it has decreased compared to Riskesdas in 2013, the prevalence is still higher than the national figure (30.8%) [2] and placing this province in 6th position at the national stage.

Stunting problem among children under five in developing countries is caused by two primary aspects, namely consumption deficiency of zinc (Zn) food sources and the presence of infectious diseases [3]. Based on the results of the study on micronutrient in Indonesia in 2007, it shows that the Zn consumption of children under five is still very miserable, which is below 30% Recommended Dietary Allowance (RDA) [4]. The low intake of micronutrients, particularly Zn, contributes to the high prevalence of stunting [5].

Children with a deficiency of Zn intake have a risk of stunting by 9.94 times compared to children with normal intake [6]. The efforts to increase the nutritional intake of children under five can be carried out by providing supplementary food (Parent Management Training [PMT]) and delivering education to parents. Several studies have shown that PMT intervention in the form of snacks substituted for fish can improve nutritional status in children under five. Rizki (2015) reports that PMT in the form of biscuits and Tempe flour cake for 30 days can increase body weight and height of children under five [7]. Children under five with undernutrition and severe malnutrition who consumed catfish biscuits for 88 days experienced an increase in their nutritional status to good nutrition as much as 47% [8]. PMT from local snacks enriched with nutrients with shellfish flour has been shown to increase the Z-score of height according to the age of stunting children under five [9].

Previously, complementary food as local snacks from South Sulawesi has been formulated which has been substituted for snakehead fish flour. The result of the study showed that fish flour substitution in biscuits could increase protein of biscuits [10]. The local

snacks that are enriched with snakehead fish flour also contain high enough nutrients. Each portion of local snacks contains an average of 165 kcal of energy, 4 g of protein, 9.1 mg of iron, and 4.4 mg of Zn [11] and has a relatively good acceptability value [12].

Intervention by providing complementary food in the form of snack sometimes ineffective in increasing the nutritional status of objects, because nutritional status depend on many factors and one of that factors is intake [13]. The complementary food in the form of snacks and supplements only serves to increase the intake of nutrients from the main meal every day. Children under five who are stunting generally have parents with a level of education and knowledge of nutrition and health is still low [3]. For that reason, the efforts to improve the nutritional status of stunting children require an educational approach to increase nutritional knowledge and changing unhealthy behavior. Nutritional counseling is one of the methods of nutrition education that useful in increasing nutritional knowledge, attitudes, and practices of mothers in feeding and nutritional intake children [14]. Nutritional counseling is conducted through direct (face to face) between counselor and client so that both parties have to provide special time. Communication between people in the current era of information technology does not have to be face to face.

The accessibility of communication tools, such as mobile phones (Hewlett Packard) and android, is an important resource to strengthen family nutrition knowledge. Practically every family in urban areas has a cell phone or android, so it needs to be utilized as a medium for conducting nutritional counseling between employees and clients. Virtual nutrition counseling is regarded to be more efficient, where employees do not ask to come to visit targets/clients, mothers of toddlers do not need to visit employees. Employees as counselors and mothers of children under five as clients/targets can provide counseling without being restricted by space and time. Based on these problems, the research has been carried out to determine the effectiveness of providing local snacks as a substitute of snakehead fish flour and nutrition counseling virtually on the growth of stunting children under five.

Methods

Research design

This study used a randomized pretest-posttest controlled trial design (filtering) of families with stunting children under five using anthropometric methods, in particular, index of height according to age (HAZ-2 SD). Samples of children under five who fulfill the criteria were carried out with the initial measurement (pretest) of height, weight, nutritional intake, and nutritional

knowledge. The samples are separated into two groups using a simple random method. The first group perceived the intervention of local snacks to substitute snakehead fish flour (PMT-Tibus) and virtual nutrition counseling. The second group was given local snacks only (without nutritional counseling). Giving PMT-Tibus to children under five and Virtual Nutrition Counseling to mothers of children under five are carried out every day for 1 month. At the end of the intervention, nutritional knowledge, weight, and height were measured again. Counseling done by virtually using WhatsApp (WA) application. The subject of this study are joined in whatsapp group that have been arranged by researchers. From this WA group, researchers give nutritional counseling topics such as nutrition and child care issues, especially regarding child feeding. All respondents (mothers of children under five) who were objected for nutritional counseling were invited to the WA group that was formed previously. The counselor is a nutritionist with a bachelor degree in nutrition, with the responsibility of providing nutritional counseling every day in the 1st and 2nd weeks and 3 times a week in the 3rd and 4th weeks. In addition to providing nutritional counseling, nutritional information and child feeding are also carried out through the WA group.

Sampling technique

The sample of this study was mothers who had children under five who were stunted with the following criteria: Age of the children under 5 years 12–59 months, not suffering from severe malnutrition (marasmus, kwashiorkor, or both), not suffering from acute or chronic infectious diseases, mothers of children under five have a cell phone/android and during intervention, objected was in the location of research. The sample size was calculated using formula [15] into standard deviation (SD) of 0.5 cm height and 0.49 cm range of height between intervention and control [16]. Based on the estimation, the total sample size was 22 people per group. We assume into account the dropout and other factors around 10%; the minimum sample size for each group is 25 people.

Data collection methods

The data collected included data on nutrition knowledge, nutrition intake, and growth. Nutrition knowledge of mothers was collected through interviews using a questionnaire containing child nutrition care. Consumption was measured using a 24 h (1 day) recall. Growth assessment is carried out through anthropometric indicators, height, and body weight. Bodyweight was measured using a digital weighing scale with a scale of 0.1 kg. Measurement of height using microtoice. The correct way to stand and the measuring instrument that fits the body frame are some things that need to be considered in measuring height. Children who can stand upright are generally measured

using a Microtoise (stature meter). Age of the child is determined based on the date of birth which is asked from parents or recorded from the Family Card.

Processing and data analysis

The data that have been collected were entered into a processing application program for statistical analysis. Data analysis with univariate and bivariate. Univariate such as sex, age and nutritional intake. Bivariate such as maternal nutritional knowledge and body weight and height changes. Univariate analysis was carried out by assessing mean and SD of the variables of nutrition knowledge, nutrient intake, body weight, and height/length. Bivariate analysis was used to assess changes in nutrition knowledge of mothers and growth of children under five between before and after intervention in two groups. These changes were assessed based on the difference of mean each variable between before and after the intervention using the "paired two-sample t-test." To measure the differences in changes variables between treatment groups was use "two-sample free t-test."

Ethical clearance

This research based on ethical recommendation approval from Health Research Ethics Committee (KEPK) Makassar Health Polytechnic, Number: 1126/KEPK-PTKMKS /X/ 2019.

Results

Characteristic children

Table 1 shows that the sample distribution according to sex did not differ between two groups. Furthermore, the distribution according to age shows that no significant difference between groups.

Table 2: Nutritional intake of children under five before intervention

| Nutrient | Group-1 (n = 25) | Group-2 (n = 23) | Sig. |
|-----------------|------------------|------------------|-------|
| Energy (kcal) | 780 ± 3.64 | 694 ± 3.39 | 0.385 |
| Protein (g) | 25 ± 1.08 | 25 ± 1.05 | 0.829 |
| Vitamin A (SI) | 825 ± 9.21 | 723 ± 5.86 | 0.561 |
| Vitamin E (mg) | 2.56 ± 1.69 | 2.70 ± 1.73 | 0.764 |
| Vitamin B1 (mg) | 0.23 ± 0.13 | 0.23 ± 0.15 | 0.857 |
| Vitamin B2 (mg) | 0.51 ± 0.30 | 0.51 ± 0.31 | 0.982 |
| Vitamin B6 (mg) | 0.43 ± 0.23 | 0.39 ± 0.22 | 0.504 |
| Vitamin C (mg) | 0.13 ± 21.22 | 15.28 ± 22.70 | 0.680 |
| Calcium (mg) | 229 ± 245 | 222 ± 299 | 0.930 |
| Magnesium (mg) | 91 ± 45 | 79 ± 38 | 0.397 |
| Phosphor (mg) | 389 ± 193 | 335 ± 185 | 0.785 |
| Iron (mg) | 3.39 ± 2.25 | 3.02 ± 2.38 | 0.694 |
| Zinc (mg) | 2.73 ± 1.30 | 2.78 ± 1.55 | 0.895 |

Table 1: Sample distribution of sex dan age

| Variable | Group-1 | | Group-2 | | Sig. |
|--------------|---------|------|---------|------|-------|
| | n | % | n | % | |
| Sex | | | | | |
| Boy | 12 | 48.0 | 13 | 56.5 | 0.382 |
| Girl | 13 | 52.0 | 10 | 43.5 | |
| Age | | | | | |
| 12–23 Months | 6 | 24.0 | 12 | 52.2 | 0.541 |
| 24–35 Months | 8 | 32.0 | 5 | 21.7 | |
| 36–47 Months | 9 | 36.0 | 4 | 17.4 | |
| 48–59 months | 2 | 8.0 | 2 | 8.7 | |

Nutritional intake

Statistical analysis of nutrient intake for each group (Table 2) shows the p-value of each type of nutrient > 0.05. This means that there is no difference with nutritional intake of children under five before the intervention looks quite the same between groups, both energy and protein intake. Furthermore, with the intake of vitamins and minerals, there is no difference between the intakes of these nutrients.

Maternal nutritional knowledge

The results of statistical analysis in Table 3 indicate that there was an increase in the score of nutrition knowledge of mothers between before and after the intervention in group one ($p = 0.010$). The same thing did not arise in group two, there was no difference in nutrition knowledge of mothers before and after the intervention ($p = 0.729$).

Table 3: Maternal nutritional knowledge score

| Group | Before | After | Sig* | Δ_{1-2} | sig** |
|----------------|--------------|--------------|-------|----------------|-------|
| Group-1 (n=25) | 63.78 ± 1.68 | 73.70 ± 1.35 | 0.010 | 9.92 ± 17.63 | 0.091 |
| Group-2 (n=23) | 61.85 ± 1.65 | 62.88 ± 1.00 | 0.729 | 1.03 ± 19.11 | |

Δ_{1-2} =Difference in knowledge before and after the intervention; *Paired t-test; ** Independent t-test.

Child growth

The results of statistical analysis showed that there was a significant increase in weight of children under five between before and after the intervention in group one ($p=0.001$). The height of children under five in both groups experienced a significant increase between before and after the intervention, both in group one ($p=0.000$) and group two ($p = 0.005$). The weight gain of children under five was higher in group one than in group two ($p = 0.021$). However, there was no significant difference between the two groups ($p=0.402$).

Table 4: Average changes in body weight and height of children under five during the intervention

| Variable | Group | Before | After | Sig* | Δ_{1-2} | sig** |
|-------------|----------------|--------------|--------------|-------|----------------|-------|
| Weight (kg) | Group-1 (n=25) | 10.49 ± 2.07 | 10.86 ± 1.96 | 0.001 | 0.37 ± 0.49 | 0.021 |
| | Group-2 (n=23) | 10.42 ± 1.53 | 10.55 ± 1.32 | 0.392 | 0.07 ± 0.39 | |
| Height (cm) | Group-1 (n=25) | 84.15 ± 7.79 | 85.97 ± 7.95 | 0.000 | 1.82 ± 0.94 | 0.402 |
| | Group-2 (n=23) | 83.38 ± 8.14 | 85.16 ± 7.45 | 0.005 | 1.53 ± 0.68 | |

Δ_{1-2} =Difference in weight/height before and after the intervention; *Paired t-test; ** Independent t-test.

Weight gain was higher in 1 year and 4 year age groups. The results of statistical analysis showed that no difference in weight gain between the intervention groups according to age groups. Changes in height

Table 5: Average changes in body weight and height of children under five according to age

| Age | Group | Body weight change (kg) | | Height change (cm) | |
|-------------|------------------|-------------------------|---------|---------------------|---------|
| | | Δ_{1-2}^* | Nilai p | Δ_{1-2}^{**} | Nilai p |
| 12–23 Month | Group-1 (n = 6) | 0.52 ± 0.35 | 0.350 | 1.58 ± 0.47 | 0.000 |
| | Group-2 (n = 12) | 0.31 ± 0.46 | | 0.68 ± 0.37 | |
| 24–35 Month | Group-1 (n = 8) | 0.35 ± 0.25 | 0.429 | 1.13 ± 0.38 | 0.005 |
| | Group-2 (n = 5) | 0.14 ± 0.66 | | 0.42 ± 0.30 | |
| 36–47 Month | Group-1 (n = 9) | 0.48 ± 0.45 | 0.325 | 0.96 ± 0.36 | 0.105 |
| | Group-2 (n = 4) | 0.05 ± 0.79 | | 0.57 ± 0.35 | |
| 48–59 Month | Group-1 (n = 2) | 0.50 ± 1.13 | 0.316 | 0.95 ± 0.07 | 0.089 |
| | Group-2 (n = 2) | 1.00 ± 1.13 | | 0.60 ± 0.14 | |

Δ_{1-2}^* : Body weight change before and after intervention; Δ_{1-2}^{**} : Body weight change before and after intervention.

were higher 1 year and 2 year age groups. The analysis showed that the change in body weight of children in group-1 was significantly higher in 1 year age group ($p = 0.000$) and 2 year age group ($p = 0.005$).

Table 5 shows that there are no different changes in children's body weight according to the level of child malnutrition before the intervention ($p = 0.705$). The height gain of the children did not differ between the short and very short groups ($p = 0.053$)

Table 6: Average changes in body weight and height of children under five according to the level of malnutrition

| Group | Stunting category | Body weight change | | Height change | |
|---------|-----------------------|--------------------|---------|---------------------|---------|
| | | Δ_{1-2}^* | Nilai p | Δ_{1-2}^{**} | Nilai p |
| Group-1 | Stunted (n=23) | 0.36 ± 0.11 | 0.700 | 1.18 ± 0.45 | 0.399 |
| | Severe Stunted (n=2) | 0.50 ± 0.10 | | 0.90 ± 0.46 | |
| Group-2 | Stunted (n=14) | 0.33 ± 0.18 | 0.701 | 0.61 ± 0.10 | 0.903 |
| | Severe Stunted (n=9) | 0.14 ± 0.66 | | 0.59 ± 0.09 | |
| Total | Stunted (n=37) | 0.35 ± 0.09 | 0.705 | 0.96 ± 0.08 | 0.053 |
| | Severe Stunted (n=11) | 0.27 ± 0.51 | | 0.64 ± 0.09 | |

Δ_{1-2}^* : Body weight change before and after intervention; Δ_{1-2}^{**} : Body weight change before and after intervention.

Discussion

The effect of virtual nutrition counseling on increasing maternal nutritional knowledge

Nutrition knowledge of mothers is increased, both in the group that perceived the nutrition counseling intervention and the group without nutrition counseling. The increase nutrition knowledge of mothers in group one who perceived Virtual Nutrition Counseling was more significant than group two who did not receive Virtual Nutrition Counseling. Submission of messages in the form of writing and images delivered through the WA application gets feedback and is realized by the object. This means that nutrition education in the form of nutritional counseling using the WA application can increase nutrition knowledge of mothers. Nutrition counseling is a personal approach to improve nutrition knowledge that can be used to help individuals acquire a better agreement of the nutritional problems faced and motivate them towards better behavior change, including about child feeding practices [17], [18]. The results of this study can match the role of social media in increasing nutritional knowledge and energy intake

of adolescents with chronic energy shortages (KEK) [19]. The knowledge of mothers who perceived nutrition education through the WA application has increased even though they have not been able to match the knowledge of mothers who are given direct nutrition education [20]. The usage of social media as a method for nutrition education has not been able to replace the direct nutritional counseling method, but the Virtual Nutrition Counseling method can help increase knowledge of nutrition, especially for targets and employees who have a busy life. The usage of social media in transmitting messages about nutrition and health is not bound by time and place, can be done anytime and anywhere.

Effects of providing local snacks accompanied by virtual nutrition counseling on growth of stunting children under five

In this study, children under five with stunting have substance intake nutrition is still miserable, although some of them come from families with quite good socioeconomic levels. As we know that the causes of stunting are influenced by direct and indirect factors. Direct factors such as infection diseases and intake. Additional nutritional intake through the providing of local Tibus snacks accompanied by support for increased knowledge of maternal nutrition through nutritional counseling can virtually increase the growth in body weight and height of stunting children under five. The combination of these two types of intervention offers better results than if the intervention is done partially. According to Table 4, changes in body weight and height for each intervention group were more rendered during the intervention. The weight gain of children during the intervention in each group was <500 g, lower than the normal weight gain of children aged 1–5 years. Low child weight gain is a result of stunting itself [21]. In addition, the lack of nutritional intake for children, especially energy-producing nutrients, is the cause of the low growth rate of children's body weight [22]. The addition of nutrients from local snacks has not been able to fulfill the increasing energy requirement of children; therefore, the children's weight growth rate is still low. The contribution of Tibus complementary food to fulfill of energy sufficiency is only 14% of the RDA for children (aged 1–3 years) and 10% (4–6 years). The contribution to protein adequacy according to age reached 13.34% and 10% of the RDA. The contribution of energy and protein snacks in this study is in line with Hapsari (2013) that the energy contribution of snack foods can only fulfill the energy needs of 13.2% and protein 3.21% [23]. Tibus local snack intervention in this study can increase the linear growth of children. The average height increase of children in the intervention group who perceived Tibus local snack and nutritional counseling was 1.82 cm and in the group who perceived additional food only was 1.53 cm. These findings strengthen the results of previous

studies that utilize of fish-processed ingredients and products can overcome the problem of height growth disorders in stunting children [9]. The Snakehead fish flour has a high potential for micronutrients, particularly Zn, calcium, phosphorus, and iron, which are very important to support children's height growth [24]. The potential content of these micronutrients is what makes us better in this study. Tibus local snack that we formed in previous research was subjected to formulation and redevelopment. The concentration of Tibus that can be substituted into snacks in the previous study only reached 5%, but in our study, we were able to add up to 15% without reducing acceptability. As a result, the Tibus supplementary food contains high levels of micronutrients that can support children's linear growth. The average content of important micronutrients in this Tibus snack calcium 578 mg, passport 670 mg, iron 17.21 mg, and Zn 12.6 mg. Calcium content of Tibus additives can fulfill the requirement of children aged 1–3 years, and the Zn content is up to 3 times the RDA of children aged 1–3 years and 2 times the RDA of children aged 4–6 years.

Children who perceived Tibus local snacks illustrated height during the intervention. This result is in line with several previous findings such as the providing of local snacks enriched with shellfish flour [9]. The high levels of micronutrients contained in this Tibus supplement are believed to be a trigger for children's growth. Micronutrients, especially Zn, have a very important part in children's growth. Zn supplementation can increase serum Zn levels, weight growth, and linear increase in premature infants, especially early in life [25]. The providing of Zn-enriched food has been shown to increase linear growth, thereby reducing the number of children under five who have growth disorders [26], [27].

Zn is required for metabolism in bone, interacts with important hormones involved in bone growth such as somatomedin, osteocalcin, testosterone, thyroid, and insulin [25]. Low growth hormone formation causes disruption of linear growth, in particular inhibition of increasing length/height [28]. Zn is also an important factor for the establishment of a number of nutrients that hold a role in metabolism and energy synthesis. Zn is known to act as an important function in biological processes, including cell growth, differentiation, and metabolism and deficiency of these micronutrients limits child growth and decreases resistance to infection, therefore increasing child morbidity and mortality [29].

The weight and height gain of the children as a result of this intervention was higher than normal children. The average weight gain of normal children aged 12–60 months for boys is 0.18 kg/month and for girls is 0.19 kg/month. The mean height increase for boys was 0.67 cm/month and for girls 0.49 cm/month (30). That is, the growth in body weight and height in this study exceeds the growth rate of normal children, both in boys and girls. The increase in child growth, especially

in the indicator of height, was higher in children aged 1–3 years and was more significant in the group that received Tibus intervention and nutritional counseling. The providing of additional food can be maximized to fulfill the needs of the body, especially for children who are malnourished. However, in this study, we did not find an effect of previous levels of malnutrition on the outcome of the intervention. Changes in body weight and height in children who were stunted and severe stunted did not differ significantly.

Conclusions

Virtual Nutrition Counseling can increase the nutrition knowledge of mothers children about child feeding. Combining complementary of Tibus local snacks and virtual nutrition counseling can increase the weight and height of stunting children under five of age

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References

1. Kementerian Kesehatan Republik Indonesia. 2018 Indonesian National Basic Health Survey. Jakarta: Kementerian Kesehatan Republik Indonesia; 2019. <https://doi.org/10.21109/kesmas.v9i3.568>
2. Kementerian Kesehatan Republik Indonesia. 2013 Indonesian National Basic Health Survey. Jakarta: Kementerian Kesehatan Republik Indonesia; 2013. <https://doi.org/10.21109/kesmas.v9i3.568>
3. Hanifah L, Wulansari R, Meiandayati R, Laksminingsih E. Stunting trends and associated factors among Indonesian children aged 0-23 months: Evidence from Indonesian Family Life Surveys (IFLS) 2000, 2007 and 2014. *Malays J Nutr.* 2018;24(3):315-22.
4. Herman S. Review on the problem of zinc deficiency, program prevention and its prospect. *Media Health Res Dev.* 2009;14(Suppl 2):575-83.
5. Ayana G, Moges T, Samuel A, Asefa T, Eshetu S, Kebede A. Dietary zinc intake and its determinants among Ethiopian children 6-35 months of age. *BMC Nutr.* 2018;4:30. <https://doi.org/10.1186/s40795-018-0237-8>

- PMid:32153891
6. Dewi C, Adhi T. Effect of protein and zinc consumption and history of infectious disease of stunting children among 24 – 59 months in Nusa Dua Health Cennter Penida III. Arch Community Health. 2016;3(1):36-46. <https://doi.org/10.36457/gizindo.v37i2.161>
 7. Rizky O, Wirjatmadi B, Adriani M. Effect of giving additional food for tempe flour and biscuits on increase body weight and height in malnourished toddlers in 2015. Medicine Journal. 2015;4(1):16-24. <https://doi.org/10.36456/embrio.vol.9.no1.a722>
 8. Kusharto CM, Marliyati A. Biscuit formulation with catfish dumbo (*Clarias gariepinus*) flour and soy (*Glycine max*) protein isolates as a potential food for undernourished young children. Journal of food technology. 2012;23(1):9-16.
 9. Nadimin, Nurjaya, Sahariah SR. The effect of local snacks enriched with shell flour on the nutritional status of stunting children. Dama Int J Res. 2017;2(7):5762.
 10. Aini Q. Biscuit Formulation with Blondo and Snakehead Fish (*Channa striata*) Flour Substitution as an Alternative to Solved Undernourished Problem in Children Under Five. Bogor: Institut Pertanian Bogor; 2014.
 11. Saeed F, Hussain M, Arshad MS, Afzaal M, Munir H, Imran M, Tufail T, Anjum FM. Functional and nutraceutical properties of maize bran cell wall non-starch polysaccharides. International Journal of Food Properties. 2021; 24(1):233-48.
 12. Nadimin N, Lestari RS. Acceptability of South Sulawesi's local snacks substituted with snakehead fish (*Channa striata*). J Aceh Nutr. 2018;3(2):141-8.
 13. Candra AA, Setiawan B, Rizal M. The effect of snack feeding, nutrition education, and iron supplementation to nutritional status, nutrition knowledge, and anemia status in elementary school students. J Gizi Pangan. 2013;8(2):103-8.
 14. Hestuningtyas TR. The influence of nutrition counseling to mother's knowledge, attitude, practice in children feeding and nutrient intake of stunted children among 1-2 years in east Semarang district. J Nutr Coll. 2014;3(1):17-25.
 15. Sastroasmoro S, Ismael S. Dasar-Dasar Metodologi Penelitian Klinis. 5th ed. Jakarta: Sagung Seto; 2014.
 16. Imdad A, Yakoob MY, Bhutta ZA. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. BMC Public Health. 2011;11(Suppl 3):S25. <https://doi.org/10.1186/1471-2458-11-s3-s25>
PMid:21501443
 17. Snetselaar LG. Nutrition Counseling Skill for the Nutrition Care Process. 4th ed. USA: Jones and Bartlett Publishers; 2009. p. 3-4.
 18. PERSAGI. Penuntun Konseling Gizi. Jakarta: PT, Abadi; 2011. p. 25-47.
 19. Ibnu Zaki HP. Social media-based nutrition education improves knowledge and energy - protein intakes of adolescent girl with chronic energy deficiency (CED). Gizi Indones. 2019;42(2):111-22.
 20. Nadimin, Sirajuddin, Amir A, Rahmah S,. The effect of virtual nutrition education for the improvement of mother's knowledge about complementary feeding: Randomized control trial. Sys Rev Pharm. 2020;11(9):825-9.
 21. De Onis M, Branca F. Childhood stunting: A global perspective. Matern Child Nutr. 2016;12(Suppl 1):12-26. <https://doi.org/10.1111/mcn.12231>
PMid:27187907
 22. Saarilehto S, Lapinleimu H, Keskinen S, Helenius H, Talvia S, Simell O. Growth, energy intake, and meal pattern in five-year-old children considered as poor eaters. J Pediatr. 2004;144(3):363-7. <https://doi.org/10.1016/j.jpeds.2003.12.028>
PMid:15001944
 23. Hapsari LN. Kontribusi Makanan Jajanan Terhadap Tingkat Kecukupan Asupan Energi dan Protein pada Anak Sekolah Yang Mendapat PMT-AS di SD Negeri Plalan 1 Kota Surakarta. Surakarta: Universitas Muhammadiyah Surakarta; 2013. <https://doi.org/10.47718/gizi.v11i01.754>
 24. Nadimin, Retno Sri L. Improving the nutritional value of micro local breast through substitution of fish flours cabled for prevention of stunting in Sulawesi Selatan. Media Kesehatan Polit Kesehatan Makassar. 2019;14(2):152-7. <https://doi.org/10.32382/medkes.v14i2.1021>
 25. Díaz-Gómez NM, Doménech E, Barroso F, Castells S, Cortabarría C, Jiménez A. The effect of zinc supplementation on linear growth, body composition, and growth factors in preterm infants. Pediatrics. 2003;111(5 Pt 1):1002-9. <https://doi.org/10.1542/peds.111.5.1002>
PMid:12728080
 26. Syam A, Burhan FK, Hadju V, Citrakesumasari C, Akhmar AM. The effect of biscuits made from pumpkin seeds flour on serum zinc levels and weight in malnutrition wistar rats. Open Access Maced J Med Sci. 2020;8(A):428-33. <https://doi.org/10.3889/oamjms.2020.4402>
 27. Christian P, Shaikh S, Shamim AA, Mehra S, Wu L, Mitra M. Effect of fortified complementary food supplementation on child growth in rural Bangladesh: A cluster-randomized trial. Int J Epidemiol. 2015;44(6):1862-76. <https://doi.org/10.1093/ije/dyv155>
PMid:26275453
 28. Ayuk J, Sheppard MC. Growth hormone and its disorders. Postgr Med J. 2006;82(963):24-30.
PMid:16397076
 29. Brown KH, Peerson JM, Baker SK, Hess SY. Preventive zinc supplementation among infants, preschoolers, and older prepubertal childre. Food Nutr Bull. 2009;30(1):12-36. <https://doi.org/10.1177/15648265090301s103>
PMid:19472600
 30. Kementerian Kesehatan Republik Indonesia. Standar Antropometri Anak. Jakarta: Kementerian Kesehatan Republik Indonesia; 2020. p. 16-74. <https://doi.org/10.31002/rep.v5i1.2050>