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Nutrimenu: nutrition education program to increase knowledge, attitude, and practices on the Indonesian balanced nutrition

Dodik Briawan[1], Elma Alfiah[2*], Pramita Ariawati Putri[3]

[1]Department of Nutrition, IPB University, Kampus IPB, Jalan Raya Dramaga, Babakan, Kec. Dramaga, Kabupaten Bogor, Jawa Barat 16680, Indonesia
[2]Nutrition Study Program, Faculty of Science and Technology, Universitas Al-Azhar Indonesia, Jalan Sisingamangaraja, Kebayoran Baru, Jakarta Selatan 12110, Indonesia
[3]Nutrition Study Program, Faculty of Health Science, Universitas Ibn Khaldun Bogor, Jalan K. H. Sholeh Iskandar Km. 2 Kedung Badak Tanah Sareal, Bogor, Indonesia

**Corresponding author*: elma.alfiah@uai.ac.id

ABSTRAK

Latar Belakang: *Saat ini, Indonesia masih menghadapi permasalahan stunting yang cukup tinggi dibandingkan dengan negara lain, termasuk di Asia Tenggara. Oleh karena itu, pemerintah melakukan program percepatan penurunan stunting melalui program spesifik dan sensitif yang melibatkan banyak sektor. Berbagai strategi disusun dengan sasaran prioritas pada kelompok ibu hamil dan anak usia 0-2 tahun dalam gerakan 1.000 HPK (Hari Pertama Kehidupan). Salah satu penyebab langsung stunting adalah rendahnya kualitas konsumsi makanan, yang dimulai sejak ibu hamil sampai anak usia dua tahun.*
Tujuan: *Penelitian ini secara umum bertujuan untuk menganalisis efektivitas program Nutrimenu terhadap pengetahuan, sikap, dan praktik ibu-ibu.*
Metode: *Desain penelitian ini adalah pre-post intervention study yang secara khusus menganalisis perubahan pengetahuan, sikap, praktik sebelum dan setelah program Nutrimenu. Program tersebut berupa edukasi gizi yang diberikan kepada ibu-ibu yang mempunyai anak batita/balita/usia sekolah, ibu hamil, ibu menyusui, dan calon pengantin. Sebanyak 517 ibu-ibu dipilih dari 12.000 sasaran program yang berasal dari 4 kabupaten.*
Hasil: *Terdapat 53% ibu-ibu peserta program yang mengalami peningkatan skor pengetahuan tentang gizi seimbang. Sebagian besar ibu-ibu (54%) mengalami peningkatan nilai skor sikap positif tentang gizi seimbang. Terdapat peningkatan yang signifikan jumlah ibu-ibu yang dapat mempraktikkan konsumsi pangan harian sesuai pedoman isi piringku, yaitu dari 13% menjadi 20% setelah program ($p<0.05$).*
Kesimpulan: *Secara umum program Nutrimenu berhasil meningkatan pengetahuan, sikap, dan praktik gizi seimbang pada ibu-ibu peserta. Peningkatan ini berpotensi menjadi langkah preventif yang penting dalam pencegahan stunting.*

KATA KUNCI*:* *edukasi; gizi; isi piringku; perilaku; seimbang*

ABSTRACT

Background: *Currently, Indonesia is still facing a high stunting problem compared to other countries, including Southeast Asia. Therefore, the government is implementing a program to accelerate stunting reduction through specific and sensitive programs involving many sectors. Various strategies were prepared with priority targets for the group of pregnant women and children aged 0-2 years in the 1,000 HPK (first day of life) movement. One of the direct causes of stunting is low quality food consumption, which starts from pregnant women to children aged two years.*
Objectives: *This study generally aims to analyze the effectiveness of the Nutrimenu program on the knowledge, attitudes, and practices of women of mothers.*
Methods: *The research design is a pre-post intervention study which specifically analyzes changes in knowledge, attitudes, practices before and after the Nutrimenu program. The program takes the form of nutritional education provided to mothers who have toddlers/school age children, pregnant women, breastfeeding mothers, and prospective brides and grooms. A total of 517 mothers were selected from 12,000 program targets in 4 districts.*
Results: *There were 53% of mothers participating in the program who experienced an increase in knowledge cores about balanced nutrition. Most mothers (54%) experienced an increase in positive attitude scores regarding balanced nutrition. There was a significant increase in the number of mothers who were able to practice daily food consumption according to the contents of My Plate guidelines, namely from 13% to 20% after the program ($p<0.05$).*
Conclusions: *In general, the Nutrimenu has succeeded in increasing the knowledge, attitudes, and practices of balanced nutrition among participating mothers. This improvement potentially served as a crucial preventive measure against stunting.*

KEYWORD*:* *balanced-nutrition; behavior; education; my plate*

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INTRODUCTION

In 2021, it was reported that stunting was still a significant problem in Indonesia, with a prevalence of 24.4%(1). Various efforts have been made by the government, private institutions, non-governmental organizations, and multiple parties to collaborate with the National Strategy for the Acceleration of Stunting Prevention 2018-2024. Various activities were arranged for vulnerable groups, such as pregnant women and children aged 0-2 years, called the First 1,000 Days of Life movement. Strategic interventions for stunting management were divided into 2 (two) types, namely specific nutritional interventions, such as supplementation and promotion of nutrition, and sensitive ones, such as access to sanitation and clean water (2). National strategies and policies were also handed down to regions, especially stunting loci, and implemented through various programs and approaches by multiple sectors.

Previous research showed that educational media through structured modules impacted increasing knowledge, attitudes, and procedures related to maternal and child health in mothers (3). The 2019 Nutrimenu program was previously carried out in Garut Regency, West Java. The program involved 5,000 mothers from 139 Posyandu in 12 districts. The result showed that the program could significantly change participants' knowledge, attitudes, and practices (4).

To support the success of the previous Nutrimenu program, monitoring and evaluation steps need to be sustainable and carried out synergistically with program development. Therefore, this research will determine the program's effectiveness in four other districts: Bangkalan, Bondowoso, Gunung Kidul, and Pekalongan. This study generally aimed to analyze the effectiveness of the Nutrimenu program on the knowledge, attitudes, and practices of balanced nutrition of the participants.

MATERIALS AND METHODS

Research Design

Developing nutrition cadres was the basic concept of the Nutrimenu program. Sixty cadres participated in the training of trainers (ToT). Then they educated about balanced nutrition to other women surrounding their home living areas. A total target of 12,000 women participated in this program: pregnant women, mothers of children under five years old, mothers with school-age children, and women of reproductive age. This education was carried out using an educational tool kit as a booklet containing balanced nutrition education and food menus recipe developed previously. After implementing the ToT, the cadres carried out the 21-Day Nutrimenu Movement by cooking dishes according to the choices from the recipe booklet.

The research design was a pre-post intervention study that observed differences in knowledge, attitudes, and behavior (KAP) among participants before and after the Nutrimenu program. This activity was carried out in 4 (four) districts from 3 (three) provinces, namely Pekalongan District in Central Java Province, Gunung Kidul District in the Special Region of Yogyakarta (DIY) Province, Bangkalan Regency, and Bondowoso Districts in East Java. This research has passed the ethics protocol assessment from the Commission of Ethics for Research Using Human Subjects at IPB University.

The questionnaire of this study consisted of knowledge, attitude, and practice sections carried out by Google Forms. The questionnaire was pre-tested in Bogor Regency. The trial mainly emphasized the mothers' understanding of the questions and the technical way of filling them out. This research was conducted from October 2022 – January 2023.

Number of Participants

The population of this study was 12,000 beneficiaries of the Nutrimenu Program from four districts. The number of participants in this study was based on the assumption of an accuracy of 5% and a prevalence of 50% of mothers who practice balanced nutrition, and the level of confidence (α = 95%) obtained a minimum number of participants as many as 357 mothers. In this study, the number of participants involved was 517 program beneficiary women in 4 districts, with 120 participants in each community, with the following criteria:

1. Pregnant women, mothers of children under five years old, mothers with school-age children, and women of reproductive age who had received the Nutrimenu Program and were willing to participate in the research until the end;
2. She could read and type via mobile phone.
3. Understood how to fill out online forms using Google Forms.

Processing and analysis of data

Data collected through online questionnaires then be cleaned and analyzed with IBM SPSS Statistics. Participant's answers are processed by scoring each question and presenting it as a percentage, and categorized as "Good" if the score is correct/positive ≥90%, "Medium" if the score is correct/positive 71-89%, and "Bad" if the score is right/ positive <70%. Differences in knowledge scores, attitudes, and practices before and after the program were identified using the Wilcoxon test. Differences in the proportion of categories of knowledge, attitudes, and practices before and after the program was determined using the Friedman test. Differences in the percentage of participants who answered correctly/positively on knowledge, attitudes, and practices before and after the program were identified using the McNemar test

RESULTS AND DISCUSSION

Participants Characteristics

Participants characteristics consists of education level, jobs, money spent in one month, money spent for food in one day, family size, and people who cook at home (Table 1). Half of the participants (51.11%) had graduated from high school, and almost a quarter of the participants (22.8%) had graduated from junior high school. Most of the participants (69.0%) are housewives.

Money spent in one month in the ≤2,000,000 Rupiah group was greater, namely 81% compared to the >2,000,000 Rupiah group (18.8%). More than half of the participants (67.1%) spent ≤50,000 Rupiah on food in one day. The results of this study are in line with research in Garut (4), that the average food expenditure in one day is 33,223 rupiah.

The family members in the participants was balanced between the categories ≤4 people and >4 people, namely 48.2% and 51.8% respectively. Based on BPS data for 2019, the average number of family members in Central Java and East Java is 3.6 and 3.7 (5). Most of the participants cooked their own food served at home (77.8%), while nearly a quarter were cooked by their mother or grandmother (21.9%). Participants' backgrounds influence nutritional problems and a person's ability to understand new information related to nutrition (6).

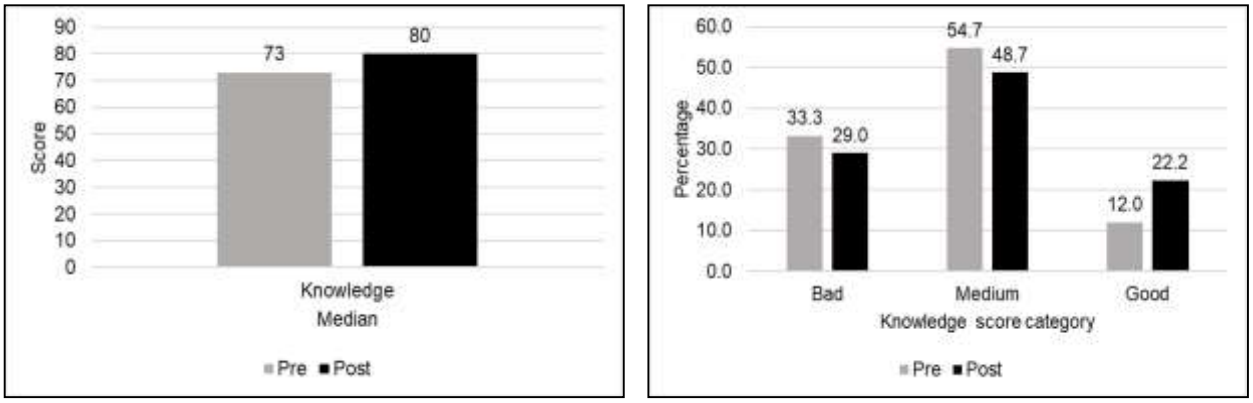
Table 1. Participants Characteristics

Participants Characteristics	n (%)
Education level	
Not graduated from elementary school	3 (0.6)
Elementary school	54 (10.4)
Junior high school	118 (22.8)
Senior high school	264 (51.1)
College	78 (15.1)
Jobs	
Housewives	357 (69.0)
Workers	160 (31.0)
Money spent in one month	
≤2,000,000 Rupiah	420 (81.2)
>2,000,000 Rupiah	97 (18.8)
Money spent for food in one day	
≤50,000 Rupiah	347 (67.1)
>50,000 Rupiah	170 (32.9)
Family size	
≤4 orang	249 (48.2)
>4 orang	268 (51.8)
People who cook at home	
Mother/grandmother	113 (21.9)
Another people	2 (0.4)
Herself	402 (77.8)

Nutritional Knowledge

Nutritional knowledge can influence a person's actions (7,8). Based on Picture 1 (left), there was a significant increase in knowledge ($p < 0.05$ using the Wilcoxon test) before and after the program from a median score of 73 to 80, and there was 53% of participants who experienced an increase in knowledge score. These results were in line with the nutritional education intervention research using the Focus Group Discussion (FGD) method conducted on pregnant women in Bogor, where there was an increase in the knowledge score from 54.9 to 85.0.

The key determinants of food preference were environment, biological status, gender, and socio-economic factor, included mother's education background (9–11). Providing education by involving stakeholders, cadres, or local health workers and paying attention to the mother's background is necessary so that the education provided follows the mother's ability to understand education. Using appropriate and interactive methods could increase nutrition knowledge, attitudes, and practices (12). The education provision in the Nutrimenu program involved cadres so that nutrition education became effective



Picture 1 The Difference of balanced nutrition knowledge before and after the Nutrimenu program

In **Picture** 1 (right), participants' knowledge in the bad/worse category decreased from 33% to 29%, and the medium category from 55% to 49% after the program ($p<0.05$). Participants in the good knowledge category increased after the program, from 12% to 22% ($p<0.05$)). The results of this study followed the previous program in Garut, namely that there was an increase in the number in the good knowledge category from 1.6% to 6%, with the duration of providing nutrition education the same as Nutrimenu, namely for 21 days (4). Another study in Ethiopia on mothers with children aged two years had the same results: an increase in the good knowledge category from 59% to 96%. The study lasted four months of nutrition intervention, and delivering nutrition messages was conducted every two weeks for two hours at each meeting with media in the form of posters, brochures attractive demonstrations (13).

A total of 15 questions were asked to assess the balanced nutrition knowledge of the participants (Table 2). Participants who answered correctly about food consumption and its relation to being overweight (obesity) increased significantly by 6% ($p<0.05$). It showed that the information regarding obesity - explicitly contained in the booklet – could be transferred well by the cadres. According to Permatasari et al. (2021), cadres could deliver nutrition education interactively as health workers who work in the community (12). The inner community approach method could make participants feel more comfortable receiving and paying attention to the information. There was a slight decrease in knowledge regarding water consumption and washing

hands suggestions (72.0% to 67.5%). This decrease could be due to the delivery of cadres during transferring education only focused on essential balanced nutrition topics, but not others. The principle of balanced nutrition based on the Ministry of Health of the Republic of Indonesia in 2014 did not only about food consumption but must be accompanied by other principles such as drinking water and washing hands to achieve good nutritional status (14).

There was an increase of 4.1% in participants who answered correctly on food groups in My Plate knowledge ($p<0.05$). The information about the four food groups in My Plate was stated explicitly in the booklet used by the cadres and was supported by an interesting visualization. Visual media usage in nutrition education provided many benefits, and using more images than writing attracted the audience's attention and made it easier to remember (15). Another study, namely nutrition education for pregnant women, used posters, brochures, flipcharts, and blackboards also had similar results as this study; there was an increase in participants who answered correctly about balanced nutrition from 34.8% to 95.7% (16).

Participants who had correct answers increased on knowledge of micronutrients, namely by 7.1% ($p<0.05$). The information provided in the booklet also discussed the function of micronutrients in detail. Functions and examples of vegetables that contain micronutrients were also listed on each page in the menu booklet given to participants, accompanied by pictures of sources of food ingredients that contain these micronutrients. Other studies had similar results, namely that there was an increase in participants who answered questions correctly about sources of micronutrients from 31.9% to 100% in the group that was given nutrition education (16).

Table 2 Participants Who answered the knowledge questions correctly before and after the program

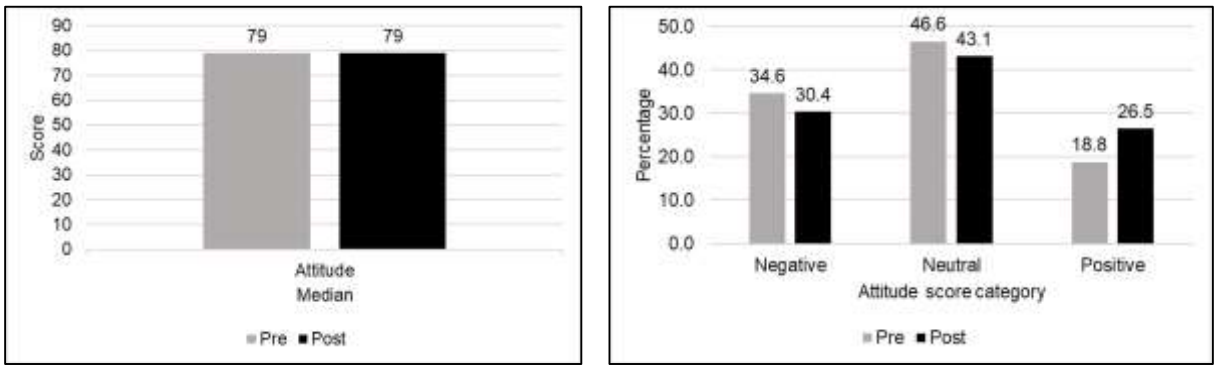
Knowledge questions	Correct answered		P value
	Before	After	
Impact of nutrition deficiency	66.2%	69.8%	0.166
Food consumption and obesity	65.4%	71.4%	0.018*
Balanced nutrition in pregnancy	78.5%	77.8%	0.764
Physical activity and obesity	63.6%	67.7%	0.124
Stunting and child growth	80.5%	82.6%	0.305
Non communicable disease & imbalanced nutrition	84.7%	86.8%	0.329
Water consumption, hygiene	72.0%	67.5%	0.032*
Food groups in My Plate	94.2%	98.3%	0.001*
The example of food groups in My Plate	97.7%	98.1%	0.824
Proportion of My Plate	65.4%	70.0%	0.072
Macronutrient function	78.5%	82.4%	0.103
Micronutrient function	77.6%	84.7%	0.001*
Nutrition problem solution	95.6%	97.1%	0.230
Portion size of carbohydrate group in My Plate	52.2%	57.3%	0.060
Vegetable and fruit sufficiency	53.4%	53.2%	1.00

Note: *significantly different

Attitude on Balanced Nutrition

The median attitude score before and after the program showed 79, with a minimum score of participants before the program being positive was 7% and increasing at the end of the program, which was 16%.

Even though there was a similarity in the median values, the results of the Wilcoxon differential test show that there was a statistically significant difference ($p<0.05$) between the scores of positive attitudes before and after program implementation (**Picture 2**).



Picture 2.The Difference of Balanced Nutrition Attitude Before and After the Nutrimenu program

Most participants (54%) experienced increased positive attitude scores after the program. Picture 2 showed a significant increase in participants with a positive attitude category after the program ($p <0.05$). The results of research by Permatasari et al. (2021) in Bogor with 194 pregnant women also showed an increase in positive attitudes regarding balanced nutrition after providing nutrition education (12). Nutrition education was given periodically for three months every two weeks. The increase in positive attitude scores in this study was as much as 9%. This research also found positive changes in the participants' balanced nutrition practices at the end of the activity.

A total of 14 (fourteen) question points related to a balanced nutritional attitude were posed to participants. The results in Table 3 showed that there was a significant increase ($p<0.05$) in the number of participants (6.7%) with a positive attitude after the program. A positive attitude was shown in the statement components regarding food consumption and its relation to obesity. Explicitly, information about the imbalance of nutritional intake and obesity was available in the booklet media. It was stated that obesity could cause diabetes as an adult, decrease intelligence in children, and increase the risk of heart and blood vessel disease as an adult. With the help of educational explanations from cadres, this information changed the participants' attitudes to be positive at the end of the activity.

A significant increase in attitude ($p<0.05$) also occurred in 6.4% of participants regarding fulfilling the four food groups in My Plate and 9.3% regarding examples of food groups in My Plate. Education regarding My Plate was explicitly written in the booklet. With the help of explanations from cadres, the picture of My Plate in the booklet changed the participants' attitudes towards this information.

Participants with a positive attitude regarding the adequacy of intake of vegetables and fruit as a source of fiber also increased significantly after the program's implementation ($p<0.05$). In addition to education related to My Plate contents, the booklet explicitly provided an alternative vegetable consumption with the potential for health quality, namely Moringa leaf.

With the help of explanations from cadres, this information changed participants' attitudes towards ideal food portions and the adequacy of vegetable and fruit intake.

There was a significant decrease in the number of participants with a positive attitude towards the ideal proportion of the consumption that needs to be consumed (5.6%). The proportion of the My Plate is essential to the core message in My Plate guideline. Limited delivery/education methods by cadres might be one reason for this. Training related to conveying information on portion proportions in My Plate contents needed to be intensively increased using other educational media besides visual media (booklet), such as stickers or audio (songs).

Another study conducted on 40 mothers with toddlers showed a significant increase in attitude scores after providing education related to nutrition. The positive attitude score increased by 8.75% compared to before the education was delivered. Education was delivered through mobile applications and regular health services (17). In this study, nutrition education was delivered by cadres directly around the location where the participants lived. Furthermore, participants took pre and post-tests using online questionnaires accessed directly by participants, while cadres assisted others.

The ultimate goal of changing one's attitude was to be followed by changes in food consumption practices. Nonetheless, changing attitudes alone, without changing food consumption practices, was quite good progress (18). In this study, an increase in the participants' positive attitude was also followed by changes in the participants' food consumption practices, which will be discussed in the next sub-chapter.

Table 3. Participants Who Answered Positively the Attitude Questions, Before and After the Program

Attitude questions	Positive answered		P Value
	Before	After	
Impact of nutrition deficiency	66.5%	67.3%	0.800
Food consumption and obesity	66.0%	72.7%	0.007*
Balanced nutrition in pregnancy	79.7%	80.1%	0.927
Physical activity and obesity	76.4%	77.9%	0.492
Stunting and child growth	76.8%	77.8%	0.729
Non communicable disease & imbalanced nutrition	72.9%	74.9%	0.444
Water consumption, hygiene	93.6%	93.4%	1.000
Nutrition problem solution	81.6%	81.8%	1.000
Food groups in My Plate	71.4%	77.8%	0.004*
The example of food groups in My Plate	51.8%	61.1%	0.000*
Vegetable and fruit sufficiency	70.2%	76.2%	0.010*
Micronutrient function	79.9%	82.6%	0.239
Proportion of My Plate	62.3%	56.7%	0.040*
Macronutrient function	75.8%	77.6%	0.448

Note: *significantly different

Balanced Nutrition Practice

Part of the Nutrimenu Program included cooking 21 different healthy menus in 21 days for participants. After program implementation, the frequency of mothers preparing complete family meals increased. However, the provision of fruits served by participants still needed to be higher; only about 30% of

participants provided fruits daily (Table 4). The 21-Day Movement food menu consisted of main meals and side dishes, which were developed considering each menu's variety, nutritional content, and affordability.

Through the 21-Day Movement, participants were expected to be able to form good habits in providing balanced nutrition for children and families. A person's habit could be formed if the same activity occurred in approximately 21 days. One of the success factors for changing habits was inseparable from participants' commitment to building habits (19). Interventions focused on changing behavior and habits were an effective strategy to improve children's nutritional status. Other research showed that nutrition education for mothers could significantly change the habits of physical activity and children's consumption of vegetables, fruit, and animal side dishes (20,21).

Table 4. Percentage of Participants Who Practiced to Serve Food Groups as My Plate, Before and After the Program

Balanced nutrition practice	Practices		P Value
	Before	After	
Serving food groups every day			
Carbohydrate source/staple foods	51.3%	56.3%	0.033*
Protein source/side dishes	47.8%	56.9%	0.000*
Vegetables	41.6%	49.9%	0.001*
Fruits	19.7%	31.7%	0.000*
Consumed ideal portion	13.0%	19.7%	0.000*
Carbohydrate source/staple foods	48.5%	55.1%	0.021*
Protein source/side dishes	29.8%	39.5%	0.000*
Vegetables	40.8%	46.0%	0.068
Fruits	31.5%	43.9%	0.000*
Other healthy good practice			
Washing hand	40.8%	54.4%	0.000*
Water consumption	42.0%	53.4%	0.000*
Physical activity at least 30 minutes	21.1%	27.3%	0.004*

Note: *significantly different

Table 4 shows an increase in participants consuming food according to the My Plate guidelines from 13% to 20% after the program (53.8% increase). This suitability was based on the recommended number of servings and the type of food group in My Plate. The 21-Day Movement aimed to change participants' habits by providing a variety of healthy food at home. Educational activities in this program were able to change the practice of balanced nutrition in the community for better health.

There was a significant increase ($p<0.05$) in the number of participants who practiced consuming food according to the portion of My Plate in almost all food groups. The increase in the number of participants who consumed staple foods, side dishes, vegetables, and fruits according to the portion of My Plate was 13.6%; 32.6%; 12.7%; and 39.4%, respectively (Table 4). In particular, there was no statistically significant change in vegetable consumption ($p>0.05$). Based on the 2018 Riskesdas (Basic Health Research) results, most people in Indonesia's consumption of vegetables and fruit was still below the recommendation (22). Meanwhile, vegetable consumption was linked with higher fast-food consumption which associated with poor kind of diet (23,24). Lower liking for vegetables also associated with higher Body Mass Index (BMI) (25,26)

Research by Ine et al. (2022), conducted on mothers with children exposed to material related to balanced nutrition through media

counseling and demonstrations, showed significant improvements in mothers' practices (27). After counseling, mothers practice proper feeding practices by giving MP-ASI to children according to balanced nutrition guidelines. In the final stage of the study, toddlers from mothers who participated in education experienced an increase in body weight. The results of this study indicated that the provision of nutrition education had great potential to change a person's behavior (28,29).

Table 4 showed that other balanced nutrition practices related to washing hands, consuming sufficient amounts of water, and doing physical activity for at least 30 minutes also increased significantly at the end of the activity ($p<0.05$). The increase in the practice of washing hands, consuming water, and doing physical activity, respectively, was 33.6%; 27.1%; and 29.4% from the beginning of the program. Explicitly, recommendations related to these three things were also available in the booklet. With educational assistance from cadres, this information was able to change the practice of program beneficiaries.

The 2018 Riskesdas (Basic Health Research) showed that proper handwashing behavior was only practiced by some people in Indonesia aged ≥10 years. The same thing was also shown by the frequency of sufficient physical activity in residents aged ≥10 years, which showed that more than 30% of them were in the low-frequency category (22). Therefore, strategies to improve these behaviors still need to be developed to improve the quality of public health as a whole. Another research that was used Riskedas data also found that low physical activity was correlated with overweight and obesity among urban and rural people (30,31).

CONCLUSIONS AND RECOMMENDATIONS

The Nutrimenu program generally increased the balanced nutritional behavior of participating mothers and women of reproductive age. Improvement in each aspect is as follows:

1. 53% of program participant mothers experienced an increased in knowledge scores about balanced nutrition. The median value significantly increased from 73 to 80. Almost all knowledge questions experienced an increase, but the significant ones were about obesity, the four food groups in My Plate, and the function of micronutrients.
2. Most of the mothers (54%) experienced an increased score of a positive attitude about balanced nutrition. Even though the median score of attitudes before and after the program was the same (79), the proportion of positive attitudes in the "high" category increased from 19% to 26%.
3. According to my plate's guidelines, there was a significant increase in the number of mothers who could practice daily food consumption, from 13% to 20% after the program. Based on the food group consumed, at the end of the program, 46% of mothers consumed vegetables, and 39% of mothers consumed animal side dishes according to recommendations for balanced nutrition portions.

CONFLICT OF INTEREST

The Authors declare no conflict of interest.

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Exclusive breastfeeding practices among women in Kei Besar Island: a descriptive study

Jessica Gloria Mogi[1*], Sylvia Winnie Melinda[1], Henry William Burhan[2]

[1]Therapeutic Feeding Center, doctorSHARE (Yayasan Dokter Peduli), Kei Besar Island, Southeast Maluku, Indonesia
[3]Department of Internal Medicine, Prof. Dr. R. D. Kandou General Hospital, Manado, North Sulawesi, Indonesia

**Corresponding author*: mogijessica@gmail.com

ABSTRAK

Latar Belakang: *ASI eksklusif telah terbukti dapat mengurangi kejadian stunting dan meningkatkan pertumbuhan jangka panjang di Indonesia, serta mencegah kejadian penyakit menular seperti diare. Sebagai bagian dari strategi penurunan stunting di Indonesia, pemerintah Indonesia memasukkan ASI eksklusif sebagai salah satu dari 11 strategi intervensi spesifik. Bagaimanapun, area-area dengan prevalensi stunting yang cukup tinggi seperti Maluku Tenggara, juga cenderung memiliki prevalensi ASI eksklusif yang lebih rendah.*
Tujuan: *Penelitian ini bertujuan untuk menyajikan profil ibu hamil multigravida dan ibu menyusui yang memiliki bayi berusia 0-5,9 bulan, baik yang melakukan ASI eksklusif maupun yang tidak, di Pulau Kei Besar, Maluku Tenggara.*
Metode: *Penelitian deskriptif ini menggunakan rancangan potong lintang. Kuesioner diberikan pada 23 ibu hamil multigravida yang pernah menyusui anaknya dan 8 ibu menyusui yang memiliki bayi berusia 0-5,9 bulan untuk mempelajari karakteristik demografik, pengetahuan, dan praktik terkait menyusui. Hasil dipaparkan dalam bentuk statistik deskriptif.*
Hasil: *Di antara ibu hamil, 52% kekurangan pengetahuan mengenai inisiasi menyusui dini. 95.7% memeriksakan kehamilannya pada bidan, dengan 39.1% di antaranya memiliki frekuensi ANC >4 kali. Selain itu, 60.9% mengaku menyusui anak sebelumnya secara eksklusif. Di antara ibu menyusui, 75% mengakui menyusui secara eksklusif, namun 62,5% tidak tepat dalam menyebutkan definisi ASI eksklusif dan juga mengaku memberikan susu formula dalam sehari terakhir. Terdapat juga kepercayaan seperti bahwa perempuan kurus menghasilkan ASI lebih sedikit dan bahwa kandungan gizi susu formula sama dengan ASI.*
Kesimpulan: *: Promosi kesehatan tentang ASI eksklusif sangat penting untuk meningkatkan pengetahuan dan mengoreksi kepercayaan yang keliru. Bidan memiliki potensi untuk menjadi agen yang efektif dalam mempromosikan ASI eksklusif saat memeriksa kehamilan ibu-ibu Kei Besar.*

KATA KUNCI*:* *ASI eksklusif; Kei Besar; Maluku*

ABSTRACT

Background: *Exclusive breastfeeding has shown evidence of effectiveness in reducing stunting and promoting long-term growth in Indonesia, as well as preventing infectious diseases such as diarrhea. As part of stunting reduction acceleration strategies, the Indonesian government recognizes the importance of exclusive breastfeeding and includes it in the 11 specific intervention strategies. However, areas with high stunting prevalence such as Southeast Maluku, tend to also have low exclusive breastfeeding prevalence.*

Objectives: *This study aims to delineate the profiles of multigravida pregnant women and women with infants aged 0-5.9 months old engaged in exclusive breastfeeding and those who do not in Kei Besar Island, Southeast Maluku.*

Methods: *This study was an observational study with a cross-sectional design. This study was conducted on 132 premarital women of reproductive age in Bantul district who registered their marriage at the office of religious affairs. Body image measurement used Body Shape Questionnaire 34 (BSQ-34) and skipping meals behavior was measured by questionnaire. Data was analyzed with Mann-Whitney because data was not normally distributed.*

Results: *Among pregnant women, 52% lacked knowledge of early breastfeeding initiation. 95.7% received antenatal care from midwives, with 39.1% attending four or more times. Notably, 60.9% reported exclusively breastfeeding their previous child. Among breastfeeding mothers, 75% reported exclusive breastfeeding, but 62.5% provided incorrect definitions of breastfeeding and admitted to formula milk use within the past day. Additionally, misconceptions included beliefs that thinner women produce less breast milk and that formula milk's nutritional content resembles that of breast milk.*

Conclusions: *Addressing knowledge gaps and misconceptions through health education on exclusive breastfeeding is essential. Midwives have the potential to serve as effective agents in promoting exclusive breastfeeding during ANC appointments for Kei Besar mothers.*

KEYWORD***:*** *exclusive breastfeeding; Kei Besar; Maluku*

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INTRODUCTION

The triple burden of malnutrition, encompassing issues like malnutrition, undernutrition, and overweight, underscores the significance of dietary choices and care as direct factors influencing the nutritional well-being of mothers and children (1). Proper feeding, including breast milk and complementary feeding after 6 months, and the mother's nutrition are crucial for children's growth, survival, and health (1). It is widely recognized in scientific literature that breastfeeding confers various advantages, including both short-term and long-term advantages. These encompass a reduced risk of conditions like diarrhea and pneumonia, a lower likelihood of future obesity and diabetes, and improvements in cognitive development, exemplified by enhanced intelligence quotient (2–6).

The current breastfeeding guidelines from the World Health Organization (WHO) emphasize initiating breastfeeding within one hour of birth, exclusive breastfeeding for the initial six months, continued breastfeeding for up to two years or more, and introduction of complementary foods after the first six months (7). These recommendations are also included in the 11 specific interventions to tackle stunting, curated by the Indonesia's Ministry of Health. These interventions aimed to start stunting prevention from pregnancy until the child is 6-23 months old (8). In the year 2022, the stunting prevalence has seen a drop from 24.4% in 2021 to 21.6% (9). However, to achieve the 2024 goal of a 14% stunting prevalence, the government must expedite progress, aiming for a minimum annual reduction of 3.8% (9,10).

From 2010 to 2018, a comprehensive analysis across 57 low- and middle-income countries (LMICs) revealed global weighted prevalence rates of 51.9% for early initiation of breastfeeding, 45.7% for exclusive breastfeeding under 6 months, and 32.0% for exclusive breastfeeding at 4-5 months (11). Furthermore, the South-east Asia/Western Pacific region displayed rates of 47.4% for early initiation of breastfeeding, 55.2% for exclusive breastfeeding under 6 months, and 41.3% for exclusive breastfeeding at 4-5 months (11). Conversely, according to the Indonesia Nutritional Status Survey (SSGI) as shown in Figure 1, while there is an increase in the number of breastfeeding, there is also a sharp drop of exclusive breastfeeding rate, from 48.2% in 2021 to 16.7% in 2022 (9).

Although there exists a disparity in the data compared to figures reported by the Indonesia National Statistic Bureau (BPS) for the same time period, which indicated a prevalence of 72.4% in exclusive breastfeeding for infants aged 6 months or younger (12), these findings underscore that over a quarter of infants in Indonesia are still not availing themselves of the benefits associated with exclusive breastfeeding. We are especially concerned about provinces with stunting prevalence above the national average, which tend to also have an exclusive breastfeeding rate that is lower than the national average

Maluku, as a province, faces the dual challenge of not only having a stunting prevalence exceeding the national average at 26.1%, but also confronting a notably low exclusive breastfeeding prevalence of just 59.2% (9,12). Focusing on the specific district of Southeast Maluku, including the Kei Islands Regency, the area grapples with an even higher stunting prevalence, surpassing both the provincial and national averages at 26.8% (9).

The decision to extend exclusive breastfeeding up to the child's sixth month is influenced by a range of factors, including the child's age, maternal education, occupation, delivery method, parity, economic circumstances, place of residence, and early breastfeeding initiation (13–15). It is crucial to consider how the diverse cultural contexts across Indonesia's extensive geographic expanse contribute to the determinants of exclusive breastfeeding practices, despite the practice being mostly culturally-acceptable (13,16). This understanding frames the context of our study's aim, which is to delineate the profiles of women engaged in exclusive breastfeeding and those who do not, within the specific context of Kei Besar Island.

MATERIALS AND METHODS

Study Setting Description

Kei Besar Island, also known as Great Kei Island, is one of the principal islands situated within the Southeast Maluku Regency of the Maluku province. It shares this region with Kei Kecil, also known as Lesser Kei Island. The island itself is geographically subdivided into five primary sub-districts, encompassing a total land area of 558.83 km2 and an estimated population of approximately 53,882 individuals (17). It is worth noting that the reported population figures may be underestimated due to certain factors. Most government offices are mostly located in Kei Kecil Island, that necessitates residents of Kei Besar to travel by ship, resulting in a somewhat limited registration system (18). Additionally, there are instances of births occurring in informal settings, resulting in the absence of official birth records or certificates (19). The administrative structure of Kei Besar includes 37 ohois, which are the smallest administrative units akin to villages (20).

In this island locale, there are 11 Community Health Centers, or Puskesmas, distributed across 5 districts. In these centers, eight districts are each equipped with a singular primary care physician (21). Additionally, situated near the district capital, there exists a non-governmental organization known as doctorSHARE, which extends primary care and nutrition services to the community (22). The Kei Besar district boasts 46 integrated health services posts, referred to as Posyandu, within each village. These Posyandu facilities, staffed by community members and healthcare providers, play an instrumental role in bolstering government initiatives to diminish maternal, infant, and under-five mortality rates (23).

Study Design

Data collection was conducted from January 2022 to March 2022, following a cross-sectional approach to obtain descriptive data relating to demographic characteristics, breastfeeding practices, and knowledge of multigravida women (women who have a history of giving birth before their current pregnancy) and breastfeeding women with children 0-5.9 months old. The study was approved by the Health Research Ethics Committee of RSUP Prof. Dr. R. D. Kandou Manado (No. 212/2022) and data collection permission was issued by the National Unity and Politics Agency of Southeast Maluku (Kesbangpol Malra) on behalf of the District Health Office (No. 070/2021).

Samples and Procedures

A total sampling method was employed to get samples for this study. Participants will be eligible for inclusion in the study if they are pregnant with a history of previous childbirth and breastfeeding, or are currently breastfeeding infants aged 0-5.9 months. They must also attend the mobile ultrasound services provided by doctorSHARE Kei. Women who don't meet these criteria will be excluded from the study. The participants hailed from three sub-districts of Kei Besar Island, namely Kei Besar sub-district (Ohoi Yamtel, Ohoi Ohoilim, Ohoi Soinrat); East Northern Kei Besar sub-district (Ohoi Haar Ohoimel, Ohoi Haar Renrahantel, Ohoi Ohoiwirin, Ohoi Watlaar); and South Kei Besar sub-district (Ohoi Weduar, Ohoi Larat, Ohoi Kilwat, Ohoi Sather, Ohoi Tutrean, Ohoi Ohoirenan).

A questionnaire was read to the pregnant women by trained midwives and nurses as a part of their antenatal appointment counseling. This questionnaire assesses the women's breastfeeding status for their previous children, knowledge about exclusive breastfeeding and early breastfeeding initiation, general nutrition knowledge, and antenatal care. Furthermore, breastfeeding women who brought their infants aged 0-5.9 months to get checked by the physicians were also included in the study and a different questionnaire that focuses more on their reasons to breastfeed, provision of food or liquid other than breast milk in the first 6 months of their children's lives, knowledge about exclusive breastfeeding and early breastfeeding initiation, and beliefs surrounding breastfeeding practices. In total, 23 pregnant women and 8 breastfeeding women were included in the study.

Data Collection and Analysis

The questionnaire used for breastfeeding women was adapted from the 2021 WHO Indicators for Assessing Infant and Young Child Feeding Practices which has been validated and used for household surveys and data collection (24–26). This questionnaire comprises sections that pertain to various aspects, including initial post-birth feeding, current breastfeeding practices, consumption of liquids, semi-solid and solid foods, the nature of family support during breastfeeding, and the nutritional guidance received. In the case of pregnant women, the questionnaire covers topics such as general nutritional knowledge, knowledge of early breastfeeding initiation, previous child's exclusive breastfeeding status, the involvement of healthcare professionals in previous deliveries, dietary diversity, and supplement intake.

We operationalize "exclusive breastfeeding" as the practice of providing only breast milk to the infant for the first 6 months of life. "Early breastfeeding initiation" is defined as the initiation of breastfeeding within the first hour of the infant's life. Although these definitions are employed in the knowledge check, the reported proportions are based on more straightforward questions: "Do you exclusively breastfeed your child?" and "Did you initiate breastfeeding within the first hour?". For this study, we will classify breastfeeding women with infants aged 0-5.9 months as exclusively breastfeeding if they have never provided anything other than breast milk to their infant, regardless of the infant's age.

Breastfeeding practices include maternal dietary behaviors and the provision of expressed breast milk, defined as "breast milk that is manually or mechanically removed from the breast and then stored for later use" and family's help in providing expressed breast milk. Misconceptions, defined as "beliefs that deviate

from the accurate understanding of a particular topic" pertain to the nutritional content of breast milk and factors that can influence the quantity of breast milk. Participant responses were then coded, transferred into spreadsheet format, and subjected to descriptive analysis using SPSS 25 (IBM Corp, Armonk, NY).

RESULTS AND DISCUSSIONS

Demographic Characteristics

The pregnant women and breastfeeding women have similar age distribution, with the mean age of 29 years old. Around 35.5% of the women are employed, and all of them have a minimum education of primary school. More information about participants' demographic characteristics is presented in **Table 1**. In this study, we found that among a total of 10 employed women, encompassing both pregnant and breastfeeding mothers, 70% reported exclusively breastfeeding their infants. Additionally, from the total of 21 women without employment, 61.9% reported exclusively breastfeeding their infants. These findings align with existing literature, which suggests that employment status is a factor that diminishes the likelihood of exclusive breastfeeding and often leads to discontinuation of breastfeeding (15,27,28).

Table 1. Demographic Characteristics of Study Participants

Characteristic	Number	Percentage
Pregnant women (n=23)		
Age (years)		
20-25	5	21.6
26-30	6	26
≥31	12	52
Education		
Primary school	1	4.3
Middle school	14	60.9
High school	6	26.1
College	2	8.7
Employed		
No	16	69.6
Yes	7	30.4
Reported early breastfeeding initiation		
No	7	30.4
Yes	16	69.6
Reported exclusive beastfeeding		
No	9	39.1
Yes	14	60.9
ANC		
1 times	2	8.7
2 times	6	26.1
3 times	6	26.1
≥ 4 times	9	39.1
Breastfeeding women with infants 0-5.9 months old (n= 8)		
Age (years)		
20-25	3	37.5
26-30	1	12.5
≥31	4	50
Education		
Primary school	1	12.5
Middle school	4	50
High school	2	25

Characteristic	Number	Percentage
College	1	12.5
Employed		
No	5	62.5
Yes	3	37.5
Reported early breastfeeding initiation		
No	3	37.5
Yes	5	62.5
Reported exclusive beastfeeding		
No	2	25
Yes	6	
Helped Delivery		
Midwives	4	50
Physicians	2	25
Traditional healers	2	25

Mothers who are employed often face challenges due to their separation from their infants when they return to work. A qualitative study conducted in Depok, Indonesia, revealed that some mothers believe their breast milk production diminishes upon rejoining the workforce, which they attribute to the heightened stress experienced in their workplace (28). Working mothers encounter various obstacles in maintaining exclusive breastfeeding, including conflicts between their professional commitments, inadequate workplace support, and a lack of breastfeeding facilities. (27). Interestingly, we found that 50% of pregnant women who reported exclusively breastfeeding their previous child attended their antenatal care (ANC) appointments four times or more. Frequent ANC visits have been identified as a positive predictor of exclusive breastfeeding (15,29,30). It is noteworthy that most information about the importance of breastfeeding is disseminated during ANC visits, which has led to improved exclusive breastfeeding practice. Counseling during ANC visits has played a crucial role in enhancing mothers' confidence and dispelling negative perceptions about breastfeeding (15).

Regarding the educational background of the participants, it's worth mentioning that the majority had a middle school level of education, with 14 pregnant women and 4 breastfeeding women falling into this category. Only 2 had a primary school education, while 3 had a college education, and the remainder had a high school education. Of those with a primary school education, 55.6% of those with a middle school education, 75% of those with a high school education, and 66.67% of those with a college education reported exclusively breastfeeding their children. While other studies have indicated a positive association between higher education levels and the likelihood of exclusive breastfeeding (29–31), our sample size did not allow us to draw the same conclusion due to the distribution of participants in each education level.

Breastfeeding practice and knowledge

The majority of the participants reported favorable breastfeeding practices, with 60.9% of pregnant women and 75% of women with infants aged 0-5.9 months indicating that they exclusively breastfeed their children. However, upon questioning, “what does exclusive breastfeeding mean?” only 37.5% was able to answer with the correct definition. Furthermore, despite over 60% of the participants confirming their adherence to early breastfeeding initiation, when asked, "What does early breastfeeding initiation mean?" only one breastfeeding woman provided the accurate definition, and less than half of the pregnant women responded correctly.

Additionally, it has come to light that half of the women with infants 0-5.9 months old who claimed to be exclusively breastfeeding their infants are currently supplementing them with formula milk. Other than formula milk, the women also admitted to giving food and other liquids to their infants in the past day (Figure 1). This

showed that the proportion of women exclusively breastfeeding was overstated due to a misinterpretation of the definition by the participants. However, in settings where mothers receive support to breastfeed or provide expressed breast milk to their infants, exclusive breastfeeding is more likely to be achieved, as mothers have the confidence to breastfeed and the assurance that their family supports their decision (33,34

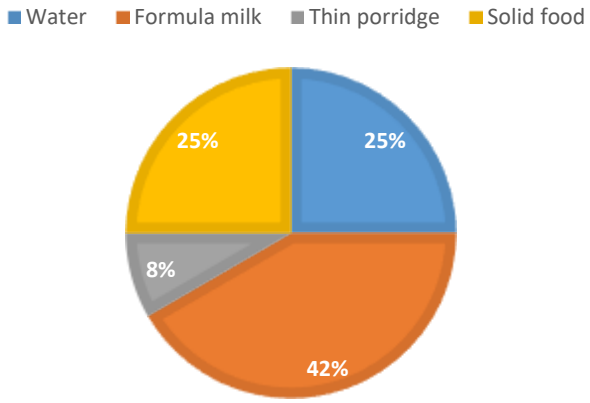

Figure 1. Food and liquids given to infants 0-5.9 months old other than breast milk.

It is concerning that, despite reporting exclusive breastfeeding, a significant proportion of the participants were unable to correctly define exclusive breastfeeding. The fact that some women who claimed to be exclusively breastfeeding their children were also supplementing them with formula milk highlights a lack of understanding of the concept of exclusive breastfeeding. Mothers with a higher level of breastfeeding knowledge are more likely to initiate early breastfeeding within an hour of birth and exclusively breastfeed their children (35,36). Given that less than 70% of the participants exhibited good knowledge of exclusive breastfeeding and early breastfeeding initiation in this study, there is an urgent need for nutrition-education interventions (37).

Maternal nutrition practices and knowledge

Only 2 pregnant women reported not consuming the iron tablets they received from Posyandu. Additionally, only 47.8% reported taking their folic acid tablets, while 65.2% reported taking multivitamin tablets. Concerning dietary habits, more than half of the women (52.2%) reported consuming 2-4 servings of plant-based or animal-based protein daily, whereas only 47.8% reported eating 3-4 servings of vegetables or fruits each day.

A significant proportion of pregnant women, 95.7%, exhibited knowledge of the importance of a balanced and nutritious diet during pregnancy, understanding that it should include sources of carbohydrates, animal-based or plant-based proteins, vegetables, and fruits. Moreover, 87% were aware of the necessity of consuming iron and folic acid tablets for a minimum of 90 days before and during pregnancy. However, this same group believed that during pregnancy, it was necessary to consume twice their usual portion to accommodate the developing fetus.

In terms of food selection, 39.1% of pregnant women admitted to not choosing their meals daily, with the mother or mother-in-law making these choices for 44.4% of them, while the remaining 55.6% had their husbands involved in meal selection.

A supportive family environment was reported by 91.3% of pregnant women, and 69.6% acknowledged their families as valuable sources of pregnancy-related information. It is noteworthy that the primary source of

information on healthy foods for pregnant women, cited by the majority (87%), was the midwives at Posyandu. This information included guidance on healthy food options, foods rich in calcium and iron, and normal weight gain during pregnancy. The summary of nutrition knowledge and practices among pregnant women is presented in **Figure 2.**

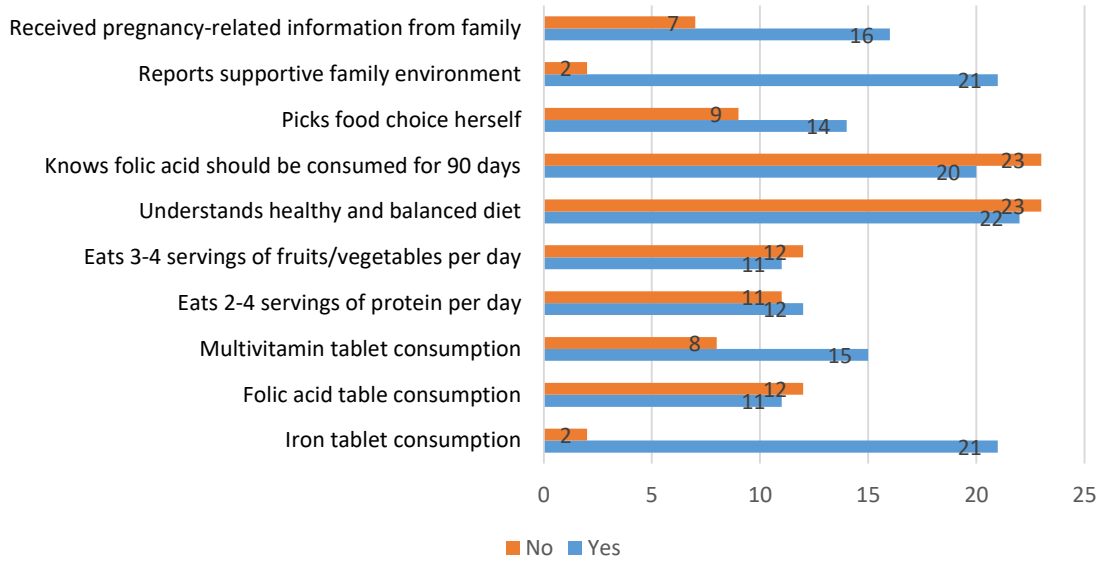

Figure 2. Maternal Nutrition Knowledge and Practices

Given the positive impact of antenatal care visits on the likelihood of exclusive breastfeeding (15,29,30,38), it is crucial to emphasize the role of midwives and healthcare professionals who conduct these examinations in providing exclusive breastfeeding counseling. During these counseling sessions, women may seek information about the physiology of breastfeeding, signs of sufficient milk supply, and methods to increase breast milk supply (34). It is vital for midwives to convey this information accurately and ensure that mothers fully understand it. Misunderstandings can lead to mothers introducing other foods or liquids to their infants instead of adhering to exclusive breastfeeding (39).

Interventions aimed at increasing the prevalence of exclusive breastfeeding in this population should involve various stakeholders, including pregnant and breastfeeding women, their families (including husbands), and midwives or healthcare providers. The social environment in which a woman resides significantly influences her nutritional well-being and, consequently, her decision regarding exclusive breastfeeding. Therefore, families should also be targeted for exclusive breastfeeding education to increase knowledge, while midwives should receive training to deliver consistent, effective counseling about exclusive breastfeeding to their clients. Strategies to address low knowledge indicators may involve building upon existing knowledge and enhancing understanding through discussions, lectures, slides, and presentations (37).

Misconceptions about breastfeeding

When asked about their reasons for breastfeeding, 87.5% of the breastfeeding women mentioned health benefits as the primary motivation. Within the same group, 28.6% also expressed the belief that it's a social requirement, while 71.4% cited economic reasons, particularly the high cost of formula milk. These women were able to articulate the advantages of breastfeeding for both their

infants and themselves, including enhancing their babies' immunity, contributing to their brain and organ development, fostering a loving bond between mothers and infants, and recognizing that increased breastfeeding leads to higher milk production.

However, 25% of these women believed that the nutritional content in formula milk is equivalent to that in breast milk, viewing the two as interchangeable. Moreover, over half of the women (62.5%) lacked awareness of the potential negative consequences of introducing foods or liquids other than breast milk to infants under 6 months of age. Additionally, 37.5% held the belief that thinner women produce less milk, leading them to doubt the sufficiency of their milk production and opt for formula milk supplementation (Figure 3).

Seventy-five percent of these women acknowledged receiving information from healthcare workers regarding nutrition and health during breastfeeding, with 50% reporting that they had been educated about exclusive breastfeeding. Additionally, 62.5% had learned about early breastfeeding initiation, colostrum, nutritional requirements while breastfeeding, as well as the correct latching and breastfeeding techniques. . TThe misconceptions and beliefs that hindered women in this study from breastfeeding their infants are also found in the literature from around the world. The most common misconception is the belief that the quantity and nutritional content of a mother's breast milk are insufficient, leading them to supplement their babies with formula milk or other foods, liquids, and herbs (38–40). It's important to recognize that a mother has the potential to produce more breast milk than the average intake of a single infant. This has been demonstrated by the fact that mothers who exclusively breastfeed twins and triplets often produce more breast milk than mothers with a single infant (41,42). Furthermore, various factors related to both the infant and the mother can influence the quantity and quality of breast milk. Research indicates that more frequent nursing, especially during the early postpartum period, has a positive impact on breast milk production (43,44). While there is considerable variation among individual infants in terms of their need for sucking, it is advisable to practice on-demand breastfeeding, with a minimum of eight feedings per day during the initial postpartum period (45). This approach is recommended to ensure the appropriate hormonal stimulation of the mammary gland (45).

On the infant's side, other factors such as birth weight, gestational age at delivery, and the infant's self-regulation (suckling demand) also play a role in breastfeeding success (43,45).

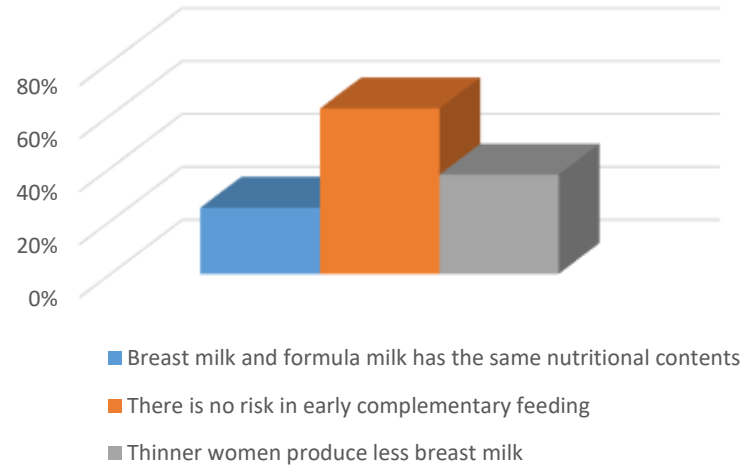

Figure 3. Misconceptions found among breastfeeding women

Maternal factors, including stress and acute illness, can impact the milk-ejection reflex and maternal behaviors, such as substance use, smoking, and excessive alcohol consumption, can affect milk volume by inhibiting the effects of prolactin and oxytocin or blocking the milk-ejection reflex (45–48).

Another prevalent misconception pertains to the belief that thinner women produce less milk. Research in industrialized countries, such as the United States, has shown that there is no significant association between a lower body mass index and the volume of milk production (49). However, in other less industrialized countries, the situation is more complex and influenced by additional variables, such as maternal undernutrition (50). Nevertheless, misconceptions and cultural beliefs are influential factors in the outcomes of exclusive breastfeeding and should be addressed during counseling sessions at ANC visits (15,38–40).

Strengths and Limitations

As per the authors' research, this is the first study that examines the profiles of mothers engaged in exclusive breastfeeding in Southeast Maluku. It has shed light on potential factors that may impact the continuity of exclusive breastfeeding, thereby informing tailored nutrition interventions. The study has also highlighted the flaws in existing intervention methods, such as the need to improve the effectiveness of nutrition information delivery through healthcare professionals.

However, this study has several limitations. First, the sample size is relatively small and may not be representative of the general population of pregnant and breastfeeding women in Kei Besar Island. The samples may also be affected by selection bias, as patients who sought mobile ultrasound services tended to have a higher awareness of health, potentially excluding women with lower health awareness. Lastly, the study's descriptive design does not allow us to establish associations between the characteristic variables and the reports of exclusive breastfeeding. These limitations should be considered when interpreting the study's results. Future research should aim to include a more diverse population and a larger sample size. Analytic approaches should be employed to establish associations, and a mixed-method approach should be used to incorporate perspectives and experiences that may influence breastfeeding decisions among women.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study reveal a persistent lack of knowledge among pregnant and breastfeeding women on Kei Besar regarding exclusive breastfeeding. Furthermore, misconceptions are prevalent, serving as barriers to adhering to the recommended practice of providing infants with only breast milk for the first six months of life. Addressing this knowledge gap and misconceptions is of paramount importance, and it necessitates the implementation of effective nutrition education strategies. To achieve this, it is imperative to conduct training sessions for midwives at Posyandu, enhancing their capacity to promote and support exclusive breastfeeding during antenatal visits. The active involvement of families is equally crucial, as they exert a significant influence on women's nutrition intake and breastfeeding decisions. Consequently, families should be targeted as a part of future intervention efforts.

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The effectiveness of WHO Anthro training in improving the data quality of nutritional status of preschool children

Evi Wahyuntari[1], Faurina Risca Fauzia[2]

[1]Department of Midwifery, Faculty of Health Sciences, Universitas Aisyiyah Yogyakarta, Jalan Siliwangi 63, Sleman Yogyakarta,
[2]Department of Nutrition, Faculty of Health Sciences, Universitas Aisyiyah Yogyakarta, Jalan Siliwangi 63, Sleman Yogyakarta,

Correspondence: evi.wahyuntari@unisayogya.ac.id

ABSTRAK

Latar Belakang: *Masalah triple burden di Indonesia menjadi salah satu target dari Sustainnable Development Goals (SDGs) yang harus segera diselesaikan karena berkaitan dengan penurunan kematian balita akibat gizi buruk. Deteksi dini tumbuh kembang anak belum optimal mengatasi masalah gizi karena masih ada guru yang masih kesulitan menentukan status gizi sehingga data yang dilaporkan masih manual dan belum akurat..*
Tujuan: *Melihat efektifitas pemberian pelatihan WHO Anthro terhadap kualitas data status gizi anak sekolah.*
Metode: *Penelitian Quasi Eksperimental dengan rancangan pretest-postest equivalent repeated measured, menggunakan dua kelompok. Penelitian dilakukan bulan Januari-Maret 2023. Sampel sejumlah 40 guru terbagi dalam 2 kelompok sama rata. Guru TK ABA di Kapenawon Gamping yang berstatus aktif dan sudah mengisi informed consent, akan masuk menjadi responden. Peserta pelatihan yang tidak mengikuti tes sebanyak 3 kali akan dieksklusi. Kelompok kontrol dilatih pengeplottan status gizi menggunakan grafik WHO dan kelompok perlakuan dilatih menggunakan aplikasi WHO Anthro Plus. Pelatihan dilakukan selam 2 bulan untuk menilai pretes, midtes, dan postes. Analisa data menggunakan Uji Friedman dilanjutkan dengan uji post hoc Tukey HSD.*
Hasil: *Hasil uji friedman, kelompok yang dilatih menggunakan aplikasi WHO Anthro Plus terbukti kualitas data status gizi yang dihasilkan signifikan berbeda dengan nilai p value= 0,000 (p<0,05) baik dari aspek keakuratan data maupun manfaatnya. Hasil Post hoc Tukey HSD membuktikan bahwa dari tiga kali penilaian kualitas data, penilaian yang dilakukan setelah dua bulan dari pelatihan terbukti signifikan berbeda p-value=0,007 (p<0,05). Hal ini disebabkan peserta pelatihan langsung mempraktekkan WHO Anthro Plus di sekolah masing-masing.*
Kesimpulan: *Aplikasi WHO Anthro Plus terbukti memudahkan guru TK/PAUD dalam penentuan status gizi dan laporan status gizinya menjadi lebih berkualitas karena lebih akurat dan bermanfaat untuk deteksi dini tumbuh kembang anak di tiap sekolah*

KATA KUNCI*: gizi; pelatihan guru; WHO Antrho; stunting*

ABSTRACT

Background: *The triple burden problem in Indonesia has become one of the Sustainable Development Goals (SDGs) targets that must be urgently addressed due to its critical role in reducing toddler mortality attributed to malnutrition. However, the early detection of child growth issues is not optimal because some teachers still struggle to determine nutritional status, resulting in manual and inaccurate data.*

Objectives: *This study aims to assess the effectiveness of providing WHO Anthro training on the quality of nutrition status data for schoolchildren.*

Methods: *This research employs a quasi-experimental design with a pretest-posttest equivalent design, measured repeatedly, using two groups. The study was conducted from January to March 2023. A total of 40 ABA School Teachers at Kapenawon Gamping who had provided informed consent participated as respondents. Training participants who did not pass the test three times were excluded. The control group received training on plotting nutritional status using WHO charts, while the treatment group was trained using the WHO Anthro Plus application. The training spanned two months, including pre-tests, mid-tests, and post-tests. Data analysis involved the Friedman test followed by the Tukey HSD post hoc test.*

Results: *The results of the Friedman test revealed a significant difference in the quality of nutritional status data produced by the group trained using the WHO Anthro Plus application (p-value = 0.000, p<0.05). This difference was observed in both data accuracy and the perceived benefits. This improvement occurred because training participants were able to practice using WHO Anthro Plus in their respective schools.*

Conclusions: *The study concludes that the WHO Anthro Plus application facilitates school teachers in determining nutritional status more accurately and efficiently. As a result, the reported data is of higher quality, enhancing the early detection of child growth issues in schools.*

KEYWORDS*:* *data quality; kindergarten teacher; training; stunting; WHO Anthro*

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INTRODUCTION

Nutrition in Indonesia remains a significant issue. It has even become a target of the Sustainable Development Goals (SDGs) due to its critical role in reducing toddler mortality attributed to undernutrition or malnutrition (1). Nutritional issues in Indonesia are characterized by a triple burden, encompassing undernutrition, overnutrition concerning macronutrients, and undernutrition related to micronutrients. These complex nutritional challenges threaten the quality of Indonesia's future generations (2).

According to the Indonesian Nutritional Status Survey (SDKI) 2021, the prevalence of stunting was 4.4% (3). In contrast, based on the SDKI 2018 data, stunting was lower at 19.3%, with malnutrition at 3.9% and overweightness at 8% (4). The health profile of Yogyakarta province revealed a malnutrition and under-nutrition rate of 8.3%, while stunting occurred at a rate of 11.08% and overweightness occurred at a rate of 3.14% (5).

Inadequate nutritional intake in children can disrupt their growth and development. It worsens when the condition remains unsolved, posing a risk of illness and death in children. Insufficient nutritional intake may compromise their immune system, rendering children more susceptible to diseases (6). Preventing and addressing nutritional problems in preschool children

involves conducting screenings and surveys. These screenings observe the growth and development of preschool children in various service areas, including health centers, integrated health posts (Posyandu), and educational institutions (7). Developmental screenings are conducted monthly by measuring the weight and height of children. Research conducted on kindergarteners in Semarang using digital scales for weight measurement and microtoise for height measurement can effectively detect nutritional problems in preschoolers (8).

Challenges persist due to teachers' lack of knowledge regarding proper growth measurement, the use of non-standard measuring instruments, and interpreting measurement results. In a community service conducted by Wahyuntari, it was found that in observing children's growth conducted by cadres, there was no plotting in the Growth Chart (KMS), resulting in a lack of result interpretation (9). Inputting weight and height measurements' growth data is imperative for early detection of nutritional problems (10). Similarly, previous research highlighted the absence of growth observation involving plotting weight and height measurements' results, leading to a lack of interpretation of children's nutritional status (11). In previous research, an improvement was observed in the quality of nutritional status information and the quantity of beneficial output information for planning, monitoring, and evaluating nutrition programs in the same research (12).

Considering the aforementioned challenges and gaps in previous research, this study aims to assess the effectiveness of teacher training in utilizing the WHO Anthro to enhance the quality of nutritional status data for students. This effort targets early detection of nutritional problems. The novelty of this research lies in involving schools in addressing malnutrition issues, equipping teachers at TK ABA to determine nutritional status using the WHO Anthro Plus application.

MATERIALS AND METHODS

Quasi-Experimental Quantitative Research design and samples

The research design employs a pretest-posttest equivalent repeated measures approach and utilizes two randomly assigned groups. The study was conducted from January to March 2023 at 20 TK ABA Kapanewon Gamping clinics. The total population of TK ABA teachers in the Kapenawon Gamping region, consisting of 98 individuals, serves as the affordable population for this study. A sample of 40 ABA gym teachers was selected, with 20 individuals forming the case group and 20 serving as the control group, chosen through random sampling techniques. Exclusion criteria include individuals who did not attend the training sessions and those who did not complete the data quality questionnaire on three separate occasions. The research has been registered with the ethics certificate from Aisyiyah Yogyakarta University's ethics committee number 2595/KEP-UNISA/II/2023.

Data collection

The research instrument comprises a questionnaire assessing respondent characteristics and the quality of nutritional status information data. This questionnaire has undergone validation and demonstrates a reliability of 0.67 and 0.63. Evaluations of nutritional status information data quality are obtained from observational assessments conducted during pre-tests, mid-tests, and post-tests. Two key aspects assessed for data quality include the accuracy of the produced data and the perceived benefits reported by the teachers. The training sessions spanned two days and were conducted in two groups. The case group received training on utilizing the WHO Anthro Plus software, whereas the control group received training on manually interpreting and determining the nutritional status of preschool children using WHO graphs. There was a two-month interval between the first and second training sessions to allow participants to implement anthropometric measurement data collection in their respective schools.

Statistical Analysis

Data analysis was performed using the Friedman test. After a difference in the average quality of nutritional status data was confirmed, the Post Hoc Tukey HSD test was conducted to identify which assessment group demonstrated the most significant difference in data quality within each case and control group.

RESULTS AND DISCUSSION

Research Subject Characteristics

The characteristics of research subjects comprise the aspect of age and latest education, in which both have equal proportion in the case group and control group.

Table 1. The Distribution of Research Subject Characteristics Based on Research Group

Variable	Research Group			
	Case		Control	
Age (years)	**n**	**%**	**n**	**%**
Productive (20-35)	5	25%	6	30%
Non-Productive (<20 or >35)	15	75%	14	70%
Education				
High	18	90%	17	85%
Middle	2	10%	3	15%

Table 2 illustrates that within the case group, fifteen respondents (75%) were of non-productive age, whereas in the control group, there were fourteen (70%). The majority of teachers in TK ABA hold higher education qualifications, with 18 individuals (90%) in the case group and 17 individuals (85%) in the control group having completed associate or bachelor's degrees. This suggests that the teachers in TK ABA in Kapenawon Gamping generally possess a solid educational background, having attained at least an associate or bachelor's degree. While most TK ABA teachers may not be within the productive age range, their enthusiasm for work remains high, likely honed during their active involvement in the Muhammadiyah/'Aisyiyah organization during their youth. A teacher is an individual possessing a professional diploma and specialized expertise in education. Their primary responsibilities include educating, teaching, guiding, training, examining, and evaluating students across various educational stages (14), as defined in the Indonesian Constitution No. 20 of the National Education System in 2003. The stages of education correspond to learners' developmental phases, the intended objectives, and the skills to be mastered. For preschool/kindergarten education, teachers are required to hold academic qualifications of at least an associate degree (DIV) or a bachelor's degree (S1), as stipulated by the Department of Education in 2007 (Departement of Education, 2007).

Adherence to these regulations is in line with the Educational Minister's directives in 2007. The professionalism of teachers significantly impacts early childhood education, enabling them to innovate and devise diverse lessons to remain abreast of current conditions and developments (15). Generally, younger teachers tend to offer more engaging lessons, with age impacting a teacher's professionalism and performance (16). Studies, such as Sebayang (2020), have demonstrated that a teacher's educational background significantly influences their performance, leading to enhancements in motivation and work ethics (14).

The Data Quality of Nutritional Status
WHO Anthro Plus Application Training Group

The analytical data analysis includes normality and homogeneity tests conducted on two facets of data quality: data accuracy and benefits in the teacher group receiving WHO Anthro Plus training. The evaluation of data quality reveals an overall improvement in results before, during, and two months after the training sessions.

The Shapiro-Wilk test for data normality across the three repetitions in assessing data quality in terms of accuracy and benefit indicates that most p-values are < 0.05. This implies that the data from the three evaluation repetitions in each aspect data accuracy and benefit do not exhibit a normal distribution. Conversely, the homogeneity test shows p-values > 0.05, signifying that all data repetitions in both the aspects of data accuracy and benefit demonstrate homogeneity. Detailed results are presented in **Table 3**.

Table 2. The Average of Data Quality in WHO Anthro Plus Application Training

Aspect of Data Quality	Pre -test	X^2	Mid-Test	X^2	Post-test	X^2
	Mean ± SD		Mean ± SD		Mean ± SD	
Data accuracy	76.65 ± 14.072	0.066 (0.541)	85.35 ± 10.604	0.010* (0.001)	87.90 ± 12.082	0.008* (0.541)
Benefit	69.50 ± 11,033	0.076 (0.575)	81.05 ± 11.232	0.356 (0.001)	90.70 ± 26.49	0.076 (0.575)

**)Significant on CI:95%*

Following the analysis presented in **Table 3**, the data examination proceeded with bivariate analysis utilizing the Friedman test to evaluate variations in the mean rank value among all sample groups measured three times or more at different intervals.

As depicted in **Table 4** blow, a noteworthy variation is observed in the aspects of data accuracy and benefit concerning the assessment of data quality from the pre-test, mid-test, and post-test stages subsequent to the WHO Anthro Plus training, displaying a significant p-value of 0.000 ($p<0.05$). The statistical analysis substantiates a substantial improvement in the mean score of the data accuracy aspect, rising from 76.65 ± 14.072 in the pre-test to 87.90 ± 12.082 after the training. Furthermore, there was another noticeable increase to 90.70 ± 26.49 observed after two months of training.

Table 3. The Disparity of Data Quality Assessment after WHO Anthro Plus Training

Aspect of Data Quality	Pre-test	Mid-Tes	Post-test	N	X^2
	Mean Rank	Mean Rank	Mean Rank	Chi^2	
Data Accuracy	1.33	2.10	2.58	20 (22.750)	0.000*
Benefit	1.18	2.05	2.78	20 (32.094)	0.000*

**) significant on CI:95%, df=2*

The research findings align with Al Rahmad's study (2020), indicating that training utilizing WHO Anthro effectively enhances the quality of nutritional status information within a month of training (13). Training serves as a fundamental method to enhance data quality, involving a series of planned events aimed at improving participants' skills, knowledge, experience, or behavior change. Previous studies supporting this research have emphasized the effectiveness of training in determining children's nutritional status to prevent stunting by employing applications with audio-visual mediums. These studies have shown significant improvement in respondents' competence and knowledge, elevating scores from 60 in the pre-test to 80 in the post-test (p=0.000). The implementation of training for preschool/kindergarten teachers holds the potential to optimize their roles in preventing stunting among preschool children (17). Moreover, web/application-based education on nutrition offers advantages in terms of user-friendliness and enhancing skills in observing

children's nutritional status compared to conventional methods (18).

WHO Graph Plotting Training Group

Table 5 presents the outcomes of normality and homogeneity tests conducted on two aspects of data quality, specifically data accuracy and benefit, within the control group. In the teacher group trained in plotting WHO Anthro manual graphs, improvements in data quality were observed on average. Regarding the results of data normality obtained from the Shapiro-Wilk test for each assessment repetition in terms of quality assessment based on data accuracy and benefit, it was noted that some displayed a p-value < 0.05. This indicates that the data from the pre-test, mid-test, and post-test in both aspects of data accuracy and benefit do not exhibit a normal distribution. Conversely, the results from the homogeneity test revealed a p-value < 0.05, signifying that all data repetitions analyzed from the perspectives of data accuracy and benefit indicate non-homogeneity within the data set. Upon evaluating the data quality in the control group, it was observed that the data did not follow a normal distribution.

Table 4. The Mean Value of Data Quality on the Training of WHO Anthro Manual Graphic

Aspect of Data Quality	Pre-test	X^2	Mid-Test	X^2	Post-test	X^2
	Mean ± SD		Mean ± SD		Mean ± SD	
Data Accuracy	79.25 ± 21.59	0.113 (0.001)	89.25 ± 12.38	0.785 (0.000)	90.25 ± 11.97	0.999 (0.001)
Benefit	79.50 ± 21.08	0.004* (0.001)	87.50 ± 14.00	0.986 (0.000)	91.50 ± 9.74	0.492 (0.001)

**)Significant on CI:95%*

Consequently, the bivariate analysis utilized the Friedman test to identify significant differences among each repetition of the data quality analysis in the control group. As depicted in Table 6, a noteworthy disparity was observed in the data quality assessment between the pre-test, mid-test, and post-test stages subsequent to receiving the training materials, demonstrating a significant p-value of 0.000 (p<0.05). The statistical analysis confirms variations in the aspect of data accuracy, transitioning from an initial mean of 79.25 ± 21.599 to 90.25 ± 11.973. Similarly, in the aspect of benefit, a disparity was observed, starting from an initial mean of 79.50 ± 21.083 and rising to 91.50 ± 9.747 after two months of training.

Table 5. The Disparity of Data Quality Assessment after Plotting WHO Manual Graphic

Aspect of data quality	Pre -test	Mid-Test	Post- test	N	X^2
	Mean Rank	Mean Rank	Mean Rank	Chi^2	
Data Accuracy	1.45	2.23	2.33	20 (20.971)	0.000*
Benefit	1.45	2.05	2.50	20 (21.143)	0.000*

The training sessions introducing the utilization of WHO Anthro for kindergarten teachers serve as a pivotal step toward preventing stunting in preschool children. WHO Anthro Plus facilitates the easy determination of children's nutritional status by providing automatic interpretations of z-score measurements for each indicator, making it user-friendly. In addition to using the application, nutritional status determination can also incorporate the manual use of the standard growth chart provided by WHO Anthro. However, despite the improvement observed in data quality after employing WHO Anthro or the WHO standard manual growth chart in this research,certain challenges persist in using the manual growth chart. Teachers encounter

difficulty in interpreting children's nutritional status beyond merely measuring and plotting the graph. This aligns with Hadi's research (2018), indicating that while the manual growth chart is user-friendly, difficulties arise in interpreting the growth curve based on sex and months (19).

Outside of school, manual records of nutritional status are maintained at Public Health Center (Puskesmas) Kasihan I. Here, the plotting of nutritional status utilizing the Growth Chart (KMS) according to WHO standards has led to some inaccuracies in reported data. This inaccuracy resulted in an underutilization of data, with a reported data incompleteness rate of 9.75% in the 2019 nutritional data report (20). Despite encountering issues within our research subjects, Table 6 shows a significant difference in the average data quality. Respondents in this research were proficient in generating nutritional status reports. This proficiency is evident in the increased average scores of data accuracy from 79.25 ± 21.599 to 90.25 ± 11.973 and the benefit score from 79.50 ± 21.083 to 91.50 ± 9.747 after two months of training. This achievement is attributed to the high motivation and dedication of participants who actively engage in nutritional problem screening among preschool students, especially in Gamping, an area still facing stunting concerns since 2021 (21) and remains a focal location for stunting (22).

One crucial aspect assessed for accuracy in this research is the anthropometric measurement method (weight and height). It is imperative to employ standardized methods and equipment for children's anthropometric measurements (23). In this research, digital scales and microtoise were utilized, and teachers were trained in proper weight and height measurement procedures.

For instance, while measuring weight, it was recommended for students to wear minimal clothing/footwear/hats/bags to avoid measurement bias (23). Another crucial aspect for accuracy pertains to the provision of data required to measure nutritional status, particularly the children's age in months for those aged 0-72 months (7). Age significantly influences nutritional status determination, and any error in noting children's age in months could lead to misinterpretation of nutritional status (6).

The disparity in data quality between both training groups indicates substantial differences in the assessment of data quality in the treatment group regarding the aspect of benefit compared to the control group for the same aspect, with a p-value of 0.001 ($p < 0.05$). This conclusion is substantiated by WHO Anthro Plus application v 1.0.0, which offers three user-friendly features facilitating research subjects' understanding and usage. These features significantly enhanced participants' abilities, notably improving from the initial score of 69.50 ± 11.033 to 90.70 ± 26.49 ($p=0.001$).

The anthropometry calculator feature simplifies determining children's nutritional status across weight/age (BB/U), height/age (TB/U), and body mass index (BMI/U). Categories are color-coded, aiding participants in easy identification. Additionally, the individual assessment feature allows participants to save students' anthropometric measurements monthly, aiding teachers in accessing previous measurements due to the program's seamless data integration. The nutrition survey feature enables kindergarten teachers to map students' nutritional status based on location (24). The significant improvement in benefit and data accuracy after employing the WHO Anthro application aligns with previous research. It highlights a 13.6% enhancement in the quality of nutritional status data among Nutrition Service Officers (TPG) at Public Healthcare Centers (Puskesmas) in Aceh, with a deviation of 5.623 and a 95% CI in accuracy and benefit aspects, each with $p=0.000$, after a month of WHO Anthro software-based training (25).

The Effectiveness of Training towards the Data Quality of Nutritional Status in Preschool Students

WHO Anthro Plus Application Training Group

Statistical analysis demonstrates a 90% confidence interval (CI) in two aspects of data quality: data accuracy and benefit. Within the case group's data accuracy aspect, a

substantial average disparity of 11.25 with a standard error of 3.559 was observed from the pre-test to the mid-test, exhibiting a significant p-value of 0.007 ($p < 0.05$). Additionally, an average disparity of 8.700 with a standard error of 3.559 was noted from the mid-test to the post-test, with a significant p-value of 0.046 ($p < 0.05$). In contrast, concerning the benefit aspect, a considerable average disparity of 21.200 with a standard error of 5.626 was identified from the pre-test scores to the mid-test, with a p-value of 0.001 ($p < 0.05$) within a 95% confidence interval. The results of the post hoc test are detailed in **Table 7**.

Table 6. The Effectiveness of WHO Anthro Plus Training towards the Disparity of Data Quality

Aspects of Data Quality	Pre-test – Mid-test		Mid-test – Post-test	
	Mean ± SD	P-value (95% CI)	Mean ± SD	P-value (95% CI)
Data Accuracy	11.25 ± 3.56	0.007* (2.68-19.82)	-8.70±3.55	0.046* (-17,27-(-0.13))
Benefit	21.20 ±5.62	0.001* (7,66-34.74)	-11,55±5.62	0.109 (-25.09-1.99)

**)Significant on CI:95%*

The outcomes of the research affirm that the WHO Anthro Plus training administered to kindergarten teachers significantly enhances their skills in utilizing digital applications, as demonstrated by a p-value of 0.001 ($p < 0.05$). The term “benefit” extends beyond the mere outcome of data reporting from WHO Anthro Plus; it encompasses the enhancement of kindergarten teachers’ proficiency in using digitally-based applications. Previous research has revealed that some teachers possess relatively low technological maturity levels, necessitating improvement through training and innovative activities aimed at mastering digital technology (26).

The challenges posed during the COVID-19 pandemic have exacerbated efforts to combat stunting problems in Indonesia due to limitations in human resources at the primary care level in both healthcare and schools. There is a pressing need to enhance digital literacy among existing resources to effectively utilize software-based information systems for recording nutritional status (27). Remarkably, research subjects within the treatment group displayed adaptability in the post-COVID-19 pandemic setting, enabling nearly every teacher to benefit from utilizing the WHO Anthro Plus application.

In terms of benefit, teachers in the treatment group gained insights into interpreting nutritional status measurement results that were previously unknown to them. The training provided to teachers serves as a pivotal step in screening children’s nutrition problems and identifying stunting conditions. By understanding students’ nutritional statuses, teachers can offer guidance on balanced nutrition through the Balanced Nutrition Guide (PGS) (21). This guidance is intended for students to apply in their daily lives, such as through packed lunches. This aligns with Imani’s research (2017), indicating that students’ nutrition knowledge improves from low to sufficient levels after receiving nutrition lessons from teachers (28).

Furthermore, in addition to informing teachers of the students’ nutritional statuses, the results of anthropometric measurements are communicated to parents. This communication enables parents or primary caregivers to comprehend their children’s nutritional statuses. With this knowledge, it is hoped that parents can optimize their understanding to monitor children’s nutritional intake by regularly reporting students’ growth and development results (29).

WHO Graph Plotting Training Group

In terms of data accuracy, statistical analysis within a 95% confidence interval (CI) indicates an insignificant average disparity of 11.00 with a standard error of 5.044 from the pre-test score to the mid-test, with a p-value of 0.083 ($p > 0.05$). Similarly, from the mid-test to the post-test, there is an average disparity of 10.000 with a standard error of 5.044, yielding a p-value of 0.126 ($p > 0.05$). Conversely, concerning the benefit aspect, a statistically significant disparity is evident within a 95% CI. There is a substantial average disparity of 12.000 with a standard error of 4.952 from the pre-test to the mid-test, resulting in a p-value of 0.048 ($p < 0.05$). The detailed results of the post hoc test are presented in **Table 8**.

Table 7. The Effectiveness of Training on WHO Graph Plotting towards the Disparity of Data Quality

Aspects of Data Quality	Pre-test – Mid-test		Mid-test – Post-test	
	Mean ± SD	P-value (95% CI)	Mean ± SD	P-value (95% CI)
Data Accuracy	11.00±5.04	0.083 (-1.14-23.14)	-10.00±5.04	0.126 (-22.14-2.14)
Benefit	12.00±4.95	0.048* (0.08-23.92)	-8.00±4.95	0.247 (-19.92-3.92)

*)Significant on CI:95%

The outcomes of the "multiple comparisons" post hoc tests employing Tukey HSD reveal that in the aspect of data accuracy, the average disparity from the pre-test to mid-test and from mid-test to post-test is insignificantly different, indicated by an asterisk (*) or p-value > 0.05. Conversely, in the aspect of benefit, there exists a significant difference in the average scores from the pre-test to mid-test with a p-value of 0.048 ($p < 0.05$). However, there is no significant difference in scores from the mid-test to post-test, yielding a p-value of 0.247 ($p > 0.05$). Consequently, it can be concluded that the scores obtained from WHO Anthro plotting training do not exhibit significant disparity in the data quality produced. Despite the inadequacy of the WHO manual graph in generating accurate data, it remains beneficial as it provides information about students' nutritional status to parents.

The significance of counseling and training for preschool teachers is highlighted by a survey conducted among 200 teachers, revealing that a majority (69.85 ± 16.34 or 83.5%) possess little to no knowledge about nutrition, and a considerable portion (66.54 ± 18.71 or 22%) have never received education on children's nutrition (30). This aligns with the scenario among TK ABA teachers in the Kapanewon Gamping area, where most teachers are female and have limited experience in nutritional counseling or training. Hence, there is a crucial need to educate them, particularly in determining the nutritional status of preschool children.

This research emphasizes that the TK ABA teachers involved were initially unfamiliar with determining nutritional status using WHO Anthro, evident in the significantly different average results between the pre-test, mid-test, and post-test, with a p-value of 0.007. Before the training, teachers were unable to interpret anthropometric measurements, leading to a lack of knowledge about the students' nutritional status. Preschool institutions should offer services, including counseling and training about health, growth and development, and preschool children's nutrition, to contribute to addressing children's nutritional issues (31).

CONCLUSIONS AND RECOMMENDATIONS

The training of WHO Anthro usage and WHO manual growth chart was proven effective in the improvement of data quality, seen from the aspect of data accuracy and the aspect of benefit. Notably, teachers who received WHO Anthro Plus training exhibited higher scores in data

quality within the aspect of benefit compared to those trained using the WHO standard manual growth chart. This research strongly recommends the implementation of WHO Anthro among kindergarten/preschool teachers as a valuable tool for the early detection of stunting in preschool children

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Dietary diversity on complementary feeding by maternal employment status during COVID-19 Pandemic

Herwinda Kusuma Rahayu[1], Yhona Paratmanitya[1], Herni Dwi Herawati[1], Esther M Nguyen[2], Rindi Nuryani[1]

[1]Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata Yogyakarta, Jalan Brawijaya 99, Tamantirto Yogyakarta,
[2]Johns Hopkins University Bloomberg School of Public Health

Corresponding author: herwinda@almaata.ac.id

ABSTRAK

Latar Belakang: *Praktik pemberian Makanan pendamping ASI (MPASI) yang tepat selama pandemi COVID-19 menjadi tantangan tersendiri karena kebijakan pemerintah untuk mengurangi penularan virus di tempat kerja seperti perubahan status pekerjaan termasuk bekerja dari rumah. Perubahan status pekerjaan, khususnya bagi ibu bekerja, berkaitan dengan keragaman pola makan dalam praktik pemberian MPASI.*
Tujuan: *Penelitian ini bertujuan untuk menganalisis dampak status pekerjaan ibu terhadap Keanekaragaman Gizi Minimum (MDD) selama pandemi COVID-19.*
Metode: *Penelitian cross-sectional dilakukan dan online self-administered questionnaires digunakan untuk mengumpulkan data dari 403 ibu yang memiliki anak usia 6-23 bulan yang tinggal di Jawa, Indonesia.*
Hasil: *Secara keseluruhan, 91,1% anak memenuhi kriteria MDD. Dalam model yang disesuaikan, anak-anak dengan ibu yang bekerja di luar rumah dikaitkan dengan penurunan peluang mengalami MDD (AOR: 0.85, 95%CI: 0.42-0.98). Faktor yang berhubungan dengan MDD pada praktik pemberian MPASI adalah daerah tempat tinggal (AOR: 0.12; 95%CI: 0.03-0.54), usia anak (AOR: 2.93; 95%CI: 1.12-7.67), dan usia ibu (AOR: 1.39 ; 95%CI: 1,16-3,93).*
Kesimpulan: *Praktik pemberian makanan pendamping ASI dipengaruhi oleh status pekerjaan ibu selama pandemi. Namun demikian, strategi lain untuk meningkatkan keragaman pangan MPASI diperlukan untuk mencegah malnutrisi pada anak dengan meningkatkan pengetahuan ibu terkait gizi anak, khususnya pada ibu bekerja.*

KATA KUNCI*: COVID-19;keanekaragaman pangan minimum; pemberian makanan pendamping ASI; status pekerjaan ibu*

ABSTRACT

Background: *Appropriate complementary feeding practices during the COVID-19 pandemic are challenging due to government policies to reduce the virus transmission in workplace such as changes of employment status including working from home . The changes of employment status, especially for working mothers was related to the dietary diversity of complementary feeding practice.*
Objectives: *This study aimed to analyze the impact of maternal employment status on Minimum Dietary Diversity (MDD) during the COVID-19 pandemic.*
Methods: *A cross-sectional study was conducted, and online self-administered questionnaires were used to collect data from 403 mothers of children ages 6-23 months who live in Java, Indonesia.*

Results: *Overall, 91.1% of the children met the criteria for MDD. In the adjusted model, children with mothers who work outside of home were associated with a reduced odds of meeting MDD (AOR: 0.85, 95%CI: 0.42-0.98). The factors related to MDD on complementary feeding practices were area of residence (AOR: 0.12; 95%CI: 0.03-0.54), child's age (AOR: 2.93; 95%CI: 1.12-7.67), and maternal ages (AOR: 1.39; 95%CI: 1.16-3.93).*
Conclusions: *Complementary feeding practices were impacted by maternal employment status during pandemic. However, other strategies to increase dietary diversity of complementary feeding are needed to prevent child malnutrition by increasing maternal knowledge related to child nutrition, especially for working mothers.*

KEYWORDS*:* *Complementary feeding; COVID-19, Minimum dietary diversity, Maternal employment status*

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INTRODUCTION

The COVID-19 pandemic was first identified in Wuhan, China in 2019. The virus spread throughout the world, reaching Indonesia in 2020. Due to the highly contagious airborne transmission, several policies were applied related to physical restriction (1,2). In working environments, the government implemented work from home policies for non-essential businesses and work from office for essential businesses. Work from home policies were known to have positive impacts on employees such as shorter work duration that increases leisure time and family care responsibilities. However, work from home also could increase stress and depression (3). The changes of employment status, especially for working mothers, were related to the quality of infant feeding practice (4,5).

Infant feeding practices are an important aspect to improving child survival and promoting child growth and development. The first two years of a child's life are a crucial window of opportunity to assure growth and development (6). Appropriate infant feeding practices can prevent nearly 19% deaths of all under-five aged children (7). The World Health Organization (WHO) recommends children age 6-24 months should be given complementary food with continuing breastfeeding up to two years (8). Appropriate complementary feeding practices are required to support growth and development and to prevent growth faltering and malnutrition including stunting, wasting, and underweight (9–11). Complementary feeding practices incorporate several components including adequate nutrition, proper meal frequency based on the age of infants, and minimum required food groups or Minimum Dietary Diversity (MDD). Consumption of five or more food groups out of the eight food groups provided higher dietary quality and ability to meet daily energy and nutrient requirements (12).

A previous study in Daerah Istimewa Yogyakarta showed that 44% of infants had inappropriate complementary feeding during the COVID-19 pandemic (13). The research by Pradeilles et al from Peru found that the minimum dietary diversity score on complementary feeding was higher during COVID-19 than pre-COVID-19 pandemic (14). A study done in North West Amhara, Ethiopia showed that housewives or mothers who worked from home had twice the chance of meeting MDD (13,15).

Java is the center of the Indonesian economy, which has been affected by changes of employment status during COVID-19 pandemic. A national survey of appropriate complementary feeding practices during the COVID-19 pandemic was unavailable in Indonesia, especially in all

areas of Java Island. This study aimed to analyze the impact of maternal employment status on complementary feeding practices, especially MDD, during the COVID-19 pandemic, and factors associated with MDD of complementary feeding practice in Java, Indonesia.

MATERIALS AND METHODS

Study design

A cross-sectional study design was used with convenience sampling on 403 mothers with children aged 6-23 months during the COVID-19 pandemic who lived in Java, Indonesia. An online self-administered questionnaire from April 2022 to May 2022 was distributed through social media, including Instagram, WhatsApp, Line, Facebook, and Twitter. Data was collected from local community organizations, such as the Association of Indonesian Breastfeeding Mothers in the Java region as an efficient method to reach respondents. The study was approved by the Research Ethics Committee of Faculty of Health Sciences, Universitas Alma Ata (KE/AA/ VI/ 10832/ EC/ 2022). All protocols concerning the study participants were kept private and used exclusively for the purpose of the study. This protocol was carried out in compliance with the Declaration of Helsinki's principles. An informed consent form was signed digitally by the respondent before initiating the survey. The self-administered structured online questionnaire consisted of two parts (1) Sociodemographic characteristics (2) Food group consumption on complementary feeding.

Outcome variables

The outcome variables were complementary feeding practices including food group consumption and MDD. Food group consumption on complementary feeding was defined as children 6-23 months who consumed each food group on the previous day. The eight food groups recommendations based on Infant and Young Child Feeding (IYCF) from UNICEF and WHO 2021 (12) guidelines included (1) Breastmilk; (2) Grains, root, and tubers such as rice, noodle, cassava, potato, etc.; (3) Legumes, nuts, and seeds such as tempeh, tofu, beans, etc.; (4) Dairy products such as milk, cheese, yoghurt, etc. (5) Eggs; (6) Flesh food such as meat, poultry, fish, seafood, organ meats, etc.; (7) Vitamin A rich fruits and vegetables such as pumpkin, carrot, papaya, dark leafy vegetable, etc.; (8) Other fruits and vegetables such as apple, banana, cauliflower, etc. Appropriate MDD was defined as children who consumed foods and beverages from at least five out of eight defined food groups during the previous day.

Explanatory variables

The explanatory variables included sociodemographic characteristics, such as the area of residence of five provinces in Eastern Java, Central Java, Western Java, DI Yogyakarta, and DKI Jakarta, child's age (6-11, 12-17, and 18-23 months), child's gender (male and female), maternal educational level (low if junior high school and below, middle if senior high school, and high if the college or above), maternal ages (18-25, 26-35, and >36 years), maternal employment type (housewife/ unemployed, government employees, and private employees), maternal employment status (housewife/ unemployed, work from home, and work away from home), father's occupation (unemployed, government employees, and private employees), and household income level was defined based on median income quintiles (low if IDR <= 3.000.000, middle if IDR > 3.000.000 - 3.500.000, and high if IDR > 3.500.000). Maternal employment status was based on the mother's work location, work from home if the mother fulfilled their role from home instead of in an office environment, and work away from home if the mother fulfilled their role from an office or outside home environment, and housewife/ unemployed.

Data analysis

Food group consumption and sociodemographic data were analyzed using a descriptive analysis for frequency distribution. A Pearson's Chi-Square test ($p<0.05$) was used to conduct a bivariate analysis of food group consumption and maternal employment status. For adjusted analyses, multinominal logistic regression analysis was used to estimate the adjusted odds ratios and 95% confidence intervals

for the association between MDD and variables related to sociodemographic characteristics. Statistical analyses were computed using Statistical Package for Social Sciences (SPSS) 26 Software (IBM Corp, Armonk, NY).

RESULTS AND DISCUSSION

The number of total respondents **(Table 1)** were 403 mothers of children aged 6-23 months who lived in Java, Indonesia. Majority of respondents were from Western Java (32.5%) and were from low-income level households (55.3%). Most mothers were housewives/ unemployed (61.8%) and in the middle level of education status (64.3%). Among the working mothers, the majority were private employees (26.1%). Most mothers worked away from home (25%).

Table 1. Respondent Characteristic (N=403)

Characteristic	Frequency (n)	Percentage (%)
Area of residence		
Eastern Java	65	16.1
Central Java	109	27.0
Western Java	131	32.5
DI Yogyakarta	72	17.9
DKI Jakarta	26	6.5
Child's age		
6-11 months	166	41.2
12-17 months	155	38.5
18-23 months	82	20.3
Child’s gender		
Male	212	52.6
Female	191	47.4
Maternal educational level		
High	3	0.7
Middle	259	64.3
Low	141	35.0
Maternal ages		
18-25 years	111	27.5
26-35 years	264	65.5
>36 years	28	8
Maternal employment type		
Housewife/ Unemployed	249	61.8
Government employees	49	12.2
Private employees	105	26.1
Maternal employment status		
Housewife/ Unemployed	249	61.8
Work from home	53	13.2
Work away from home	101	25.0
Father’s occupation		
Unemployed	2	0.5
Government employees	115	28.5
Private employees	286	71.0

Household income level		
High	159	39.5
Middle	21	5.2
Low	223	55.3
Minimum Dietary Diversity (MDD)		
Yes	367	91.1
No	36	8.9

Table 2 shows that mothers who work away from home during the COVID-19 pandemic were statistically significant and have decreased odds of food group consumption, such as breast milk (OR: 0.42; 95%CI: 0.23-077), eggs (OR: 0.57; 95%CI: 0.35-0.93), and flesh food (OR: 0.53; 95%CI: 0.29-0.94). Plant based foods have no significant association with maternal employment status, including grains, root, and tubers; legumes, nuts, and seeds; vitamin A rich fruits and vegetables; and other fruits and vegetables. Minimum dietary diversity (OR: 0.46; 95%CI: 0.22-0.96) also decreased among mothers who work away from home than housewives/unemployed during the COVID-19 pandemic.

Table 2. Consumption of each food group on complementary feeding during COVID-19 pandemic by maternal employment status

Maternal employment status	Food group consumption				OR	95% CI	p-value
	Yes		No				
	n	%	n	%			
Breast milk							
Work away from home	77	76.2	24	23.8	0.42	0.23-0.77	0.005*
Work from home	45	84.9	8	15.1	0.74	0.32-1.73	0.488
Housewife/ unemployed	220	88.4	29	11.6	Ref		
Grains, root, and tubers							
Work away from home	94	93.1	7	6.9	0.34	0.23-1.65	0.339
Work from home	50	94.3	3	5.7	0.69	0.21-2.86	0.697
Housewife/ unemployed	238	95.6	11	4.4	Ref		
Legumes, nuts, and seeds							
Work away from home	76	75.2	25	24.8	0.78	0.45-1.35	0.381
Work from home	44	83	9	17	1.26	0.58-2.75	0.563
Housewife/ unemployed	198	79.5	51	20.5	Ref		
Dairy product							
Work away from home	83	82.2	18	17.8	1.49	0.83-2.69	0.178
Work from home	38	71.7	15	28.3	0.82	0.42-1.59	0.563
Housewife/ unemployed	188	75.5	61	24.5	Ref		
Eggs							

Maternal employment status	Food group consumption				OR	95% CI	p-value
	Yes		No				
	n	%	n	%			
Work away from home	61	60.4	40	39.6	0.57	0.35-0.93	0.025*
Work from home	44	83	9	17	1.84	0.85-3.96	0.121
Housewife/ unemployed	181	72.7	68	27.3	Ref		
Flesh food							
Work away from home	77	76.2	24	23.8	0.53	0.29-0.94	0.030*
Work from home	48	90.6	5	9.4	1.57	0.59-4.22	0.371
Housewife/ unemployed	214	85.9	35	14.1	Ref		
Vitamin A rich fruits and vegetables							
Work away from home	90	89.1	11	10.9	0.64	0.39-1.78	0.636
Work from home	49	92.5	4	7.5	0.69	0.41-3.77	0.696
Housewife/ unemployed	226	90.8	23	9.2	Ref		
Other fruits and vegetables							
Work away from home	73	72.3	28	27.7	0.77	0.46-1.31	0.340
Work from home	44	83	9	17	1.45	0.67-3.15	0.347
Housewife/ unemployed	192	77.1	57	22.9	Ref		
Minimum Dietary Diversity							
Work away from home	87	86.1	14	13.9	0.46	0.22-0.96	0.040*
Work from home	48	90.6	5	9.4	0.70	0.25-1.99	0.509
Housewife/ unemployed	232	93.2	17	6.8	Ref		

OR= Odd Ratio; CI = Confidence Interval; * Statistically significant at p-value <0.05

Based on multivariate analysis (**Table 3**), MDD was lower in children who lived in Eastern Java (AOR: 0.12; 95%CI: 0.03-0.54), Western Java (AOR: 0.24; 95%CI: 0.11-0.55), DI Yogyakarta (AOR: 0.37; 95%CI: 0.16-0.87) and had a working mother who worked away from home (AOR: 0.85; 95%CI: 0.42-0.98). The odds of MDD were increased among younger aged children (AOR: 2.93, 95%CI: 1.12-7.67) and children who had a mother who was 26-35-years-old (AOR: 1.39, 95%CI: 1.16-3.93).

Table 3. Multivariable logistic regression of factors associated with minimum dietary diversity on complementary feeding during COVID-19 pandemic

Characteristic	Minimum Dietary Diversity	
	COR (95% CI)	AOR (95% CI)
Maternal employment status		
Work away from home	0.46 (0.22-0.96)*	0.85 (0.42-0.98)*
Work from home	0.70 (0.25-1.99)	0.88 (0.33-2.49)
Housewife/ unemployed	Ref	Ref

Characteristic	Minimum Dietary Diversity	
	COR (95% CI)	AOR (95% CI)
Area of residence		
Eastern Java	9.94 (2.33-9.39)*	0.12 (0.03-0.54)*
Central Java	2.14 (1.10-4.15)	0.56 (0.28-1.13)
Western Java	4.85 (2.19-9.76)*	0.24 (0.11-0.55)*
DI Yogyakarta	2.52 (1.12-5.69)*	0.37 (0.16-0.87)*
DKI Jakarta	Ref	Ref
Child's age		
6-11 months	3.02 (1.23-7.40)*	2.93 (1.12-7.67)*
12-17 months	1.11 (0.67-1.84)	1.01 (0.92-6.23)
18-23 months	Ref	Ref
Child's gender		
Female	0.97 (0.60-1.57)	
Male	Ref	
Maternal educational level		
Low	0.16 (0.05-0.52)	0.43 (0.18-1.02)
Middle	1.12 (0.67-1.12)	4.49 (0.31-6.02)
High	Ref	Ref
Maternal ages		
18-25 years	1.40 (0.63-3.14)	1.22 (0.24-1.49)
26-35 years	2.57 (1.17-5.64)*	1.39 (1.16-3.93)*
>36 years	Ref	Ref
Maternal employment type		
Private employees	1.05 (0.47-2.34)	
Government employees	0.59 (0.35-1.00)	
Housewife/ unemployed	Ref	
Father's occupation		
Unemployed	1.46 (0.16-13.30)	
Informal worker	2.11 (0.22-19.82)	
Formal worker	Ref	
Household income level		
Low	0.70 (0.27-1.84)	
Middle	0.99 (0.59-1.64)	
High	Ref	

COR= Crude Odd Ratio; AOR= Adjusted Odd Ratio; CI = Confidence Interval; *Statistically significant at p-value <0.05

This study set out to analyze the impact of maternal employment status on complementary feeding practices during COVID-19 pandemic in Java, Indonesia using observational data from April – May 2022. The proportion of maternal employment with work from home or work away

from home status during COVID-19 were 13.2% and 25%, respectively. Maternal employment status had a role in providing appropriate complementary feeding, particularly with meeting the MDD indicator.

This research showed that 45% of working mothers tend to not meet the MDD indicator. Working mothers typically don't have enough time to prepare a variety of food for their children. Mothers who work from home could provide appropriate complementary feeding practice while they are working (16). Working mothers also might have increased workloads that might lead to psychological problems, especially during the COVID-19 pandemic with risk of virus exposure in their environment (17). Mental conditions of working mothers during COVID-19 pandemic could also limit a mother's ability to provide nutritious food (18). Working mothers who are stressed tend to prepare simple meals, which often incorporate low dietary diversity, low animal source food intake, and high cereal intake (19). Mothers' positive emotions were related to greater probability of providing healthy foods, healthy home food environments, and parental role modeling of healthy eating behavior (20). Maternal support systems, such as husbands who had understanding and cooperating attitudes were related to decreased maternal stress and fewer maternal mood disorders (21).

The present findings show significant associations between maternal employment status and breastfeeding practices. Mothers who worked away from home had 42% lower odds of breastfeeding their child compared to housewives/unemployed mothers. This result was similar to the previous study in Taiwan that found how breastfeeding practices decreased when mothers returned to work (22). Basrowi et al stated that 45% of working mothers in Indonesia had stopped breastfeeding because of returning to work (23). Maternal employment can be a barrier to breastfeeding practices when there is no adequate support from family and the workplace (24). Lactation counselors at work, lactation facilities, and support by colleagues at the workplace are critical to help working mothers continue breastfeeding practices (25–27).

Maternal employment status also significantly lowered the odd consumption of eggs and flesh food in complementary feeding, particularly with mothers who worked away from home. This result may be because of the higher workload of working mothers so they didn't have enough time to prepare complementary feeding for their children. Mothers did not have time to provide complementary feeding that required a long duration of processing, such as eggs and flesh food groups compared to other food groups. Eggs and flesh food groups tend to be consumed during weekends or other special occasions days when mothers have more free time to cook rather than on weekdays (28). Consumption of animal source protein foods, including eggs and flesh food will increase dietary diversity (29).

There were several factors influencing MDD compliance, such as area of residence, child's age, and maternal age. The Eastern Java, Western Java, and DI Yogyakarta residents tend to have lower odds of meeting the MDD standard rather than DKI Jakarta, Indonesia's capital city. This condition may be related to economic factors (30,31). Jakarta's minimum salaries are twice as high than other area. Furthermore, reduction of working hours and lay-offs during the COVID-19 pandemic resulted in a decrease of household income (32). A previous study that conducted in Ethiopia showed that a higher household monthly income and being in a higher wealth quintile were positively associated to providing food in adequate minimum dietary diversity for children. Households with high income or wealth provide the opportunity and ability to purchase diverse foods compared to households with low income (33).

Younger children (6-11) had increased odds of meeting the MDD indicator by 2.9 times. This result contrasts from a previous study in Nepal which stated that children 6–11 months and 12–17 months had higher odds of not meeting the MDD (34). This different result may be due to how the previous study used an old version of IYCF with 7 food groups of diverse diets, whereas this study used the new version of IYCF with 8 food groups, which includes breastmilk as one of the food groups. Breastmilk consumption of children 6-11 months was higher than in older children, which resulted in higher MDD compliance in younger children.

Children with a 26-35-year-old mother had

higher odds of meeting the MDD indicator (AOR=1.38, 95%CI: 1.16-3.93). The result is similar to the previous study by Costa et al which stated that children with young mothers tend to have lower dietary diversity score. Lower dietary diversity scores were caused by younger mothers feeding foods with more sugars, oils, as well as salty foods, and less meats, eggs, beans, fruits, and vegetables (35). MDD and maternal ages were correlated with education status and nutrition knowledge. Higher maternal education status correlated to having more knowledge of nutrition and a higher diverse meal preparation practice score (36). During COVID-19 social media was utilized to increase health and nutrition knowledge because of the decrease in accessibility to health services (37,38).

Limitations of this study included barriers to methods, such as only using an online questionnaire due to social distancing protocols. Our sample may be less representative in regard to the diversity of the Indonesian region. This study only represents mothers who can access the internet and fill out the online questionnaire.

CONCLUSIONS AND RECOMMENDATIONS

Most children in this study met the criteria for MDD (91.1%). Meeting the MDD requirements and providing appropriate complementary feeding practices can prevent child malnutrition. One of the factors that significantly decreased the odds of meeting the MDD criteria was employment status, especially with mothers who worked outside of the home. Nutrition interventions are needed to increase maternal nutrition knowledge and skills regarding the importance of providing complementary feeding with diverse food ingredients, especially to working mothers. Health promotion activities can be carried out during the pandemic by health workers utilizing social media to share nutrition education resources. Understanding the present complementary feeding practices during the COVID-19 lockdown will help public health authorities reshape future policies on child feeding recommendations when new pandemics and lockdowns occur.

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The effects of raja banana (*Musa acuminata*) peel extract on body weight, body mass index, body fat percentage, and visceral fat mass in male rats with obesity

Kezia Elian Devina[1], Dono Indarto[2*], Tri Nugraha Susilawati[3], Budiyanti Wiboworini[1]

[1]Department of Nutrition Science, Postgraduate Program, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Department of Physiology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
[3]Department of Microbiology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

**Correspondence*: dono@staff.uns.ac.id

ABSTRAK

Latar Belakang: *Obesitas menjadi faktor risiko penyakit sindrom metabolik yang dapat meningkatkan angka kematian. Penderita obesitas seringkali mengalami kegagalan dalam menurunkan berat badan (BB) melalui terapi non farmakologi. Obat sintetik obesitas dapat menimbulkan efek samping maka diperlukan bahan alami sebagai terapi alternatif.*
Tujuan: *Penelitian ini bertujuan untuk mengetahui pengaruh pemberian ekstrak kulit pisang raja (RBPE) terhadap BB, Indeks Massa Tubuh (IMT), body fat percentage (BFP), dan massa lemak viseral pada tikus jantan obesitas.*
Metode: *Subjek penelitian adalah 30 ekor tikus wistar jantan berumur delapan minggu dengan BB 125-200 g. Induksi obesitas dengan diberikan pakan tinggi lemak tinggi fruktosa atau High Fat High Fructose (HFHFr) selama 28 hari. Tikus dirandomisasi dan dibagi menjadi lima kelompok yaitu kelompok kontrol negatif (KN) diberi pakan standar dan aquades, kontrol positif (KP) diberi pakan standar dan obat orlistat, perlakuan 1 (P1), perlakuan 2 (P2), dan perlakuan 3 (P3) yang diberi pakan standar dan RBPE dosis 200 mg/kgBB/hari, 400 mg/kgBB/hari, dan 800 mg/kgBB/hari. Data sebelum dan sesudah induksi obesitas dianalisis menggunakan uji paired t-test. BB, IMT, dan massa lemak viseral dianalisis menggunakan uji One-Way Analysis of Variance (ANOVA) dan Repeated Measure ANOVA. BFP dianalisis menggunakan uji Kruskal Wallis dan uji Friedman.*
Hasil: *: RBPE secara signifikan dapat menurunkan BB (p=0,026), IMT (p<0,001), dan BFP (p<0,001). Namun, tidak ada perbedaan yang signifikan pada massa lemak viseral antar semua kelompok (p=0,187). P3 merupakan kelompok dengan rata-rata BB, IMT, BFP, dan massa lemak viseral yang paling rendah meskipun penurunan BB tertinggi selama masa intervensi terjadi pada K+.*
Kesimpulan: *RBPE berpotensi sebagai terapi alternatif untuk obesitas karena dapat menurunkan BB, IMT, dan BFP. Penelitian selanjutnya dapat meneliti pengaruh RBPE pada parameter obesitas lainnya seperti profil lipid.*

KATA KUNCI*:* *obesitas; pisang; ekstrak kulit pisang; musa acuminata; pisang raj*

ABSTRACT

Background: *Obesity is a risk factor for metabolic syndrome which can increase mortality. Obese sufferers often fail to lose body weight (BW) through non-pharmacological therapy. Obesity synthetic drugs can cause side effects, so natural ingredients are needed as alternative therapies.*

Objectives: *This study aims to determine the effect of raja banana peel extract (RBPE) on BW, body mass index (BMI), body fat percentage (BFP), and visceral fat mass in obese male rats.*

Methods: *The research subjects were 30 male Wistar rats weighing 125-200 g, aged eight weeks. Obesity was induced by being given high-fat high fructose (HFHFr) feed for 28 days. Rats were randomized and divided into five groups: the negative control group (C-) was given standard feed and distilled water, the positive control (C+) was given standard feed and orlistat, treatment 1 (T1), treatment 2 (T2), and treatment 3 (T3). Which were given standard feed and RBPE doses of 200 mg/kgBW/day, 400 mg/kgBW/day, and 800 mg/kgBW/day. Data before and after the induction of obesity were analyzed using paired t-tests. BW, BMI, and visceral fat mass were analyzed using the One-Way Analysis of Variance (ANOVA) and Repeated Measure ANOVA tests. BFP was analyzed using the Kruskal-Wallis test and the Friedman test.*

Results: *RBPE can significantly reduce BW (p=0.026), BMI (p<0.001), and BFP (p<0.001). However, all groups had no significant difference in visceral fat mass (p=0.187). T3 was the group with the lowest average BW, BMI, BFP, and visceral fat mass although the highest weight loss during the intervention period occurred in C+.*

Conclusions: *RBPE has the potential as an alternative therapy for obesity because it can reduce BW, BMI, and BFP. Future studies can investigate the effect of RBPE on other obesity parameters such as lipid profiles.*

KEYWORD*:* *obesity; banana; banana peel extract; musa acuminata; raja banana*

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INTRODUCTION

Currently, obesity has become a common health problem in the global community. Obesity can be a risk factor for metabolic syndrome diseases such as DM type 2 and cardiovascular diseases which can increase mortality (1). The prevalence of obesity continues to increase in both developed and developing countries (2). According to Lobstein et al. (2023), as many as 2.6 billion (38%) of the world's population were overweight and obese in 2020 and this prevalence is expected to continue to increase to 42% in 2025 whereas the prevalence of obesity in Indonesian children is estimated to increase by 7.9% and 5.8% in adults in 2035 (3). Indonesian basic health research Riskesdas also shows that the prevalence of obesity in residents aged > 18 years has increased by 50% in five years, from 14.8% in 2013 to 21.8% in 2018 (4).

Dietary habits that often consume foods high in energy and fat, snacking at night, and lack of physical activity can cause excess energy (5). Excess energy leads to fat accumulation in adipose tissue. Fat accumulation in subcutaneous adipose tissue, skeletal muscle, and metabolic organs can cause an increase in body weight (BW), while fat accumulation in visceral adipose tissue causes a decrease in adiponectin levels and oxidation of triglycerides. This causes adipose tissue dysfunction, increasing BW above the standard limit, and obesity will occur (6,7). Obesity is also influenced by genetic, stress, hormonal, and environmental factors such as gut microbiota dysbiosis (8–10). Obesity I is characterized by a Body Mass Index (BMI) of 25-29.9 kg/m2, and obesity II with BMI ≥30 kg/m2 (11). In addition, obesity can also be diagnosed by measuring the body fat percentage (BFP). Obesity in men is

characterized by a BFP >25% and in women >35% (12). For children, there are no accepted international standard cut-offs for BFP. However, several studies have reported that 30% for girls and 25% for boys are associated with obesity (13).

Non-pharmacological therapies such as dietary adjustments and physical activity often fail to be carried out by obese people, while pharmacological therapy using synthetic drugs such as orlistat can cause side effects if consumed for a long time (14,15). Common side effects include nausea, vomiting, diarrhea, constipation, and gastrointestinal disturbances (16). Therefore, natural ingredients are needed that contain certain active compounds that can be used as an alternative in pharmacological therapy for obesity.

Banana is one of the tropical fruits that contribute to 16.8% of the world's fruit supply (17). Banana is the most common fruit produced in Indonesia, a total of 9.6 million tons of banana was produced in 2022 (18). The high production and consumption of bananas cause an increase in banana peel waste because each banana consists of 40% peel. Banana peel waste is usually used as animal feed and organic waste, but many benefits are produced by banana peel waste (19). Banana peel contains nutrients and several active compounds such as flavonoids, phenols, tannins, alkaloids, and saponins which have the potential for pharmacological therapy of obesity (20). A previous research conducted showed that giving banana peel extract added to phosphatidylcholine (PC) can reduce BW, blood glucose levels, and insulin in rats that are given a high-fat diet (21). However, until now, no research has been conducted to determine the effect of raja banana peel extract (RBPE) on obesity. This study aimed to determine the effect of RBPE administration on BW, BMI, BFP, and visceral fat mass in obese male rats.

MATERIALS AND METHODS

Extraction of RBPE

The skin of ripe, yellow banana was obtained from a fruit seller in Klaten City, Central Java, Indonesia. Extraction was carried out at the Phytochemical Laboratory of Setia Budi University, Surakarta. The extraction process began with manufacturing of banana peel flour using the method developed by Maulana (2018), using a cabinet dryer temperature of 80oC for 8 hours (22). Banana peel flour was extracted using the maceration method and was carried out by modifying the method developed by Aboul-Enein et al. (2016) (23). As much as 1 kg of banana peel flour was soaked in 80% methanol solvent (Shisam Mas Chemical Pharmacy) with a ratio of 1:10 (v/v) for 72 hours. The solution was filtered using whatman filter paper to produce filtrate, then redissolved twice. The filtrate obtained from the three screenings was then concentrated with a rotary evaporator at a temperature of 80oC at 80 rpm. Next, the concentrated results were dried using an oven blower (Binder FD 56) with a temperature of 45-50oC for 12 hours until a thick extract was obtained and stored at 4oC before use.

Research Design

This type of research was a laboratory experimental research design pre-posttests with control group for the measurement of BW, BMI, and BFP as well posttest only for visceral fat mass. The inclusion criteria in this study were white Wistar male rats, 8 weeks old, weighing 125-200 g, and in good health. The number of research samples was calculated using the degree of freedom (E) formula. Each group consisted of five rats with the addition of 10% of the minimum number of samples to overcome drop-out so that each group consisted of six rats (24).

Generating a Rat Model with Obesity

The maintenance of rats was carried out at the Integrated Laboratory Technical Implementation Unit of Universitas Sebelas Maret using cage polypropylene; each cage contained three rats. The cage was placed in a room with a temperature of 22-27oC, 37-56% humidity, and a light-dark cycle for 12 hours (25). Rats were adapted for seven days, given standard Comfeed Broiler-2 (BR-2) (PT. Japfa Comfeed Indonesia Tbk.), and drank regularly. Obesity induction was carried out by providing high-fat or high-fructose feed High Fat High Fructose (HFHFr) for 28 days. Based on research conducted by Sundari (2022), the composition of HFHFr consisted of 54.64% fat and 10% fructose (26). Feed was given every morning and evening. After the rats became obese, the rats were randomized into five groups, namely the negative control (C-), positive control (C+), treatment 1 (T1), treatment 2 (T2), and

treatment 3 (T3). C- was a group that was only given standard feed and aquadest. C+ was given standard feed and orlistat (Novell Pharmaceutical Laboratories) at 12.3 mg/kg BW (27). Groups T1-T3 were given standard feed and RBPE doses of 200 mg/kgBW/day, 400 mg/kgBW/day, and 800 mg/kgBW/day for 28 days. The Research Ethics Committee of Faculty of Medicine, Universitas Sebelas Maret approved the research protocol (No. 50/UN27.06.11/KEP/EC/2023).

Measurement of BW, BMI, BFP, and Visceral Fat Mass

The naso-anal length was obtained by measuring the rat's body length (BL) from the tip of the nose to the anus of the rat. Anthropometric data (BW and BL) were measured using digital scales (Joil) and Metlin (OneMed), which were measured before, during, and after the intervention. BMI was calculated using the Rohrer index formula: [body weight (g)/naso-anal length (cm)3] × 103. Rats were declared obese with a Rohrer index > 30 (28). BFP was calculated by the formula body fat percentage by calculating the TM index (28,29).

TM Index = [body weight (g)/naso-anal length (cm)2,823] × 103

BFP = 0.581 × [TM index] – 22.03

At the end of the intervention, the rats were sacrificed to gain fat mass using the following method: the rats were dissected, and the fat attached to the epididymal and retroperitoneal areas located in the kidneys were taken, then weighed to determine the mass of visceral fat in the rats (12).

Statistical Analysis

Numerical data were presented in terms of mean and standard deviation using SPSS version 26. The Shapiro-Wilk test and the Levene test were used to test the data normality and the homogeneity of variants, respectively. Paired t-tests were used to determine the difference before and after obesity induction. BW, BMI, and visceral fat mass were analyzed using the One-Way ANOVA and continued with the post hoc test Least Significance Different (LSD) to determine the average difference between groups at one measurement time. Repeated Measure ANOVA followed with Bonferroni test were used to determine the mean differences between groups of rats at the time before, during, and after the intervention. BFP was analyzed using Kruskal Wallis and Friedman's test. Significant data continued with the test post hoc Mann-Whitney and Wilcoxon. The p-value <0.05 was considered as statistically significant.

RESULTS AND DISCUSSIONS

Table 1 shows that all groups of rats induced by obesity experienced a significant increase in BW, BMI, and BFP (p<0.001). The highest increase in BW occurred in G2 with an increase of 65.50±25.85, while the lowest increase in BW occurred in G1 with an increase of 46.67±12.97. There was no significant difference in the mean BW between groups either before induction (p=0.153) or after induction (p=0.548). The highest increase in BMI and BFP occurred in G2, with an increase of 6.18±1.49 and 6.22±1.39, respectively. The lowest increase in BMI and BFP occurred in G1, with an increase of 6.22±1.39 and 5.24±1.58, respectively. The mean BMI between groups did not differ significantly either before induction (p=0.076) or after induction (p=0.888). The same thing happened to the average BFP before induction (p=0.089) and after induction (p=0.952).

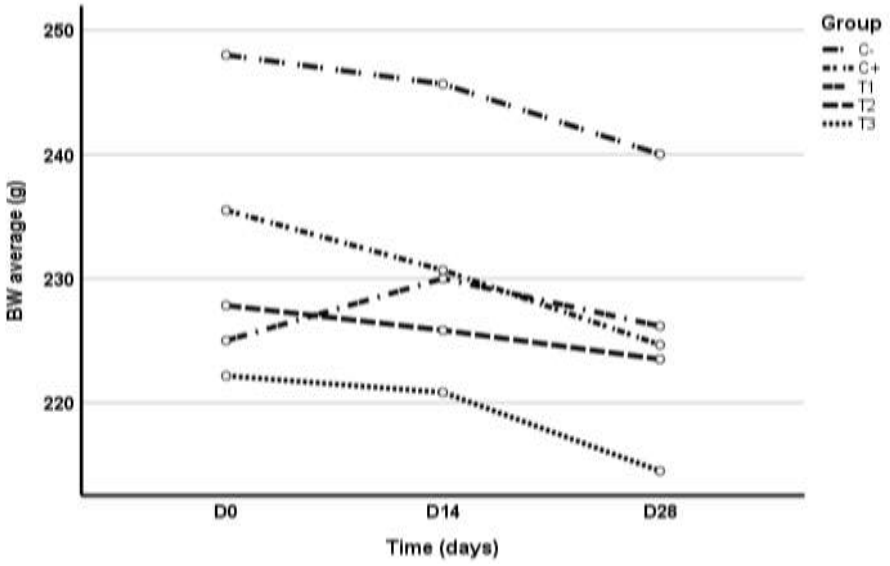
Table 1. Average BW, BMI, and BFP of Rats Before and After Obesity Induction

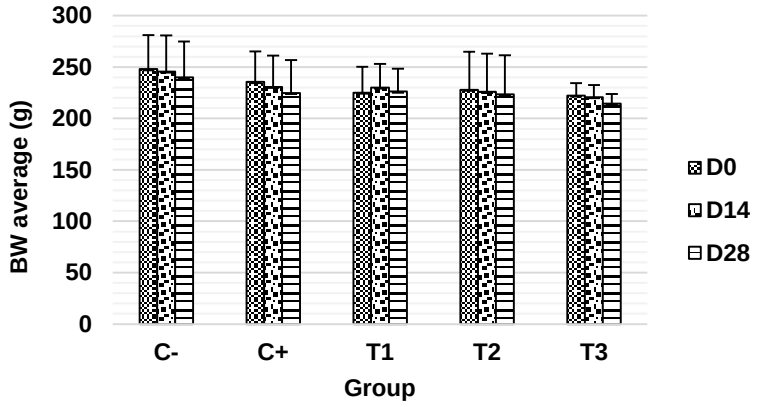
Obesity Parameters	Group	Before Induction	After Induction	Δ	p^a
BW (g)	G1	175.50±9.73	222.17±12.35	46.67±12.97	<0.001*
	G2	170.00±17.29	235.50±29.63	65.50±25.85	<0.001*
	G3	174.83±21.15	225.00±25.23	50.17±14.92	<0.001*
	G4	192.83±16.40	248.00±33.11	55.17±17.78	<0.001*
	G5	168.67±20.37	227.83±37.05	59.17±24.94	<0.001*
	p^b	0.153	0.548		
BMI (g/cm^3)	G1	26.29±1.37	31.55±1.28	5.27±1.71	<0.001*
	G2	24.72±0.30	30.90±1.58	6.18±1.49	<0.001*

Obesity Parameters	Group	Before Induction	After Induction	Δ	p^a
	G3	25.38±1.21	31.04±1.54	5.65±1.19	<0.001*
	G4	25.30±0.42	30.87±1.34	5.57±1.30	<0.001*
	G5	25.16±0.70	31.30±0.90	6.15±1.23	<0.001*
	p^b	0.076	0.888		
BFP (%)	G1	3.65±1.28	8.89±1.20	5.24±1.58	<0.001*
	G2	2.15±0.32	8.37±1.36	6.22±1.39	<0.001*
	G3	2.81±1.24	8.43±1.57	5.62±1.14	<0.001*
	G4	2.87±0.47	8.44±1.32	5.57±1.21	<0.001*
	G5	2.54±0.69	8.69±0.95	6.15±1.27	<0.001*
	p^b	0.089	0.952		

*p^a) simple paired t test; p^b) One-Way ANOVA; *) p<0.05*
Group 1 (G1), Group 2 (G2), Group 3 (G3), Group 4 (G4), Group 5 (G5)

The average BMI in all groups after induction is >30 indicating successful induction of obesity (28). Rats treated with HFHFr tended to experience increased food intake and decreased energy expenditure (30). High-fat consumption and lack of energy expenditure cause Free Fatty Acid (FFA) in the form of triglycerides will be distributed and stored in adipose tissue resulting in hyperplasia and hypertrophy of adipose tissue and can increase BW (7,31). Fructose can enter liver cells without requiring insulin signaling due to the presence of the GLUT5 transporter. High fructose consumption can cause greater absorption of fructose and triglyceride levels in the blood and liver will increase. In addition, fructose is mediated by GLUT2 in the liver causing fructose that enters the hepatocyte cytoplasm to be phosphorylated into Fructose 1-phosphate, which can increase fatty acid synthesis, inhibit fat distribution to mitochondria, and cause hypertrophy increasing BW (32,33). After the induction period, the groups underwent a randomization process and were divided into 2 control groups and 3 treatment groups. The control groups consisted of a negative control group (C-), originally G4, and a positive control group (C+), originally G2. The treatment group consisted of treatment group 1 (T1), which was originally G3, treatment group 2 (T2), which was originally G5, and treatment group 3 (T3), which was originally G1. All groups experienced a significant reduction in BW after being given the intervention for 28 days (p=0.026). Figure 1. (a) shows a significant difference between D14 and D28 (p<0.001). In C+, there was the highest decrease in BW, with a decrease of 10.83±23.69. In T1, it experienced an increase in BW of 1.17±9.48. In T2 and T3, there was a decrease in BW but not as much as the decrease in BW in the C+ group, namely 4.33±12.57 and 7.67±10.27, respectively. Figure 1. (b) shows that there was no difference between groups before the intervention (p=0.548), during the intervention (p=0.656), and after the intervention (p=0.672).



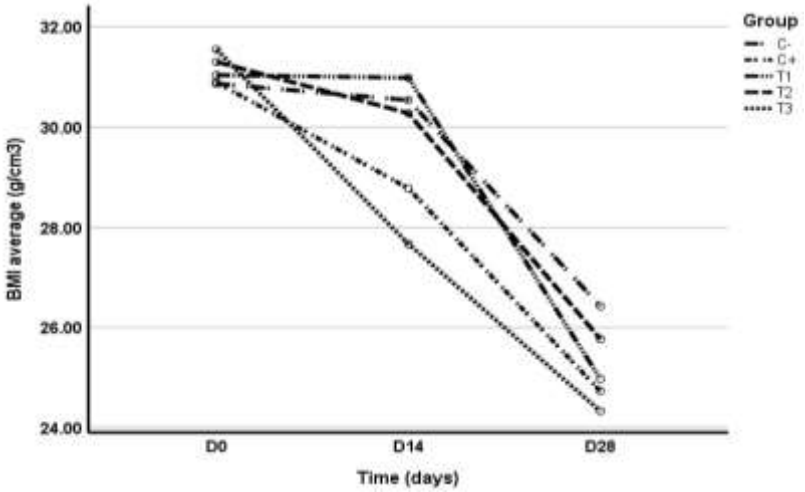


(b)

Figure 1. The RBPE administration reduce rats' BW in the dose-dependent manner. Figure1.(a) indicates significant BW reduction among groups after 14 days and 28 days of RBPE treatment (p<0.05) and Figure 1.(b) indicates slight reduction of rats' BW within groups (p>0.05).

All groups experienced a significant reduction in BMI after 28 days of intervention (p<0.001). **Figure 2**. (a) shows significant differences of BMI between D0 and D14, D0 and D28, and D14 and D28 (p<0.001). The group that experienced the highest decrease occurred in T3 with a decrease of 7.23±1.83, while the group with the lowest decrease occurred in C- with a decrease of 4.44±0.79. Figure 2. (b) shows that on day 0, there was no significant difference between groups (p=0.888), but on days 14 and 28, there was a significant difference between groups with p=0.010 and 0.011, respectively. After 14 days of intervention, there was a significant difference between C- and T3 (p=0.006) and C+ and T1 (p=0.029). After 28 days of intervention, there was a significant difference between C- and C+, T1, and T3 (p≤0.021).

(a)



(b)

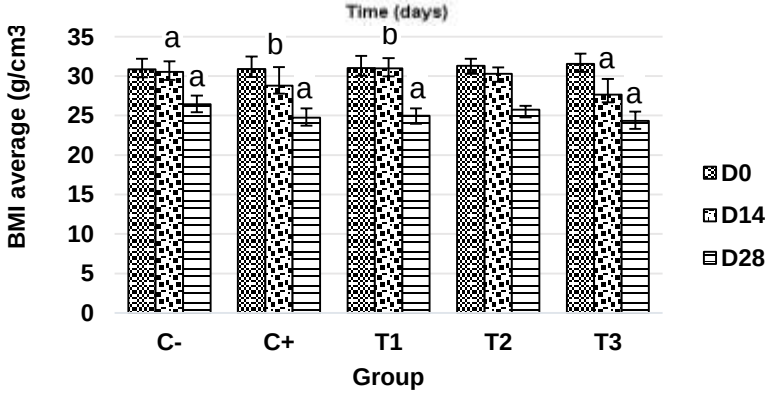


Figure 2. The RBPE administration reduce rats' BMI in the dose-dependent manner. Figure 2.(a) indicates significant BMI reduction among groups on day 0 and after 14 days and 28 days of RBPE treatment (*p*<0.05) and Figure 2.(b) indicates significant mean differences of rats BMI within groups (*p*<0.05).

All groups experienced a significant reduction in BFP after 28 days of intervention ($p<0.001$). **Figure 3**. (a) shows that there are significant differences between D0 and D14, D0 and D28, and D14 and D28 ($p\leq0.001$). The group that experienced the highest decrease occurred in T3 with a decrease of 6.77±1.70, while the group with the lowest decrease occurred in C- with a decrease of 4.20±0.74. **Figure 3**. (b) shows that on day 0, there was no significant difference between groups ($p=0.863$), but on days 14 and 28, there was a significant difference between groups with $p=0.042$ and 0.006, respectively. After 14 days of intervention, there was a significant difference between C- and T3 ($p=0.037$). After 28 days of intervention, there was a significant difference between C- and C+, T1, and T3 ($p\leq0.025$).

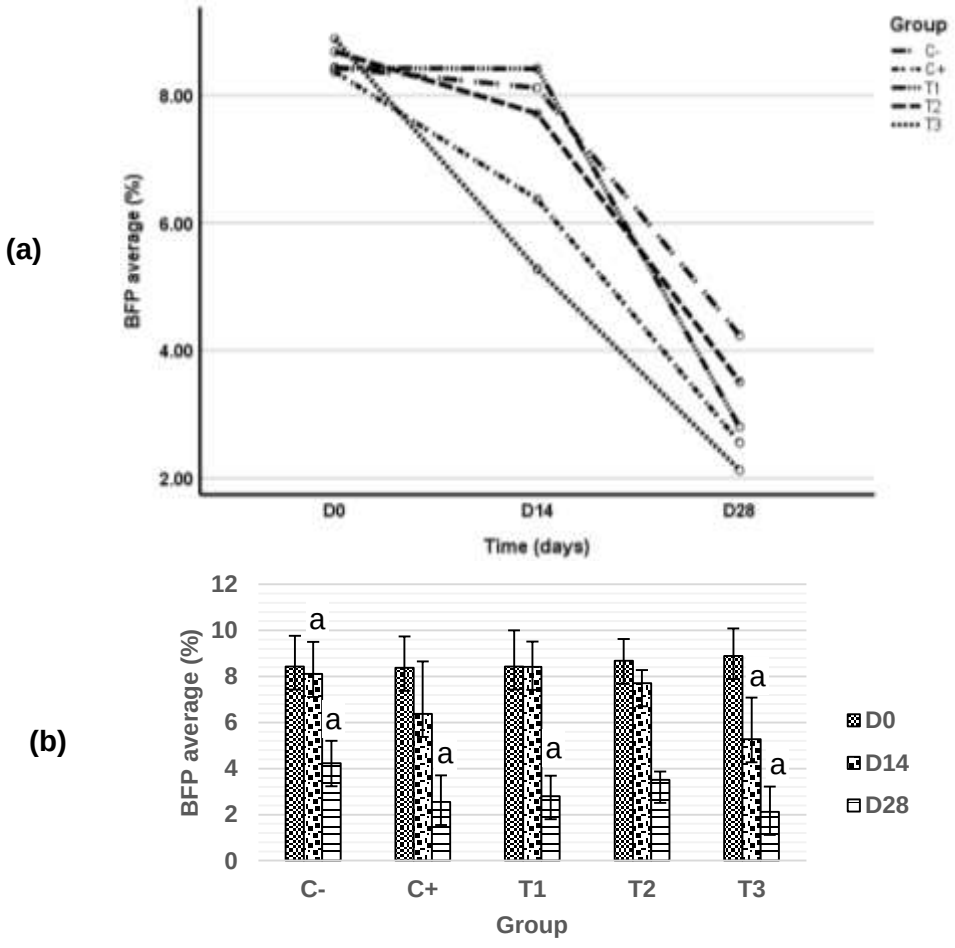


Figure 3. The RBPE administration reduce rats' BFP in the-dose dependent manner. Figure 3.(a) indicates significant BFP reduction among groups on day 0 and after 14 days and 28 days of RBPE treatment (*p*<0.05) and Figure 3.(b) indicates significant mean differences of rats BFP within groups (*p*<0.05).

The highest BW loss occurred in C+, but the lowest average BW was in the group given RBPE at 800 mg/kgBW/day (T3). Meanwhile, the highest decrease in BMI and BFP and the lowest average BMI and BFP were owned by T3. This research is in line with Jomard's study (2021), which stated that the group of obese rats given banana peel extract added to phosphatidylcholine (PC) had the lowest average BW when compared to the other groups (21). In addition, research conducted by Bagabaldo et al. (2022) stated that '*saba*' banana skin extract (*Musa acuminata x balbisiana BBB* Group), which grows a lot in the Philippines, can reduce fat accumulation in the body so that it can reduce BW, BMI, and BFP (34).

Visceral fat mass in each group did not experience a significant difference in either the control or treatment groups, which was indicated by the value of *p*=0.187. T3 was the group with the lowest visceral fat mass while C- was the group with the highest visceral fat mass (1.02±0.49 vs 1.58±0.37).

Table 2. Mean differences in visceral fat mass of rats with obesity with or without RBPE administration

Group	Mean ± SD (g)	*p*
	After 28 days of intervention	
C-	1,58±0.37	
C+	1,52±0.39	
T1	1,25±0.50	0.187
T2	1,23±0.42	
T3	1,02±0.49	

p) One-Way ANOVA

There was no significant difference in visceral fat mass in all groups (p=0.187). However, when compared to all groups, T3 had lower visceral fat mass when compared to other groups, including C+. This may have happened because, in this study, no physical activity was carried out on experimental animals, while the decrease in visceral fat mass did not only occur due to dietary interventions but also required physical activity (35). Research conducted by Wijaya and Surdijati (2020) stated that obese male Wistar rats supplemented with virgin coconut oil had a visceral fat mass of 2.40 g, and rats given coconut oil supplementation had a visceral fat mass of 2.77 g (36). In this study, the visceral fat mass was lower. The difference in visceral fat mass may be due to differences in BW in the experimental animals after the intervention and the type of intervention given. The average BW of rats in the study by Wijaya and Surdijati (2020) was 258.25 g, while in this study, it was 225.77 g. BW has a positive correlation with visceral fat mass, so the greater the BW, the greater the visceral fat mass (37).

The results of this study indicate that RBPE produces a positive effect in obesity therapy. This may be caused by compounds in RBPE, such as quercetin, a flavonoid derivative compound. Previous research that has examined the quercetin compound in green tea and grape seeds states that the mechanism of quercetin, which acts as an anti-obesity agent, is carried out by inhibiting pancreatic lipase activity. Quercetin can reduce the body's absorption of fatty acids by as much as 50% (38). In addition, research on rat models of metabolic syndrome states that quercetin can reduce abdominal circumference by reducing visceral fat mass (39).

Lipogenesis is a fat deposition process that begins with the conversion of glyceraldehyde-3-phosphate (GDP) to lysophosphatidic acid (LPA) by Glycerol-3-phosphate acyltransferase (GPAT). Furthermore, LPA changes to phosphatidic acid (PA), a biosynthetic acylglycerol precursor. These changes are assisted by Lysophosphatidic acid acyltransferase theta (LPAATθ). PA will be converted into

diacylglycerol (DAG) by Lipin1, and then DAG will be synthesized into triglycerides by Diacylglycerol O-Acyltransferase 1 (DGAT1). The quercetin compound can inhibit the action of LPAATθ, Lipin1, and DGAT1, causing a decrease in fat accumulation and triglycerides (40,41).

This study shows a difference in the decrease between the average BW, BMI, and BFP. Fat mass did not significantly differ, but T3 had a lower fat mass than C+. T3 also had a lower average BW than the control group, but during the intervention period, the highest average decrease occurred in C+. In addition, T3 was the group with the lowest average BMI and BFP and experienced the highest average decline during the intervention period. Therefore, further research is needed to evaluate the effect of higher dose of RBPE on obesity. Whilst our study shows a significant reduction of obesity, the mechanism is still unclear, whether it is caused by the quercetin compound contained in RBPE or other compounds, so further study is needed to examine the effect of pure quercetin compound from RBPE on obesity.

CONCLUSIONS AND RECOMMENDATIONS

RBPE can reduce BW, BMI, and BFP in obese model rats although there is no difference in visceral fat mass between groups. Therefore, RBPE has the potential as an alternative pharmacological therapy for the treatment of obesity. Further research is needed to isolate the quercetin compound in RBPE so that a pure quercetin compound is obtained and RBPE testing can be carried out on other obesity parameters such as lipid profiles.

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Effectivity and cost-effectiveness of oral nutrition supplement on malnourished children: A Literature review

Siti Helmyati[1, 2*], Maria Wigati[1, 2], Yuliana Novita Rachmawati[2], Cut Alima Syarifa[2], Gifani Rosilia[2], Renita[2]

[1]Department of Nutrition and Health, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[2]Center for Health and Human Nutrition, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

Correspondence: helmyati@ugm.ac.id

ABSTRAK

Latar Belakang: *Kekurangan gizi pada anak adalah masalah global yang berpotensi diatasi dengan dukungan pangan olahan untuk keperluan medis khusus, salah satunya yaitu suplemen gizi oral (oral nutrition supplement/ONS).*
Tujuan: *Tinjauan literatur ini bertujuan untuk mengkaji efektivitas ONS pada anak malnutrisi dilihat dari indikator pertumbuhan, lama rawat inap, dan kejadian efek samping, serta mengeksplorasi efektivitas biaya ONS dalam menangani malnutrisi pada anak.*
Metode: *Artikel dikumpulkan dari database elektronik yang meliputi PubMed, ProQuest, dan Google Scholar dengan tambahan artikel dari mesin pencari Google. Artikel dimasukkan dalam tinjauan literatur jika subjek adalah anak di bawah lima tahun yang berisiko kurang gizi, kurang gizi, pascaoperasi, atau dirawat di rumah sakit dan diresepkan ONS; merupakan penelitian eksperimental dengan atau tanpa kelompok pembanding atau kelompok kontrol; dan meneliti status gizi, luaran lain yang secara langsung atau tidak langsung berhubungan dengan malnutrisi, dan efektivitas biaya.*
Hasil: *Terdapat 16 artikel yang ditinjau dari hasil pencarian. Anak yang mengonsumsi ONS, memiliki konsumsi ONS yang baik, dan mengonsumsi ONS dengan kepadatan yang lebih tinggi mengalami kenaikan berat dan tinggi badan, peningkatan status gizi yang lebih baik, serta lama rawat inap yang lebih singkat dibandingkan dengan anak yang tidak diberi ONS, memiliki konsumsi ONS yang buruk, dan mengonsumsi ONS dengan kepadatan yang lebih rendah, meskipun ditemukan beberapa efek samping konsumsi ONS, seperti gejala gangguan pencernaan, diare, dan muntah. Bukti tentang efektivitas biaya ONS dalam menangani anak malnutrisi sangat terbatas. Namun, perbaikan luaran medis akibat konsumsi ONS berpotensi menurunkan biaya medis langsung.*
Kesimpulan: *Konsumsi ONS dapat memberikan hasil pertumbuhan dan hasil medis yang diharapkan. ONS dapat menjadi intervensi gizi untuk penanganan malnutrisi anak yang efektif biaya karena biayanya yang relatif rendah, kemampuannya untuk meningkatkan luaran medis, serta bukti efektivitas biayanya pada populasi lain.*

KATA KUNCI*: anak; efektivitas biaya; indikator pertumbuhan; malnutrisi; suplemen gizi oral*

ABSTRACT

Background: *Child undernutrition has been a global problem that could be potentially treated with the support of food for special medical purposes, including oral nutrition supplements (ONS).*

Objectives: *This literature review aims to examine the effectiveness of ONS administration for malnourished children as seen from growth indicators, length of stay, and adverse events occurrence, and explore ONS cost-effectiveness in treating child malnutrition.*

Methods: *Articles were collected from electronic databases including PubMed, ProQuest, and Google Scholar, with additional articles from Google search engine. Articles were included if it included children under five at risk of malnutrition, with malnutrition, post-surgery, or hospitalized and prescribed with ONS; were experimental research with or without comparison or control group; and examined nutrition status, other outcomes directly or indirectly related to malnutrition, and cost-effectiveness.*

Results: *This review summarized findings from 16 articles. Children who consumed ONS, had good ONS consumption, and consumed higher ONS density experienced better weight and height gain, better improvements in nutrition status, and shorter length of stay compared to children who didn't receive ONS, had poor ONS consumption, and consumed lower ONS density, although several adverse events of ONS consumption such as gastrointestinal symptoms, diarrhea, and vomiting were also recorded. Evidence on ONS cost-effectiveness in treating child malnutrition is limited. However, improved medical-related outcomes due to ONS consumption could potentially result in lower direct medical cost.*

Conclusions: *Studies suggest that ONS administration results in expected growth outcomes and medical-related outcomes. ONS could be a potential cost-effective nutrition intervention for child malnutrition treatment due to its relatively low cost, its ability to improve medical related-outcomes, and its cost-effectivity in other populations.*

KEYWORD*:* *children; cost-effectiveness; growth indicators; malnutrition; oral nutrition supplements*

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INTRODUCTION

Child undernutrition remains a global problem, especially in developing countries. In 2020, the WHO mentioned that over 149 children under five were estimated to be stunted and 45 million were wasted (1). In the continuous efforts to address child undernutrition around the world, a recent report by the WHO mentioned the number of 38 million wasted and severely wasted children in 15 of the worst-affected countries (2).

The negative impacts of child undernutrition on their long-term health and development as well as the effects on family and the country are already known (2). For instance, undernutrition is associated with a high risk of mortality and complications such as pneumonia, diarrhea, heart failure, decreased cognitive and motor skills. In the long term, it is associated with productivity reduction in adults (3–6). If there is a high prevalence of malnourished children in a country, it can be an impetus for slower economic growth as the result of a higher burden on health and social costs (7) The complexity of causes and effects of child malnutrition cost 2-3% of the Gross Domestic Product (GDP), perpetuating a cycle of poverty and illness (1,3,7–9).

One of the alternatives to treat child undernutrition is by providing food for special medical purposes (FSMPs). International Special Dietary Food Industries defined FSMPs as foods for special dietary uses which were specially formulated, processed, and presented for the dietary management of patients with limited or impaired capacity to take, digest absorb, or metabolise ordinary foodstuffs or certain nutrients; intended for exclusive or partial feeding; and may

be used only under medical supervision (10). Among available FSMPs is oral nutrition supplements (ONS) which provides additional calories, protein, and micronutrients for malnourished or at risk of malnourished people (11,12).

The potential of ONS to treat child undernutrition in health facilities is interesting to be explored. Oral Nutrition Supplement (ONS) could come in a variety of types, flavours, textures, and tastes and could be adapted to certain types of conditions, thus making it easily suitable for everyone's needs and liking (13). Additionally, ONS may provide functional benefits, including increased muscle strength, activity levels, and weight; decreased risk to fall, depression, and fatigue; and significantly reduced hospital admissions/readmission and length of stay which improves patients' quality of life (14).

The authors suggested the need to review the effectivity of ONS prescription for undernourished children (11,15,16). The efficiency of ONS prescription can be assessed by looking at changes in the budget and outcomes. The evaluation can also be done at the macroeconomic level to see the potential benefits and losses of the use of ONS in society. This is important since FSMPs development should be followed by a careful review of the current evidence so that the provision of the formula could enhance the success of the intervention in the broader population. That being said, this review aims to explore the effectiveness of ONS by examining the effects of ONS on growth indicators, length of stay, and adverse events, and explore the cost-effectiveness of ONS as an alternative to treat child malnutrition.

MATERIALS AND METHODS

Research Strategy

This review focused on the use of ONS for malnourished children. To obtain relevant studies, a research strategy is developed based on the PICO (population, intervention, comparison, and outcome) terms as follows:

a. Population: at risk or malnourished children indicated for ONS consumption
b. Intervention: oral nutrition supplement
c. Comparison: malnourished children not receiving oral nutrition supplement or receiving modified ONS formula
d. Outcome: nutrition status, other outcomes directly or indirectly related to malnutrition, and cost-effectiveness

Literatures were searched on three electronic databases: PubMed, ProQuest, and Google Scholar. Relevant to the PICO terms above, the search queries used the following keywords: diet therapy OR dietary supplement OR oral nutrition supplements OR food supplement OR nutrition OR diet OR foods, specialised; malnutrition OR undernutrition OR malnourishment OR nutritional status; and children OR child, preschool.

Study Inclusion Criteria

Studies were included in this review if it specifically evaluated the effect of ONS on children under the age of five, including those at risk of malnutrition, clinically diagnosed with malnutrition, post-surgery, or hospitalized and prescribed with ONS. Studies which included children older than five were also included if it includes children under five. Only original articles with experimental study design with or without comparison or control group were included in this review. Studies that have no full texts available were excluded. Studies included in this review are restricted to those written in English. To capture all available studies regarding the topic in this review, there was no publication year limitation for the literature search.

Data Extraction

Collected articles from the databases were processed using Rayyan.ai. Before the articles were screened, duplicate articles were detected and eliminated. Four reviewers (YNR, CAS, GR, and R) separately screened and assessed the articles. Articles were screened by examining the titles, abstracts, and/or full texts, then assessed by the reviewers so included articles adhere to the inclusion and exclusion criteria.

Additional Resources

To enrich the discussion in this review, search for additional articles was done using Google search engine on the following topics: nutrient dense formula intervention on length of stay, nutrient dense formula intervention on weight gain, nutrient dense formula intervention adverse events, oral nutritional supplements and cost-

effectiveness, and stunting on children with allergy. Retrieved articles were subject to the same inclusion and exclusion criteria. The process of article selection are described in **Figure 1**.

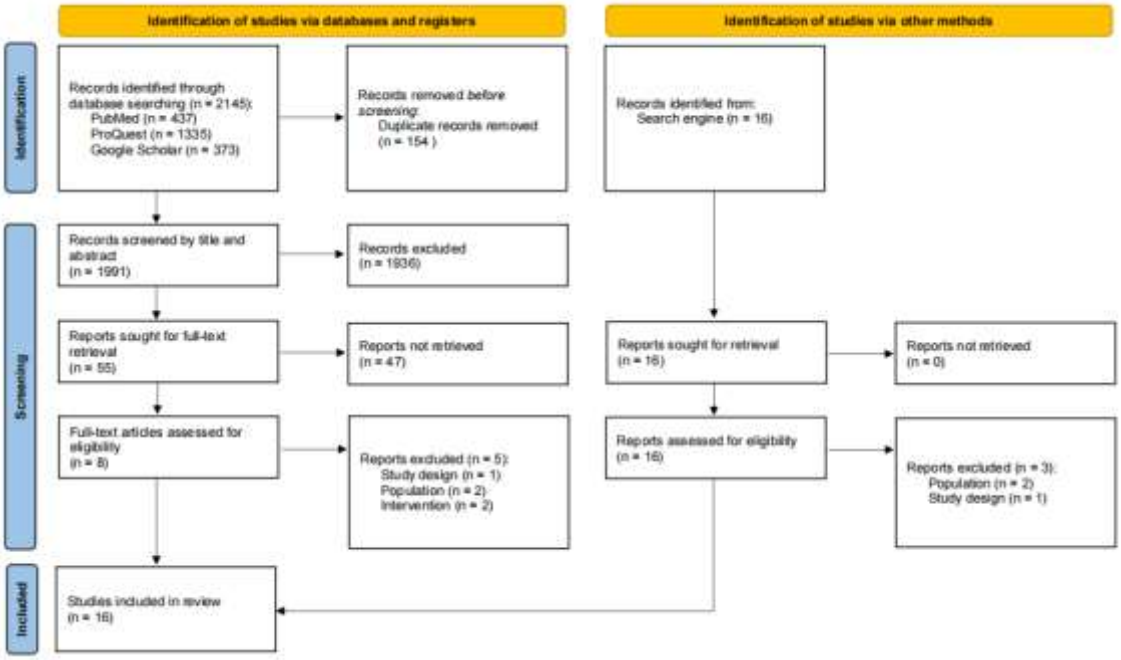


Figure 1. PRISMA Flow Diagram

RESULTS AND DISCUSSIONS

Oral Nutrition Supplements and Growth Indicators

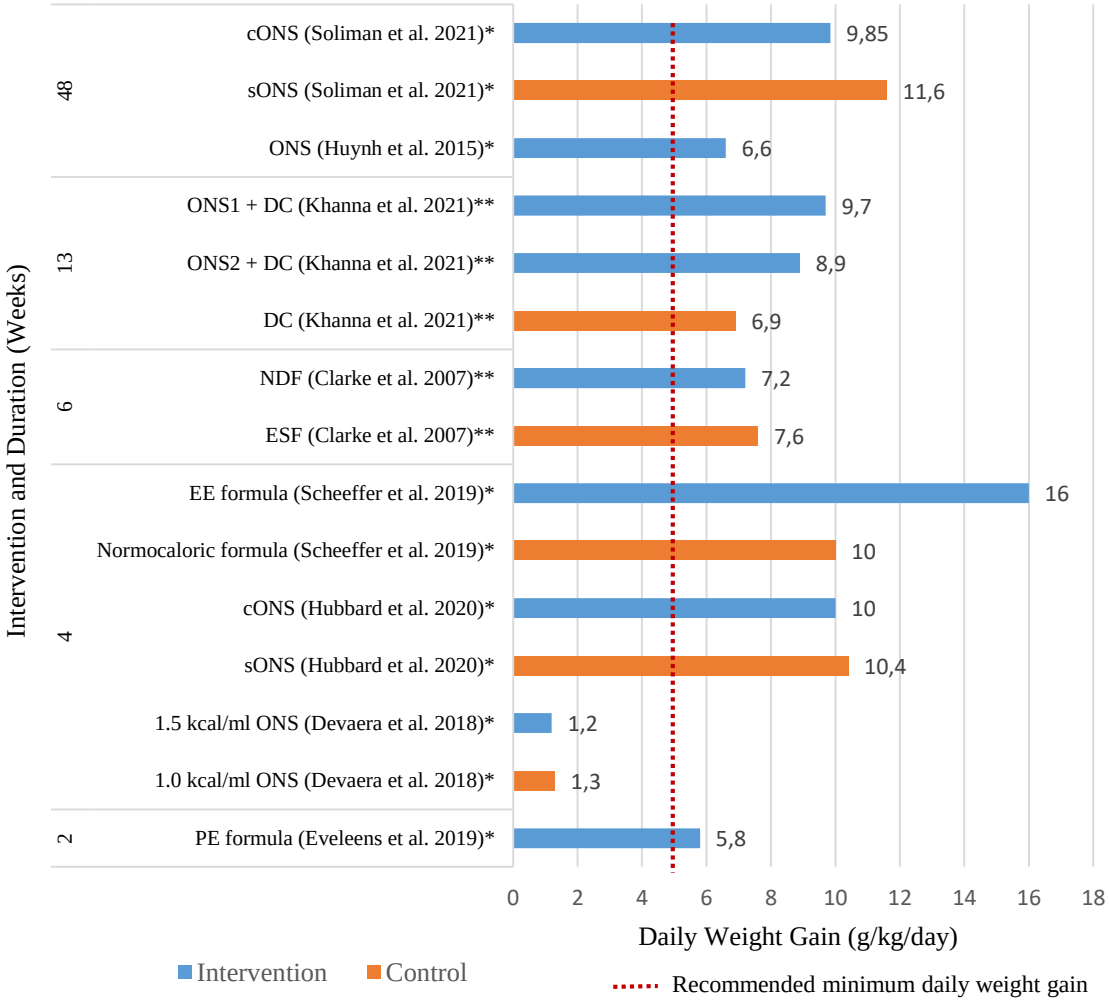
According to the consensus of the Academy of Nutrition and Dietetics and the American Society for Parenteral and Enteral Nutrition, recommended indicators to monitor child malnutrition, specifically undernutrition, include z-scores for weight-for-length/height, length/height-for-age, mid-upper arm circumference, or body mass index-for-age when a single data point is available or weight gain velocity (for children <2 years), weight loss (for children aged 2-20 years), retardation in weight-for-length/height z-score, and inadequate nutrient intake (17).

Effect of ONS on Weight and Weight-for-Age Z-Scores (WAZ)

Weight and weight-for-age measurement offer diagnostic parameters for acute undernutrition (17). During malnutrition treatment, achieved weight and weight gain velocity are monitored to trace the progress and identify the failure to respond ((18)). Sphere Standards recommends that diets for moderately malnourished children should support a daily weight gain of at least 5 g/kg/day (19).

To our knowledge, 8 studies reported the effectiveness of ONS administration on malnourished children on weight gain, as illustrated in **Figure 2**. Among 8 studies, 7 studies reported that ONS administration could meet the Sphere Standards by resulting more than 5 g/kg weight gain per day, all of which were conducted in a hospital setting ((20–26)), in which the result is significant in 4 studies (21,22,25,26). A study in a community setting also found a weight increase although insignificant (27). The British Association for Parenteral and Enteral Nutrition (BAPEN) declared that ONS may be prescribed either in the short term (less than 3 months) or long term (more than 6 months). ONS consumption should be observed regularly throughout the duration of their treatment every 3 months or, for those with longer term ONS requirements (28). It may examine the prolonged clinical need for ONS and continued properness of the product (29). The benefits of ONS on weight improvements are generally seen within 2-3 months of consumption. A research by Huynh et al (21) showed that children had more

weight increasement in the first two months of consumption with an average of 0.5 kg in the first and 0.3 kg in the second 4 weeks. It was supported by other studies that reported during a 3 months study, daily ONS consumption plus dietary counselling improved greater in weight and weight-for-age significantly from the first month until the third month compared to dietary counselling alone (25,30). Meanwhile, after 3 months, the body weight increase seemed to be lower compared to the first 3 months (0.2-0.3 kg per 8 weeks) (21). However, a study by Soliman et al (26) stated that the ONS consumption resulted in significantly increased mean total weight from baseline after 6 months and 1-year consumption. Although ONS can increase weight early, a longer period of consumption may be important to assure a significant improvement and to maintain the required weight gain (21,31), considering that there was a tendency for the weight and weight-z-score not to persist after supplementation stopped and even return to baseline (26,32).



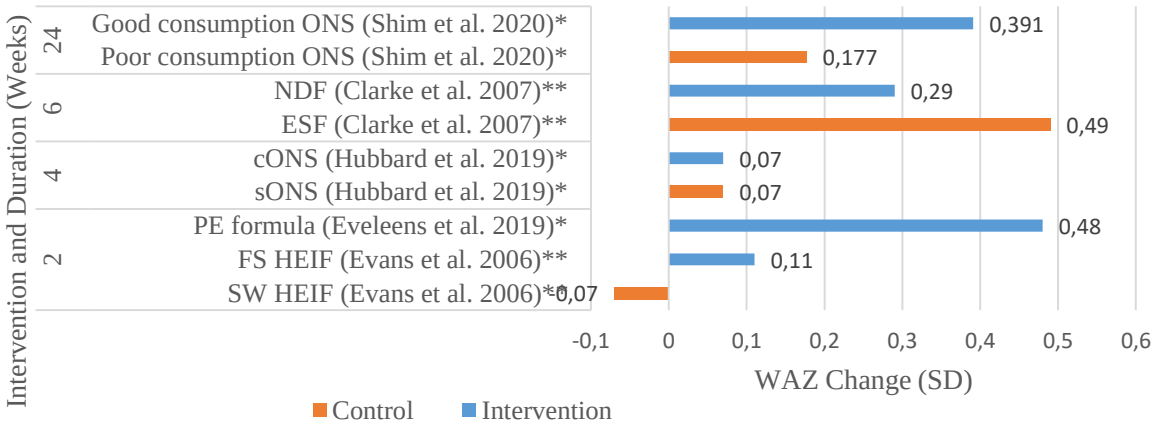
cONS, high-caloric density oral nutrition supplement; DC, dietary counselling; EE Formula, energy-enriched formula; ESF, energy-supplemented formula; NDF, nutrient-dense formula; ONS, oral nutrition supplement; ONS1, milk-based oral nutrition supplement; ONS2, lactose-free oral nutrition supplement; PE formula, protein and energy enriched nutritional formula; sONS, standard oral nutrition supplement
*mean
**median

Figure 2. Effect of ONS consumption on daily weight gain in malnourished children

ONS administration could also help provide nutritional support to children needing intensive care to avoid acute and chronic malnutrition due to their restricted body reserves and their higher nutrient needs for growth and development (22). Eveleens et al (22) reported that administering ONS enriched with a protein and energy in infants below the age of 12 months with a prolonged paediatric intensive care unit (PICU) stay resulted in weight increasement between 3.28–9.04 g/kg/day (median 5.8). ONS with a high energy formula (containing 100 kcal/100 mL) was found to be more effective to prevent weight loss (-16 g vs -181 g, p=0.001) and improve nutritional status after surgery compared to ONS with a standard energy formula (containing 67 kcal/100 mL) (33). These findings are also supported by a research by El-Ganzoury et al (34) who found that two-week perioperative nutritional prehabilitation programs have significantly higher mean weight gain than those receiving one-week nutritional prehabilitation programs.

Different energy densities of ONS also demonstrated different effects on weight gain. Gradually enhancing caloric density can be beneficial in some children because children tend to be reluctant to have their feeding volume increased, yet they are recommended to receive an addition of 20-50% calorie intake for catch-up accretion in children with growth faltering (35) Soliman et al (26) reported that the use of high caloric density ONS (cONS) on older children and young adolescents (aged 10±4 years) resulted in significantly greater mean total weight gain per day after 6 months and 1 year, compared to standard ONS (sONS) group (14.13±7.78 vs 8.65±3.98 g/day and 11.6±6.58 vs 9.85±4.71 g/day, respectively). Another study by Scheeffer et al (23). In children under 2 years of age found that the mean daily weight gain was better in those receiving energy-enriched formula (EE formula) containing 1 kcal/mL compared to those receiving normocaloric formula containing 0.67 kcal/mL although the disparity was not statistically significant (16 g/day vs 10 g/day respectively, p=0.32). However, this is not always the case. Research in a community setting by Devaera et al (27) found no significant differences in total and daily weight gain over the 4-week intervention between children who received ONS with an energy density of 1.5 kcal/mL and 1.0 kcal/mL. A study by Clarke et al (20) also found no significant difference in median weight gain (7.2 g/kg/day vs 7.6 g/kg/day, respectively) between those who received nutrient-dense formula (NDF) and energy-supplemented formula (ESF). Similarly, Hubbard et al (24) reported that after 28 days of intervention, although cONS containing 2.4 kcal/mL resulted in a significant weight increase of 0.28 kg (p=0.007) from baseline while no significant weight increase was observed in those receiving sONS containing 1.5 kcal/mL, the differences in mean weight were not significant [cONS 19.6 kg (SD 6.9) vs sONS 15.5 kg (SD 8.1), Δ4.1 kg, per protocol] between cONS and sONS group. Thus, ONS with various energy densities can be tolerated and was found to be effective in improving malnourished children's weight.

Besides resulting in weight gain, ONS administration also results in WAZ improvements in the majority of studies found, as illustrated in **Figure 3**.



cONS, high-caloric density oral nutrition supplement; ESF, energy-supplemented formula; FS HEIF, full strength high-energy infant formula; good consumption ONS, consumption of more than 60% of recommendation; poor consumption ONS, consumption of less than 60% of recommendation; NDF, nutrient-dense formula; ONS, oral nutrition supplement; PE formula, protein and energy enriched nutritional formula; sONS, standard oral nutrition supplement; SW HEIF, stepwise high-energy infant formula
*mean
**median

Figure 3. Effect of ONS on WAZ changes in malnourished children from baseline

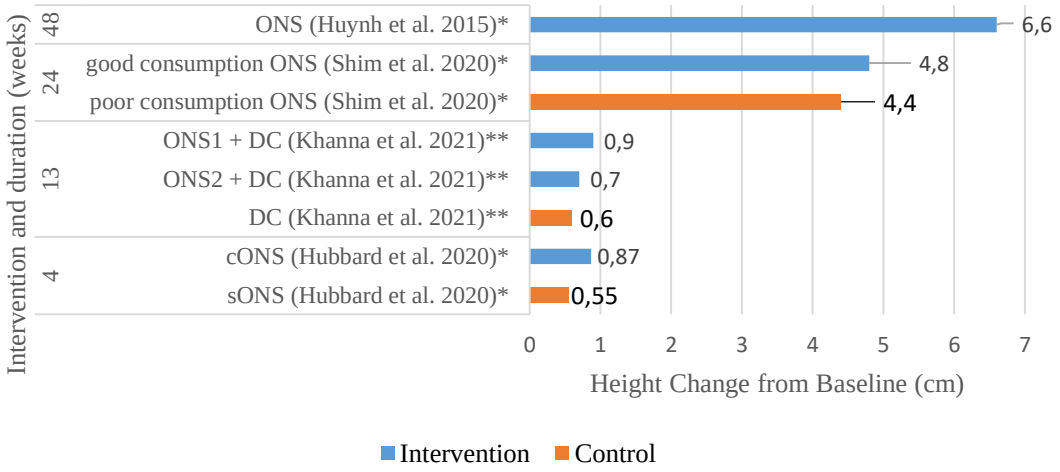
Evans et al.(36) reported that the introduction of high-energy formulas from day 1 over 2 weeks study period had a slight increase in WAZ, in contrast with the stepwise introduction over 3 days that had a slight decrease in WAZ (0.11 vs -0.07, respectively).Similarly, ONS enriched with protein and energy administered resulted in a 0.48 increase in mean WAZ.(22) ONS consumption >60% of the recommended dose of the formula also showed significant improvements in weight and WAZ compared to low consumption of ONS after 2, 4, and 6 months of supplementation (35). On the contrary, Hubbard et al (24) reported that cONS containing 2.4 kcal/mL resulted and sONS containing 1.5 kcal/mL resulted in similar WAZ changes and insignificant WAZ difference [cONS – 1.79 (SD 1.21) vs sONS -1.88 (SD 1.16), Δ0.09, per protocol]. Similarly, Clarke et al (20) also concluded that no significant difference in WAZ median improvement between NDF and ESF was present (0.29 vs 0.49, respectively, p=0.26).

.It should also be noted that ONS consumption compliance can also be affected by ONS energy density, in which children tend to have lower ONS volume intake when presented with high-energy density ONS (27). However, studies in our findings reported that both high energy density and low energy density had a high level of compliance (consumed more than 75%) (24,26,27).

Effect of ONS on Height and Height-for-Age Z-Scores (HAZ)

Height and height-for-age measurement represent linear growth that offers diagnostic parameters for chronic undernutrition (17). We found that among 4 studies (**Figure 4a**) with different intervention durations, ONS administration on malnourished children results in height gain (21,24,25,35). A study by Huynh et al (21) reported that long-term use of ONS and initial dietary counseling (DC) led to better linear growth during the maintenance growth phase and promoted ponderal growth in the catch-up phase, thereby promoting and sustaining proportional growth. This study also found that height continuously improved over the study period, with a mean rate of 0.5 cm every 4 weeks (21) Khanna et al (25) also found that after 90 days, ONS provision (milk-based or lactose-free) with additional dietary counseling (DC) resulted in a higher median height change compared to DC only, although insignificant (milk-based ONS 0.9 cm vs lactose-free ONS 0.7 cm).

A study by Hubbard et al (24) found that cONS with an energy density of 2.4 kcal/mL resulted in a significantly higher mean height and HAZ compared to sONS with an energy density of 1 kcal/mL after 28 days of intervention (mean height: 114.4 cm SD 18.2 versus 99.3 SD 24.4 Δ15.1 cm, per protocol, respectively; HAZ: cONS -1.25 (SD 1.19) versus -sONS -1.55 (SD 0.99), Δ0.3, per protocol). These findings were similar with the outcomes of a systematic review and meta-analysis of ONS intervention by Zhang et al (37) that found the administration of ONS had significant beneficial effects on height growth and weight gain. Although the majority of studies found that ONS administration results in height gain, most of studies found that there was a decrease in HAZ in malnourished children after different durations of ONS administration (**Figure 4b**).

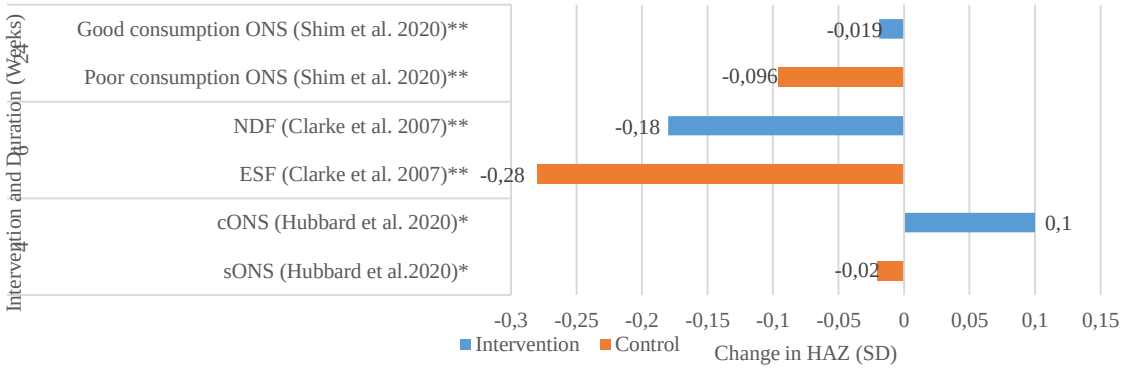


cONS, high-caloric density oral nutrition supplement; DC, dietary counselling; good consumption ONS, consumption of more than 60% of recommendation; poor consumption ONS, consumption of less than 60% of recommendation; ONS, oral nutrition supplement; ONS1, milk-based oral nutrition supplement; ONS2, lactose-free oral nutrition supplement; sONS, standard oral nutrition supplement
*mean
**median

Figure 4a. Effect of ONS on height changes in malnourished children

A study by Shim et al (35) found that ONS consumption either good or poor, had no significant difference in HAZ changes after 24 weeks. Clarke et al (20) also reported that 6 weeks supplementation using NDF and ESF showed a lower length z-score, but only the reduction in the ESF was statistically significant. Hubbard et al (24) also found that sONS administration also resulted in HAZ decrease. These findings were also in line with the study by Ghosh et al (38) that found a decrease in HAZ over the 90-day period ($p<0.05$), although the reduction of HAZ was lower in those receiving ONS and dietary counselling.

Only cONS administration resulted in an increase in HAZ as reported by Hubbard et al (24). Similarly, a study by Huynh et al (21) also found that ONS administration over 40 weeks resulted in a steady increase in height-for-age percentile (HAP) from 14.4 to 17.0. Meanwhile, no improvement in HAP from time to time was also demonstrated in the study by Khanna et al (25) It seems that the decreasing trend or stagnancy of HAZ in malnourished children receiving ONS might be due to the insufficiency of height increment to catch up with height recommendations according to the children's age.



good consumption ONS, consumption of more than 60% of recommendation; poor consumption ONS, consumption of less than 60% of recommendation; ESF, energy-supplemented formula; NDF, nutrient-dense formula; ONS, oral nutrition supplement
*mean
**median

Figure 4b. Effect of ONS Consumption on HAZ changes from Baseline in Malnourished children

Effect of ONS on Weight-For-Length/Height Z-Score (WHZ) and Mid-Upper Arm Circumference (MUAC)

According to the WHO and UNICEF, child nutrition status can be identified by weight-for-length/height z-score (WHZ) and/or mid-upper arm circumference (MUAC) (39). WHO protocols for SAM treatment intended to rapidly recover the WHZ and/or MUAC deficits (18). Thus, rapidly restoring WHZ and/or MUAC deficits could become a proxy in malnutrition treatment. We found three studies that explore the effect of ONS provision on WHZ changes (Figure 5). The majority of studies suggest that the provision of ONS may improve WHZ.

Study by Sheng et al (40) reported a significantly greater increase in WHZ among children who received nutrition supplement (NS) plus nutrition counselling (NC) than NS only. Similarly, a study by Khanna et al (25) showed a better weight-for-height percentile improvement after 90 days of daily ONS consumption with dietary counseling (DC), compared to DC only. Shim et al (35) also found that good ONS consumption resulted in a higher WHZ increase compared to those with poor consumption, although the difference is not significant. However, although both resulted in a WHZ increase above 0.4 SD, administering 1 kcal/mL or 1.5 kcal/mL ONS showed no significant differences in the increase of WHZ and the percentage of children who reached a WHZ of more than -1 over 4 weeks (27).

Meanwhile, several studies have also shown that the administration of ONS resulted in a significant MUAC enhancement (Figure 6). It should be noted that the daily MUAC gains were stated in median in the researches by Clarke et al (20), Evans et al (36), Khanna et al (25), and Moghadam et al (41) while stated in mean in the study of Shim et al (35).

A study of Clarke et al (20) showed a significant increase of median MUAC for all groups after 6 weeks, but the increase was not significantly different between the NDF and ESF groups, even when analysed by gender. Increased MUAC was found in the boys receiving NDF (0.4 cm/week) and in those receiving ESF (0.26 cm/week) (20). However, there was no significant difference in the MUAC change of the girls in either group (20). Similarly, in the study of Shim et al (35) the ONS provision for 6 months increased MUAC significantly ($p<0.001$), but there was no difference in MUAC changes between those who had good consumption of ONS and those who had poor consumption of ONS. The study of Evans et al (36) also showed that there was an increase of MUAC in both groups after 2 weeks, but the difference was not significant between the group receiving FS HEIF [median 0.5 (range 0-1.4)] versus SW HEIF [median 0.6 (range 0.1-1.5)]. Study by Khanna et al (25) found a significant difference in MUAC changes between the group receiving ONS versus the group receiving dietary counseling only, after 60 days and 90 days of intervention. Similarly, Moghadam et al (41) showed that ONS given over 12 weeks improved MUAC significantly ($p=0.001$).

Oral Nutrition Supplements and Length of Stay (LoS)

LoS is defined as a key indicator for the efficiency of an intervention or health system (42). There were 4 studies in this review that evaluated LoS in terms of hospital LoS and ICU LoS in patients given ONS (23,34,43,44). Minimising hospital LoS and ICU LoS were important in reducing resources utilised for patient care without sacrificing the quality of care. More resources such as human, material, and financial resources will be reduced for patients who have a shorter LOS in the hospital (45,46). Cui et al (43) compared LoS in the infant after congenital heart surgery given PE formula and standard formula group (S-group). The study showed that the differences of ONS formula did not significantly affect the hospital LoS and ICU LoS after congenital heart surgery (43). This result was different from other studies that showed shorter

LoS in the intervention group. El Ganzoury et al (34) evaluated the effect of perioperative nutritional prehabilitation duration on growth and surgical outcomes in malnourished children with CHD. The study found that the 2 weeks Perioperative Nutritional Prehabilitation (1 kcal/mL high energy-dense formula) can shorten hospital LoS and postoperative ICU LoS compared with the 1 week (34). Study by Scheeffer et al (23) also evaluated a reduction in hospital LoS and ICU LoS in the enriched formula group. After congenital heart surgery, the ICU LoS in 1 kcal/mL formula group was 8 days and the hospital LoS was 14 days while the ICU LoS in 0.67 kcal/mL formula group was 10 days and they discharged after 20 days. The reduction of LoS was about 28,67% in the energy-enriched group (23). The result in the study by Scheeffer et al (23) is in line with the result of Lakdawalla et al (44) that found an association between ONS use with a shorter LoS by 14.8%. From those result, it can be said that nutrition intervention with a proper duration and formula has a potential to decrease hospital LoS and ICU LoS. However, the LoS did not only vary by nutrition-related aspect, but it also influenced by other factors such as severity of illness and diagnostic diversity (46).

Oral Nutrition Supplements and Occurrence of Adverse Events (AEs)

Adverse events (AEs) are defined as unfavorable or harmful outcomes occurred during or after an intervention, but are not always caused by intervention (47). AEs can range from mild to severe and can be life-threatening. For this reason, AEs of ONS should be described. It will help to understand what a risk may have occurred after the intervention (48). There were 6 studies from 19 studies in this review that evaluated the AEs of ONS (Figure 7). The most frequently reported AEs were gastrointestinal symptoms in 5 studies (23–25,38,43), diarrhoea in 3 studies (23,40,43), vomiting in 3 studies (23,24,43), respiratory tract-related events, and pyrexia.

In the post-operative patients intervention, Cui et al (43) reported AEs including intolerable diarrhoea, intolerable vomit, and intolerable gastric retention. They reported lower AEs in the protein and energy-enriched formula group compared with the standard, with 0.49 of odds ratio (OR) (43). The percentage of AEs in the study of Cui et al (43) was higher than the percentage of AEs reported by Scheeffer et al (23) which gave an EE-Formula to the intervention group. In the setting of nutritional risk and picky eating children, the highest percentage of AEs was reported in the study of Sheng et al (40) that gave NC with a nutritional milk for intervention group. Sheng et al (40) reported AEs including upper respiratory tract infection, pyrexia, and diarrhoea. On the other hand, a lowest percentage of AEs was found in standard ONS by Hubbard et al (24). The study of Hubbard et al (24) reported AEs including gastrointestinal symptoms only when the others also reported respiratory tract events.

It has been understood that introducing high-energy feeding for infants has the risk of osmotic diarrhoea and vomiting (36). Therefore, it is necessary to evaluate the tolerance of the infants to the use of ONS. There were 4 studies in this review that reported the tolerance of ONS feeding (20,27,36,43). Indicators used in the studies include stool volumes, stool frequency or bowel actions, stool consistency, and vomiting. A study by Cui et al (43) showed significantly higher stool volumes and stool frequencies in 3 days after an intervention of protein-energy-enriched formula, compared with the standard. Clarke et al (20) reported no significant difference between the NDF and ESF in daily stool frequency and daily vomit. In a study by Devaera et al (27) there are no significant difference in stool characteristics, stool frequency, and consistency between 1.5 kcal/mL and 1 kcal/mL ONS group. Meanwhile, Evans et al (36) evaluated the feeding tolerance of a 1 kcal/mL formula for infants with growth faltering when administered at full strength from day 1 compared with stepwise introduction in 3 days. In the first 2 days, the number of bowel action in full strength introduction group was higher than the group receiving stepwise introduction (36). It appeared that the use of ONS in most studies was well tolerated and had no significant impact on vomiting or stool volume and frequency. However, this result should be interpreted carefully as it was not stated in the studies whether the adverse events are caused by ONS administration or as a result of the disease.

Cost-Effectiveness of ONS Use for Child Malnutrition

The cost-effectiveness of ONS should not be overlooked in the discussion as it could give insights into whether the cost of prescribing ONS to treat child malnutrition is worth the health benefits. The cost-effectiveness of ONS could be determined by comparing the cost of child malnutrition treatment using ONS and the health benefits of ONS use in malnourished children. When determining the cost of child malnutrition treatment using ONS, using the societal perspective by taking account direct medical, direct non-medical (e.g. transportation, day care for siblings), indirect (e.g. time lost from work of caregivers), and intangible (e.g. pain and suffering) costs are advised to gain results as a whole (49).

To our knowledge, studies that examined the cost-effectiveness of ONS in malnourished children are scarce. With the assumption that hospitalised children who received ONS were malnourished or at risk of malnutrition, we only found one study that explored the cost-effectiveness of ONS in malnourished children. Lakdawalla et al (44) conducted a retrospective analysis in the United States including 557,348 hospitalised children aged 2-8 years whose ONS indications were not stated. The study reported that the use of ONS was associated with an $8568 (95% CI, $8415-$8723) or 66,8% increase of episode cost from $12,833 to $21,401.(44) However, an instrumental variable (IV) analysis of a matched sample of 11,031 episodes showed that hospitalizations with ONS use resulted in a 9.7% lower cost [$16,552 vs $18,320; $1768 (95% CI, $1924-$1612)]. It was estimated that $1768 of episode cost was saved due to ONS use, which includes any avoided complications and is net of the cost of providing ONS. In the study, it was then estimated, based on reports that more than 3 million children were hospitalised nationally in the United States every year, assuming that 1.09% of the patients received ONS, and assuming that the sample in their study was nationally representative, ONS use among paediatric inpatients were associated with a total cost savings of approximately $57.8 million annually (44).

The cost-effectiveness of ONS may be due to the lower administration cost of ONS. This is supported by findings by Marino et al (50) that found that the total cost of administering ONS in the form of energy-dense ready-to-use infant feed (RTU formula) was lower than administering fortified powdered infant formula (PIF) in hospitalised undernourished infants aged < 12 months. RTU formula indeed had a higher actual cost compared to PIF with sunflower oil and PIF with medium triglyceride oil (MCT) (€1.62/100 mL, €0.18/100 mL, and €0.45/100 mL, respectively). However, when preparation and delivery costs were accounted for, the cost to provide 800 mL of feed per day is lower for RTU formula compared to PIF with sunflower oil and PIF with MCT (€12.51 vs €16.52 and €19.61) (50).

Other studies that examined the effectiveness of ONS in malnourished children mostly only report its medical-related outcomes without performing its cost-effectiveness analysis nor its cost analysis, yet those medical-related outcomes could still offer insights about the effect of ONS administration on hospitalisation cost. Improved medical-related outcomes such as shorter duration of mechanical ventilation (34), shorter ICU stay (34) shorter total duration of hospital stay (23,34), and less frequent antibiotic use (23) due to longer duration of ONS administration in infants suffering moderate or severe malnutrition (determined by WAZ ≥ -2) (34) and 30 days of EE ONS administration in 59 children aged < 2 years old after congenital heart surgery (23) could potentially result in lower direct medical cost, ergo, in lower children hospitalisation cost.

Despite the lack of evidence in the population of malnourished children, the cost-effectiveness of ONS use has been demonstrated in other populations. Economic modelling of ONS administration in adults by NICE reported that ONS has a cost per QALY €8,024 and is cost-effective (51) Caccialanza et al (52) found that ONS has positive and encouraging cost-effectiveness in paediatric and adult cancer patients. Meanwhile, a study by Freijer and Nuijten (53) in patients undergoing abdominal surgery in the Netherlands found that the use of ONS reduced the costs with a €252 (7.6%) cost saving per patient. The hospitalisation costs were

reduced from €3,318 to €3,044 per patient, which was an 8.3% cost saving and corresponds with 0.72 days reduction in length of stay (53). It was estimated that the use of ONS would lead to an annual cost saving of a minimum €40.4 million per year.

The findings of this review must be interpreted carefully since this review has several limitations. First, several studies in this literature review have at-risk of malnutrition children as its subject instead of clinically-diagnosed malnourished children, which such condition is making the studies prone to other variables that might confound the results. Second, the differences in study interventions, the duration of ONS administration, ONS consumption compliance, the subjects' age, and the initial conditions of subjects in existing studies make it difficult to compare the study results. Therefore, further studies exploring the effect of ONS administration strictly on clinically-diagnosed malnourished children should be conducted. More studies on the topic could be the basis for deciding the optimum duration and dose of ONS administration to support malnourished children. Furthermore, further research on the cost-effectiveness of ONS administration in malnourished children is needed to help policymakers decide whether an ONS prescription is advisable for child malnutrition treatment.

CONCLUSIONS AND RECOMMENDATIONS

The majority of studies in this literature review found that ONS administration as one type of Food for Special Medical Purposes (FSMPs) in malnourished children results in expected growth outcomes, including weight and height gain and improvements in WAZ, WHZ, and MUAC, but not in HAZ. While longer ONS administration and higher density of ONS administered in malnourished children results in shorter LoS, ONS administration is also related to the occurrence of several AEs. Meanwhile, despite the limited evidence on the cost-effectiveness of prescribing ONS to malnourished children as presented in this literature review, it is suggested that ONS might potentially be a cost-effective solution for child malnutrition treatment since ONS has a relatively low cost, improves medical-related outcomes that could potentially result in lower direct medical cost, and is found to be cost-effective in other populations.

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Declaration of interest.

The authors declare that they have no competing interests.

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The sensory and nutrient analysis by the addition of Chia seed (*Salvia hispanica L.*) to Star fruit Juice (*Averrhoa carambola L.*) as a drink for hypertension patients

Yuni Erlinda[1], Sri Anna Marliyati[2*], Budi Setiawan[3]

[1]Postgraduate in Nutrition Science, Department of Community Nutrition, Faculty of Human Ecology, IPB, University, 16680, Bogor, Indonesia
[2]Department of Community Nutrition, Faculty of Human Ecology, IPB University, 16680, Bogor, Indonesia

**Correspondence*: marliyati@apps.ipb.ac.id

ABSTRAK

Latar Belakang: *Hipertensi jika tidak dikendalikan dapat menyebabkan berbagai penyakit komplikasi hingga kematian. Pengendalian hipertensi dapat dilakukan dengan cara mengatur pola makan (diet) sehat, seperti meningkatkan konsumsi buah-buahan, biji-bijian, asupan kalium, kalsium, dan magnesium. Beberapa penelitian telah menunjukkan belimbing manis dan chia seed dapat mengontrol tekanan darah pada penderita hipertensi, akan tetapi kandungan gizi kalsium dan magnesium masih relatif rendah pada belimbing. Berdasarkan USDA chia seed memiliki kandungan kalsium, kalium, dan magnesium yang tinggi.*
Tujuan: *Tujuan penelitian ini untuk mengetahui daya terima secara sensori dan kandungan zat gizi jus belimbing dengan penambahan chia seed.*
Metode: *Jenis penelitian adalah eksperimental dengan desain Rancangan Acak Lengkap (RAL). Terdapat 4 formulasi jus belimbing dengan penambahan chia seed (0 g, 10 g, 15 g, 20g). Analisis sensori diuji menggunakan uji Kruskal Wallis dan dilanjutkan dengan uji Mann-Whitney. Selain itu, perbedaan zat gizi produk yang disukai panelis diuji dengan uji independent T-Test.*
Hasil: *Terdapat perbedaan yang signifikan (p<0,05) pada semua parameter sensori. Jus belimbing manis dengan penambahan chia seed sebanyak 10 g yang terpilih menunjukkan terdapat peningkatan zat gizi pada jus belimbing dengan penambahan chia seed, kecuali kadar air. Kadar air 89,21%, kadar abu 0,32%, kadar karbohidrat 7,14%, kadar lemak 1,75%, kadar protein 1,55%, kalium 206 mg/200 ml, kalsium 34,84 mg/200 ml, magnesium 17,80 mg/200 ml, natrium 2,46 mg/200 ml.*
Kesimpulan: *Jus belimbing manis dengan penambahan chia seed sebanyak 10 g merupakan formulasi jus belimbing dengan penambahan chia seed yang paling disukai oleh panelis dan dapat meningkatkan kandungan zat gizi terutama kandungan kalsium dan magnesium.*

KATA KUNCI*: kalsium; magnesium; jus belimbing manis; chia seed; hipertensi.*

ABSTRACT

Background: *Hypertension, when it is not controlled, can cause complications to many diseases and death. Hypertension control can be achieved by adjusting to a healthy diet, such as increasing the consumption of fruit, whole grains, potassium intake, calcium, and magnesium. Several studies have shown that star fruit and chia seeds can control blood pressure in people with hypertension. However, the nutritional content, such as calcium and magnesium, is still relatively low in star fruit. According to USDA, chia seeds contain high level of calcium, potassium, and magnesium.*

Objectives: *This research aims to determine the sensory acceptability and the nutritional content of star fruit juice by adding chia seeds.*

Methods: *This is an experimental study with a Completely Randomized Design (CRD). There were four formulations of star fruit juice with chia seeds additions (0 g,10 g,15 g, and 20 g). The sensory analysis was tested by the Kruskal Wallis test and Mann-Whitney test. While differences of the nutritional content from the product that preferred by panelists were tested by Independent T-test.*

Results: *There were significant differences ($p<0.05$) in all sensory parameters. The selected sweet star fruit juice with the addition 10 g chia seed formulation showed an increase in nutrients except for the water content. Water content of 89.21 %, ash content of 0.32 %, carbohydrate content of 7.14 %, fat content of 1.75 %, protein content of 1.55%, potassium content of 206 mg/200 ml, calcium content of 34.84 mg/200 ml, magnesium content of 17.80 mg/200 ml, and sodium content of 2.46 mg/200 ml.*

Conclusions: *Sweet start fruit juice with the addition of 10 g of chia seed is the most liked star fruit juice formulation with chia seed addition by the research panellists, and it can increase the nutritional content, especially calcium and magnesium content.*

KEYWORD*:* *calcium; magnesium; sweet star fruit juice; chia seed; hypertension.*

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INTRODUCTION

Hypertension is the leading cause of mortality and morbidity of cardiovascular disease worldwide. Data from the World Health Organization (WHO) in 2015 showed that approximately 1.13 billion people in the world suffer from hypertension, meaning that 1 in 3 people in the world is diagnosed with hypertension. The number of people suffering from hypertension continues to increase every year; by 2025, it is estimated that there will be 1.5 billion people affected by hypertension, and it is estimated that every year there are 9.4 people die from hypertension and its complications (1). Hypertension is also often called the silent killer because, in the initial phase, it does not show symptoms but can suddenly cause subclinical organ damage within the body (2).

If hypertension not be controlled in proper ways, it can cause complications to other dangerous diseases such as the risk of stroke, coronary heart disease, kidney disease and vision problems (3). The control of hypertension is divided into two ways; by pharmacological treatment and non-pharmacological treatment. the pharmacological treatment is involving antihypertensive drugs; such as angiotension corventing enzyme (ACE), inhibitors (captopril, lisinopril, enalapril), ACE receptor blockers (amlodipine), diuretics (hydrochlorothizide), renin inhibitors (aliskiren) and so on, while non-pharmacological treatment conducted by arranging a healthy eating pattern (diet) such as consuming vegetables, fruit, whole grains, low-fat dairy products, lean meat, reducing sodium intake, increasing the intake of potassium, calcium and magnesium (4–6).

Excessive fat intake affects high cholesterol deposits within the blood. These fat deposits will accumulate in the blood vessels, which later decrease the elasticity of blood vessels so that the

blood volume and blood pressure will increase. This mechanism will trigger hypertension (7). Meanwhile, excessive sodium intake will make the body retain fluid, which can increase blood volume. Excessive sodium intake can reduce the diameter of arteries and cause the heart to pump harder to increase the blood volume, so the blood pressure rises and triggers hypertension (8).

High potassium intake can reduce blood pressure substantially for people with hypertension who consume high sodium intake. Potassium has the function of lowering blood pressure so that it can prevent high blood pressure or even stroke. A high concentration of potassium in intracellular fluid can relax the vascular smooth muscle cells and then reduce peripheral vascular resistance to reduce blood pressure (9). Besides lowering blood pressure, potassium can reduce calcium excretion in the urine and benefit bone health. Blood pressure is regulated by intracellular calcium mechanisms in vascular smooth muscle cells through vasoconstriction and variations in vascular volume (10). Whereas magnesium plays a role in regulating blood pressure by modulating vascular smooth muscle tone and contractility by controlling the concentration and the availability of calcium ions (11).

Sweet star fruit (Averrhoa carambola L.) is a fruit that can control blood pressure because it contains high levels of potassium. According to the 2020 Indonesian Food Composition Table (Table Komposisi Pangan Indonesia/TKPI), the nutritional content of 100 grams of star fruit is 130 mg of potassium and 4 mg of calcium. However, the calcium content of starfruit is still relatively low compared to 100 g of milk (143 mg calcium) (12). Data from the Central Statistics Agency (BPS) 2021 showed that star fruit production in Indonesia in 2016 was 78,762 tons, increasing to 137,450 tons in 2021 (13). In addition, research from the National Health and Nutrition Examination Survey (NHANES) from 2005 to 2010 reported that whole fruit consumption decreases with age; thus, it requires food modifications that are acceptable to all ages (14). Research by Agarwal et al. (2019) in the analysis of NHANES cohort data stated that 100 % fruit juice was positively associated with diet quality and equivalent to whole fruit consumption at the nutrient intake level, except for less dietary fibre (15).

Research by Febriani and Zulfah (2016) compared tomato juice and star fruit juice (16). It stated that the average difference in blood pressure after giving tomato juice decreased by 9.75 (systolic) and 9.94 (diastolic), while for sweet star fruit juice was 20.19 (systolic) and 13.44 (diastolic). This finding aligns with the research of Arza and Irawan (2018) that consuming 200 ml of sweet star fruit juice once a day for seven days can reduce blood pressure from 175/92 mmHg to 135/79 mmHg (17). In addition, research by Khusuma et al. (2020) also stated that the consumption of sweet star fruit juice (± 150 grams) once every day after a meal for a day in the afternoon can reduce blood pressure from 149.65/94.87 mmHg to 139.61/89.52 mmHg in 28 people with hypertension (18).

Adequate nutrition is an essential element for preventing various diseases. Nutritionists and food technology experts stated that there has been broad interest in plant products, including chia seeds, in recent years. Chia seeds are often consumed as an ingredient or additional toppings to food such as baked products, muesli, milk drinks, fruit smoothies, or salads (19). Chia seeds are small grains from the Salvia hispanica L. plant. Research by Alwosais et al. (2021) stated a significant reduction of systolic blood pressure in people with type 2 diabetes mellitus (T2DM) and hypertension when consuming 40 g of chia seeds for 12 weeks (20). Chia seeds also have a complete nutritional content to help control blood pressure. According to the United States Department of Agriculture (USDA) 2011, the nutritional content in every 100 g of chia seeds is 407 mg of potassium, 631 mg of calcium and 335 mg of magnesium (21).

Research by Arza and Irawan (2018) and Alwosais et al. (2021) has shown a positive effect on reducing blood pressure. Starfruit has high potassium but relatively low calcium content, so additional foods such as chia seeds are needed to increase calcium and magnesium. Apart from that, research has yet to combine starfruit juice and chia seeds in terms of their acceptability and nutritional content. Therefore, this study aims to analyze the sensory and nutritional properties of star fruit juice by adding chia seeds, which the panellists prefer.

MATERIALS AND METHODS

The type of research is experimental research with Completely Randomized Design (CRD) research design. Product development and sensory analysis were conducted at the Food Processing and Experimentation Laboratory and the Organoleptic Laboratory, Department of Public Nutrition, Faculty of Human Ecology, IPB University. Meanwhile, the nutrient content analysis was conducted at the Chemistry and Nutrient Analysis Laboratory, Department of Community Nutrition, Faculty of Human Ecology, IPB University.

Ingredients used in this research were star fruit, chia seeds, water and honey. Type of star fruit was Paris type, the chia seeds used was Neo Oliva organic chia seeds, and the honey used was pure honey. Then, instrument or tools for making the star fruit juice with chia seeds addition was a digital food scale (Camry:eF973, capacity 5 kg and an accuracy of 0.1 g) for weighing starfruit and chia seeds, a measuring cup for measuring the volume of raw materials, a plastic bottle for drink container, a blender (Phillips), a filter, spoon, and a place to hold the filter results.

As the formula and stages in making star fruit juice refers to the research by Arza & Irawan, (2018) by the addition of chia seeds. Formula for star fruit juice with additional of chia seeds is displayed in **Table 1**.

Table 1. Star fruit juice with addition of chia seed formulation

Material	F1	F2	F3	F4
Star fruit (g)	150	150	150	150
Water (ml)	100	100	100	100
Honey (g)	5	5	5	5
Chia seed (g)	-	10	15	20

The stages in making sweet star fruit juice with chia seeds addition are: 1). Prepare the tools and raw ingredients, 2). Wash starfruit until it clean, 3). Cut the starfruit into several pieces and cut off the top part of the starfruit, 4) Weigh the pieces of cut star fruit, 5). Put the cut starfruit into a blender and added with water, blend the mixture for one minute, 6). After blending, filter the starfruit mixture and give addition of honey, 7). Pour the filtered starfruit into a plastic bottle and added with chia seeds. The volume of starfruit juice produced is 200 ml. This research was held from August to December 2023. The sensory analysis was tested by the Kruskal Wallis test and Mann-Whitney test. While differences of the nutritional content from the product that preferred by panelists were tested by Independent T-test.

RESULTS AND DISCUSSIONS

Sensory Analysis

The sensory analysis is conducted to consider and determine the star fruit juice formulation that the panellists like most, which will then be analyzed for its nutritional content. The sensory analysis carried out in this study included a hedonic test and a hedonic quality test. The hedonic test sensory parameters assessed in this research were the color, aroma, taste, viscosity, aftertaste, mouth feel, and overall. Assessment from the hedonic test is taken based on a hedonic scale from 1 (very much dislike) to 9 (very much like it), while the hedonic quality test parameters (by assessing through color, aroma, taste and viscosity parameters) are conducted on 30 panellists. The result data from the hedonic test is presented in **Table 2**, and the hedonic quality test result data is presented in **Table 3.**

The average value from panellists' preferences to the sensory parameters of the hedonic test showed that panellists tend to like (>5) or can accept all sensory parameters from the addition of chia seeds to starfruit juice. The hedonic test and hedonic quality showed that the Kruskal Wallis results for all sensory parameters in the four juice formulations were significantly different ($p<0.05$), so research analysis was continued with the Mann-Whitney test to find out which formulation was different.

Table 2. Result of hedonic test star fruit juice with the addition of chia seed

Parameter	Mean of Hedonic Test			
	F1	F2	F3	F4
Color	7,20 ± 1,028[a]	5,40 ± 1,277[b]	5,22 ± 0,986[b]	5,05 ± 1,228[b]
Flavor	6,80 ± 1,566[a]	6,59 ± 0,805[a]	6,45 ± 0,856[ab]	6,01 ± 1,116[b]
Aroma	6,97 ± 0,925[a]	6,74 ± 0,731[ab]	6,69 ± 0,735[ab]	6,30 ± 0,951[b]
Viscosity	6,83 ± 1,033[a]	6,39 ± 0,924[b]	6,09 ± 1,024[bc]	5,77 ± 1,199[c]
Aftertaste	6,79 ± 0,934[a]	6,34 ± 1,257[ab]	6,27 ± 1,151[ab]	6,01 ± 1,274[b]
Mouthfeel	6,71 ± 1,017[a]	6,20 ± 1,175[ab]	6,10 ± 1,015[b]	5,92 ± 1,105[b]
overall	7,01 ± 1,057[a]	6,42 ± 0,991[b]	6,39 ± 0,856[b]	6,19 ± 1,087[b]

Description: F1= Star fruit, F2= Star fruit with addition of chia seed (10 g), F3= Star fruit with addition of chia seed (15 g), F4= Star fruit with addition of chia seed (20 g). [a-b] = Different letter notations mean there is a significant difference at the Mann-Whitney test (p<0,05).

The results of hedonic test and hedonic quality to the color parameter showed a real difference between F1 and F2, F3, F4, but no real difference found between F2, F3 and F4. The average value from four tested formulations tended to decrease along with the addition of chia seeds. This decline was assumed came from chia seeds color that vary from black, gray, or black spots to white (22). The hedonic quality parameter of color assessed based on a hedonic quality scale from 1 (not yellow) to 9 (very yellow) F1 has a slightly yellow color, F2 and F3 have a slightly less yellow color and F4 has a non-yellow color. This research is in line with research of Lestari et.al. (2021) that reported the hedonic quality test on the color of herbal sherbet showed that its color without any additions was significantly different when compared to herbal sherbet with the addition of chia seeds. When added with chia seeds, herbal sherbet showed a darker color because of the grayish color from chia seeds (23).

Based on flavor parameter in the hedonic test, there is no real difference showed between F1,F2, and F3, but there is a real difference between F1,F2 and F4. This result is in line with research of Bhardwaj S and Saraswat S (2019) that reported the more chia seeds added to sport drink products the less taste value (reduce the flavor) of the product (24). Dislike flavor (unfavorable) towards products with added chia seeds was caused by bitter taste and water absorption quality from chia seeds that made the sport drinks products taste a little thick. According to the requirement of SNI 3719:2014, fruit juice drink has an ordinary or typical fruit taste, normal taste. Paris star fruit has a sweet taste (25). The hedonic quality test on taste parameters is assessed based on a hedonic quality scale from 1 (very not sweet) to 9 (very much sweet). The taste parameters of hedonic quality showed that F1 has a slightly sweet taste, while F2, F3, and F4 have a taste of between sweet and not sweet (neutral).

According to aroma parameters in the hedonic test and hedonic quality, it showed no real difference in aroma between F1, F2, and F3, but there is a real difference in aroma between F1 and F4. The characteristics of chia powder have a nutty aroma, brown color and sticky gum characteristics (26). Based on the requirements of SNI 3719:2014, the scent of fruit juice drink is ordinary or typical fruit aroma (normal) and the expected aroma of this product is the aroma of star fruit. The real difference in F4 is known due to addition of more chia seeds, so that the nutty aroma of chia seeds is stronger. This is in line with research of Bhardwaj S and Saraswat S (2019) where panelists preferred the aroma of sport drink with addition of 4 g of chia seeds compared to sport drink with the addition of 6 g chia seeds. From viscosity parameters in the hedonic test and hedonic quality, it showed a real difference between F1 and F2, F3 and F4, but there is no real difference between F2 and F3, F3 and F4. The viscosity parameter in hedonic quality is assessed based on hedonic quality scale from 1 (very not thick) to 9 (very much thick).

Table 3. Result of hedonic quality test star fruit juice with the addition of chia seed

Parameter	Mean of Hedonic Quality Test			
	F1	F2	F3	F4
Color	6,61 ± 0,953[a]	4,38 ± 1,445[b]	4,05 ± 1,209[b]	3,74 ± 1,343[b]
Flavor	6,01 ± 1,057[a]	5,42 ± 1,252[ab]	5,40 ± 1,312[ab]	5,24 ± 1,163[b]
Aroma	5,75 ± 1,489[a]	5,05 ± 1,264[ab]	5,03 ± 1,312[ab]	5,03 ± 1,093[b]
Viscosity	3,07 ± 1,299[a]	4,25 ± 1,474[b]	4,51 ± 1,551[bc]	5,24 ± 1,807[c]

Description: F1= Star fruit, F2= Star fruit with addition of chia seed (10 g), F3= Star fruit with addition of chia seed (15 g), F4= Star fruit with addition of chia seed (20 g). a-b = Different letter notations mean there is a significant difference at the Mann-Whitney test (p<0,05).

The hedonic quality results show that F1 is not thick, F2 and F3 are slightly thick, while F4 is between thick and not thick (neutral). The addition of chia seeds to star fruit juice affects the viscosity level of the juice, due to the gum-forming activity of chia seeds. When chia seeds are hydrated with water, a transparent capsule (gum) forms around the chia seeds (19,27). The result of this research is in line with research of Lestari et al. (2021) which states that texture quality characteristics of herbal sherbet without any additions are significantly different from herbal sherbet with chia seeds added, this is associated with a change in the viscosity of the drink in herbal sherbet with chia seeds added.

Based on aftertaste parameter, the hedonic test result showed there is no real difference between F1, F2, and F3 but there is a real difference between F1 and F4. This difference is caused by addition of more chia seeds in F4. According to research of Adawiyah et al. (2022), chia seeds that are absorbed by water have sticky or thick characteristic.

Based on mouthfeel parameters, the result from the hedonic test showed no real differences between F1 and F2, F2 and F3, F3 and F4, but there are real differences between F1 and F3, F1 and F4. From the opinion of the panellists, the more chia seeds added, the more dominant the chia seeds taste compared to star fruit juice taste since there is a change in the viscosity aspect of the star fruit juice.

From the overall parameters, results showed there are no real differences between F2, F3 and F4, but there are real differences between F1 and F2, F3 and F4. Based on the overall assessment, there was a decline in the sensory value of star fruit juice with the addition of chia seeds. According to the Commission Implementing Regulation of the European (EU) 2017/2470 on the list of new foods, the recommended consumption of chia seeds in a day should not be more than 15 g (19). The research of Bhardwaj S and Saraswat S (2019) also states that more chia seeds added to sports drink products reduce the overall sensory assessment.

Nutrient Analysis

According to the statistical results of sensory analysis from the four formulations, thebest products are F1 and F2. The analysis of nutritional content from the best products consisted of macronutrient content (moisture, ash, protein, fat and carbohydrate content) and micronutrient content (potassium, calcium, magnesium and sodium). The results of the analysis of nutritional content are presented in **Table 4.**

In this study, the macronutrient content (water content, ash content, carbohydrates, protein and fat) showed a significant difference ($p<0.05$) between the two formulations. The addition of 10 g of chia seeds to starfruit juice has an average value that increases the macronutrient content except for the water content. Water content of star fruit juice with chia seeds addition is lower than the water content of starfruit juice without any addition of chia seeds. The water content of star fruit juice has a percentage of 93.15 % meanwhile the water content of star fruit juice with chia seeds has a percentage of 89.21 %. Chia seeds are able to absorb water up to several times their dry weight (28). This statement is in line with research of Paramita et al. (2022) which showed that adding 7.5 g of chia seeds can reduce the water content in smoothies (29). The ash content of star fruit juice with chia seeds addition is higher

than only starfruit juice. Ash content in starfruit juice is 0.18 % while in starfruit juice with chia seeds addition is 0.32 %. This result is aligned with research of Costa et al., 2022 which showed that ash content in fermented milk is influenced by the amount of added syrup and chia seeds (30). Ash content describes the remaining of total mineral content after the combustion process or acid-facilitated oxidation of organic compounds in food (31).

Carbohydrate content obtained with by difference method showed the carbohydrate content in star fruit juice is 5.69 % while the carbohydrate content in star fruit juice with chia seeds addition is 7.14 %. This is in line with research of Bhardwaj S and Saraswat S (2019) which stated the addition of 2 g, 4 g, and 6 g of chia seeds increases the carbohydrate level in sport drinks.

Table 4. The Nutritional Content Analysis

Nutrient	Unit	F1	F2	p-value[1)]
		Mean ± SD		
Water Content	(%)	93,158 ± 0,250	89,219 ± 0,070	0,000*
Ash Content	(%)	0,189 ± 0,026	0,325 ± 0,053	0,017*
Carbohydrate	(%)	5,699 ± 0,218	7,146 ± 0,037	0,000*
Fat	(%)	0,365 ± 0,032	1,754 ± 0,030	0,000*
Protein	(%)	0,588 ± 0,023	1,555 ± 0,017	0,000*
Potassium	mg/ml	163,384 ± 11,522	206,640 ± 9,554	0,055
Calcium	mg/ml	5,320 ± 0,009	34,843 ± 6,289	0,022*
Magnesium	mg/ml	5,383 ± 0,424	17,803 ± 0,200	0,001*
Sodium	mg/ml	2,361 ± 0,488	2,469 ± 0,555	0,856

Description: SD = Standard deviation; F1 = Star fruit juice, F2 = Star fruit juice with the addition of chia seed 10 g; [1)]Uji *independent sample t-test*, shows that there is a significant difference in the nutritional content of F1 and F2 (**p* <0,05).

The addition of 6 g of chia seeds can increase carbohydrate level by 4.8 %. Paramita et al (2022) also stated the addition of 7.5 g of chia seeds increased the carbohydrate content in smoothies by 13.05 %. The carbohydrate content in both formulations is also assumed due to honey addition. According to TKPI (2020) the carbohydrate content in 100 g of honey is 79.5 %. The fat content in 200 ml of star fruit juice is 0.36 % while the fat content in star fruit juice with addition of chia seeds is 1.75 %. This is in line with research of Rasbawati and Irmayani (2021) that stated 10 % chia seeds addition increases the fat content in pasteurized milk (32). Chia seeds contain essential fatty acid, component that build fat, and essential fatty acid is a type of fatty acid that is really needed by the body (33).

The protein content in star fruit juice is 0.58 % while the protein content in starfruit juice with chia seeds addition is 1.55%. This result is in line with research of Bhardwaj S and Saraswat S (2019) which stated by adding 6 grams of chia seeds to sport drinks will increase the protein content by 2 %. While Rasbawati and Irmayani (2021) stated that adding 10 % of chia seeds increasing the protein content in pasteurized milk. Another study by Paramita et al (2022) also stated by adding 7.5 gr of chia seeds increasing the protein content in smoothies by 1.43 %.

The analysis of micro mineral content showed there is no significant difference in potassium and sodium level between two formulations. Sodium content in star fruit juice with no addition is 2.36 mg/200 ml, while sodium content in star fruit juice with chia seeds addition is 2.46 mg/200 ml. Value of sodium content within the product showed still meets the recommended limit for sodium intake (2000 mg/day or 5 g/day). The average of potassium level in star fruit juice is 163.38 mg/200 ml whereas the potassium level in star fruit juice with chia seeds addition is 206.64 mg/200 ml. Potassium level in star fruit juice with chia seeds addition tend to increase, however, no significant difference is found between the two formulas. It assumed that in 100 g of star fruit has a potassium level of 130 mg, while in 100 g of chia

seeds has a potassium level of 407 mg (27,28). This result is in line with the research of Kibui et al (2018) which showed there is no significant difference in the potassium level of yoghurt added with chia seeds (34).

The calcium level and magnesium level in this study showed a significant difference (p,0.05) between the two formulations. The average calcium level in star fruit juice was 5.32 mg/200 ml, while in star fruit juice with chia seeds addition is 34.84 mg/200 ml. the average of magnesium content in star fruit juice is 5.38 mg/200 ml while in star fruit juice with chia seeds addition is 17.80 mg/200 ml. Increase of calcium and magnesium level in star fruit juice known is present due to addition of 10 g of chia seeds. According to USDA (2011), 100 g of chia seeds contains 632 mg of calcium and 335 mg of magnesium. This result is in line with research of Alwi et al (2023) which showed the addition of chia seeds can increase the calcium and magnesium level in 200 ml of coconut water (35).

CONCLUSIONS AND RECOMMENDATIONS

F2 is the star fruit juice with chia seed addition selected as the most preferred formulation by the panellists. Star fruit juice with chia seeds addition can be consumed as a drink for people with hypertension because it contains good nutrients. The nutritional content of star fruit juice with chia seeds addition tends to increase in selected products. The calcium content in F2 is 34.84 mg/200 ml, and the magnesium content in F4 is 17.80 mg/200 ml.

Further research needs to be carried out to determine the effectiveness of star fruit juice with chia seeds addition on the blood pressure of people with hypertension.

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Healthy snack quartet education on knowledge and sodium intake in overweight early adolescents

Ferliani Fransisca Sa'pang [1*], Tri Rejeki Andayani[2], Muthmainah[3]

[1] Human Nutrition Departmen, Postgraduate Program, Sebelas Maret University, Surakarta, Indonesia
[2]Faculty of Psychology, Sebelas Maret University, Surakarta, Indonesia
[3]Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia

**Correspondence*: ferlifs.ff@gmail.com

ABSTRAK

Latar Belakang: *Kasus kegemukan pada anak dan remaja diperkirakan mencapai 49,5 juta kasus di dunia pada tahun 2030. Intervensi edukasi gizi untuk meningkatkan pengetahuan tentang jajanan sehat pada remaja menjadi penting sebagai salah satu bentuk pencegahan obesitas pada remaja. Kuartet jajanan sehat merupakan media edukasi yang dilakukan dengan metode permainan kelompok sehingga remaja merasa nyaman dalam proses pembelajaran.*
Tujuan: *Mengetahui pengaruh edukasi kuartet jajanan sehat terhadap pengetahuan dan asupan natrium pada remaja awal overweight.*
Metode: *Penelitian ini merupakan penelitian quasy eksperimental dengan pre-posttest with control group design. Sampel dipilih secara purposive dan terpilih 54 remaja overweight yang terbagi menjadi kelompok control dan dua kelompok intervensi. Edukasi menggunakan kuartet jajanan sehat dilakukan selama 21 hari sejak September-Oktober 2023 di Kota Makassar. Analisis data dilakukan menggunakan wilcoxon singed ranks test.*
Hasil: *Terdapat perbedaan yang signifikan pada pengetahuan remaja dengan nilai p-value <0,05 pada P1 (p=0,001) dan P2 (p=0,000). Namun, tidak terdapat perbedaan yang signifikan pada variabel asupan natrium baik pada kelompok kontrol (p=0,948), P1 (p=0,170) dan P2 (p=0,170).*
Kesimpulan: *Edukasi menggunakan kuartet jajanan sehat dapat meningkatkan pengetahuan mengenai jajanan sehat pada remaja awal overweight namun tidak berdampak signifikan terhadap asupan natrium remaja overweight.*

KATA KUNCI*: asupan natrium; edukasi gizi; pengetahuan; remaja overweight.*

ABSTRACT

Background: *Child and adolescent obesity cases are estimated to reach 49.5 million cases worldwide by 2030. Nutrition education interventions to increase knowledge about healthy snacks in adolescents are important as a form of obesity prevention in adolescents. Healthy snacks quartet is an educational media that is carried out with a group game method so that adolescents feel comfortable in the learning process.*

Objectives: *To determine the effect of healthy snacks quartet education on knowledge and sodium intake in overweight early adolescents.*

Methods: *This study is a quasi-experimental study with pre-posttest with control group design. The sample was purposively selected and 54 overweight adolescents were divided into a control group and two intervention groups. Education using healthy snacks quartet was conducted for 21 days from September to October 2023 in Makassar City. Data analysis was performed using Wilcoxon singed ranks test.*

Results: *There was a significant difference in adolescent knowledge with a p-value <0.05 in P1 (p=0.001) and P2 (p=0.000). However, there was no significant difference in sodium intake variables both in the control group (p=0.948), P1 (p=0.170) and P2 (p=0.170).*

Conclusions: *Education using healthy snacks quartet can increase knowledge about healthy snacks in overweight early adolescents but does not have a significant impact on sodium intake of overweight adolescents.*

KEYWORDS*:* *natrium intake; nutrition education; knowledge; overweight adolescent*

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INTRODUCTION

Overweight adolescents exhibit poor dietary quality and frequently lack sufficient incentive to prioritise their long-term health. This is attributed to a lack of comprehension regarding the potential consequences of the present bad dietary habits on the future well-being of adolescents (1). Unhealthy dietary habits result in imbalanced nutrient consumption and obesity is common not just among adults but also in adolescents. Unbalanced nutritional intake in adolescents, especially in school-age adolescents, which is indicated by the behavior of choosing unhealthy snacks such as fast food, snacks and drinks with excess sweeteners, is a supporting factor for overweight (2).

The long-term impact of an unhealthy diet is an increase in the incidence of non-communicable diseases in society. By 2020, as many as 41 million people will die each year from non-communicable diseases. A total of 9.3 million fatalities were attributed to cancer, 4.1 million to respiratory disorders, and 1.5 million to diabetes. Indonesia has recorded 1.3 million fatalities resulting from degenerative diseases (3). Elevated sodium consumption is linked to various degenerative conditions, including cardiovascular disease, renal failure, kidney stones, osteoporosis, and stomach cancer. Elevated sodium consumption is reportedly associated with higher Body Mass Index (BMI) in children and adolescents. As many as 73% of overweight adolescents had sodium intake that exceeded daily sodium requirements (4).

Unhealthy eating patterns reflect adolescents' low understanding of the importance of healthy food consumption and poor nutrition education in school-age adolescents. Nevertheless, the management of adolescent obesity is highly complex, and several strategies aimed at addressing this issue remain insignificant. Therefore, the development of interventions to prevent overweight in adolescents is needed (5). Implementing nutrition education interventions for adolescents is the initial and obvious approach to enhance their understanding of the significance of maintaining a nutritious diet. A strong understanding of proper nutrition

empowers adolescents to make healthier food choices that fulfil their nutritional requirements, thus preventing overweight in adolescents (6). Nutrition education needs to be delivered using attractive educational media to increase learning motivation in adolescents. Nutrition education through game methods that are professionally designed from the aspects of educational materials and media design can increase knowledge and affect the attitudes of adolescents (7). The delivery method used to deliver educational information plays a significant role in influencing the learning motivation of adolescents, particularly those who are prone to easily becoming bored. This is in addition to the presence of attractive instructional media. The efficacy of education delivered by the lecture technique is inconsistent thus requiring changes or combinations to provide a substantial influence on knowledge enhancement and behaviour transformation in a positive path (8). One approach to educating adolescents involves utilizing a combination of reinforcement rewards and punishments. Providing positive reinforcement to adolescents through rewards for positive behavior and punishment for negative behavior can enhance their motivation to learn, foster a learning environment characterized by positive competition and build the relationship between educators and students (9).

Education is carried out using healthy snacks quartet media that has been professionally designed through the Reseach and Development stage (R&D). The healthy snacks quartet is played in groups of four players per group with eight educational sub topics about healthy snacks consisting of 32 cards. Quartet educational media is an educational media and can increase learning interest in adolescents over 12 years of age (10). This study aimed to determine the impact of educational interventions using a combination of healthy foods quartet media, lectures, and reinforcement through rewards and punishments on the knowledge of healthy snacks and sodium intake in early adolescents with overweight.

MATERIALS AND METHODS

This study is a quantitative study using a quasy experimental pretest-postest with control group design. The research was conducted in September - October 2023 after obtaining ethical approval from the Ethics Commission of the Faculty of Medicine, Sebelas Maret University Surakarta with Letter Number 170/UN27.06.11/KEP/EC/2023 and IP No. 157/02/07/2023.

The sample selection was carried out purposively based on the inclusion criteria determined by the researcher. The study included early adolescents aged 12-15 years who had an overweight nutritional status based on their BMI (Body Mass Index) relative to their age. Participants were excluded if they were currently having hormone treatment or special diets, and were required to express willingness to be research subjects. According to the hypothesis proposed by Gay and Diehl, a minimum of 15 samples per group is necessary for uncomplicated experimental study (11). The study included 18 adolescents per group, resulting in a total of 54 adolescents who matched the research criteria. The participants were selected from three schools in Makassar City, which have the greatest prevalence of overweight adolescents. First, an initial assessment of the subjects' abilities was conducted as a pretest. Following this, the intervention was implemented on the sample for a duration of 21 days. Finally, a final assessment of the subjects' abilities was conducted as a posttest. The sample was divided into three groups: the control group, the intervention group with the provision of healthy snacks and quartet education (P1), and the intervention group with the provision of healthy snacks, quartet education, and lecture method with reinforcement reward and punishment (P2).

The characteristics of the research subjects and the history of obesity in the family are known based on the completion of the characteristics questionnaire obtained from the interview results. Knowledge of overweight adolescents about healthy snacks was known based on the completion of a healthy snacks knowledge questionnaire containing 15 question items using a guttman scale. Sodium intake in adolescents before and after the intervention was known based on interviews with 2 x 24-hour food recall forms on weekends and early weeks to determine sodium intake representing holidays and schools in overweight adolescents and then calculated the

average sodium intake using the NutriSurvey 2007 application.

Education is provided using a snack quartet media that has gone through the Reseach and Development (R&D) stage conducted by researchers according to the educational needs of early adolescents in Makassar City. The Healthy Snacks Quartet is an instructional media program designed for group settings consisting of four individuals. The quartet consists of 32 cards with eight card subject. The card headings include the advantages of nutritious snacks, attributes of nutritious snacks 1, attributes of nutritious snacks 2, the consequences of unhealthy snacks, prerequisites for healthy snacks, harmful components in snacks, varieties of nutritious snacks, and snacks that should be restricted. In the second intervention group (P2), a series of educational sessions on healthy snacks, using a quartet format, was conducted four times. These sessions were accompanied by lectures. Additionally, a reward and punishment system was implemented throughout each game session.

Differences in knowledge about healthy snacks and sodium intake in overweight early adolescents were analyzed using the Wilcoxon Test. Data analysis was performed using SPSS Statistic software v. 27.0 for windows.

RESULTS AND DISCUSSIONS

Characteristics of Research Subjects

Table 1 illustrates the characteristics of the research subjects in this study, the majority of research subjects were 12 years old (53.7%) and male (70.4%). Most of the research subjects in this study also carry pocket money ranging from Rp 10,000 to Rp 20,000 (64.8%) and only 5.6% carry pocket money above Rp 20,000. The research subjects in this study were overweight adolescents, most of whom did not have obese family members (48.1%) and only 3.7% of adolescents with obese parents.

Table 1. Characteristics of research subjects

Variables	Control (n=18)		P1 (n=18)		P2 (n=18)		Total (n=54)	
	n	%	n	%	n	%	n	%
Sex								
Male	15	83,3	11	61,1	12	66,7	38	70,4
Female	3	16,7	7	38,9	6	33,3	16	29,6
Age								
12 Years	15	83,3	2	11,1	12	66,7	29	53,7
13 Years	3	16,7	11	61,1	4	22,2	18	33,3
14 Years	0	0	5	27,8	2	11,1	7	13
History of Obesity								
Father	5	27,8	8	44,4	2	11,1	15	27,8
Mother	5	27,8	2	11,1	4	22,2	11	20,4
Father dan Mother	0	0	1	5,6	1	5,6	2	3,7
None	8	44,4	7	38,9	11	61,1	26	48,1
Allowance								
< Rp 10.000	5	27,8	5	27,8	6	33,3	16	29,6
Rp 10.000-20.000	12	66,7	12	66,7	11	61,1	35	64,8
>Rp 20.000	1	5,6	1	5,6	1	5,6	3	5,6

The prevalence of obesity in adolescents is influenced by multiple factors. Female adolescents were shown to have a higher impression of fatness, in addition to excessive nutrient consumption and insufficient physical activity. Female adolescents exhibit a greater inclination towards beauty and possess a more unfavorable perception of weight compared to male adolescents, resulting in a tendency for them to have a higher body weight than their male counterparts (12). This is illustrated in the table of characteristics of research subjects consisting of 29.6% overweight adolescent girls.

In addition to nutritional intake and adolescents' perception of body weight, family also plays a role in adolescents' health behavior. The family has a crucial role as the primary agent of

socialization, shaping the formation of health behavior patterns in adolescents, especially those who are overweight. Parenting strategies influence the way adolescents manage their dietary intake (13). According to the results of the study, the majority of overweight teenagers (48.1%) had parents who are not obese. This signifies a deficiency in the parental methods employed for overweight adolescents. Parents of overweight adolescents should focus on their parenting methods, particularly in three areas: physical activity, screen time, and nutritional intake. This can be achieved by reducing the consumption of unhealthy food and increasing the consumption of fruits and vegetables (14).

Healthy snacks quartet education on knowledge of healthy snacks in overweight early adolescents

Table 2 presents the difference in knowledge scores pertaining to nutritious snacks prior to and following the implementation of healthy snack quartets on the research participants (control, P1, and P2). According to the provided data, the control group had a mean knowledge score of 80. The lowest score recorded during the pretest was 67, while the lowest score during the posttest was 73. Wilcoxon analysis conducted on the control group with p=0.618 (p>0.05) which means there is no significant difference in the control group. The median score of knowledge about healthy snacks in group P1 prior to the intervention was 73, with the lowest score recorded at 47. Following a 21-day intervention involving the consumption of healthy snacks, the median score rose to 87, with the lowest score recorded at 73. The subsequent data analysis yielded a p-value of 0.001 (p <0.05), indicating a statistically significant difference in group P1 after the implementation of the healthy snacks quartet. In group P2, following nutrition education with a combination of healthy snacks quartet, lecture approach, and a reward and punishment system, the median score had a significant rise of 20 points, rising from the previous score of 73 to 93, with the lowest score recorded at 93 points. The results of the difference test analysis obtained p=0.000 (p<0.05) which means that there are significant changes in knowledge about healthy snacks in group P2.

Table 2. Differences in Knowledge about Healthy Snacks Before and After Intervention in Research Subjects

	n	Mean	Median (Min-Maks)	*p*
Control				
Pretest	18	81	80 (67-93)	0,618
Postest		82,1	80 (73-100)	
P1				
Pretest	18	71,2	73 (47-87)	0,001
Postest		84,7	87 (73-93)	
P2				
Pretest	18	77,6	73 (53-93)	0,000
Postest		96,1	93 (93-100)	

According to the findings of the preliminary evaluation, adolescents generally possess knowledge about healthy snacks that can be classified into the moderate and good categories. This can be observed by considering the mean value of the pretest responses, which comes within the range of 71.1 to 81 points. Early adolescence is a pivotal stage characterized by significant physical and cognitive growth, as well as the development of essential skills and the formation of positive behaviors. Developing knowledge about nutrition will positively influence teens. Adolescents can quickly obtain information from many media, particularly social media, due to advancements in information technology and the widespread use of smartphones. There is a growing availability of nutrition education materials that focus on eating and provide explanations on achieving nutritional balance (15). The level of knowledge among overweight adolescents in this study shows a positive influence after 21 days of education. The control group consisted of 66.7% of adolescents who had a good level of knowledge. In groups P1 and P2, 88.9% and 100% of adolescents, respectively, demonstrated a commendable understanding of healthy

snacking. Adolescents who possess a significant amount of nutritional awareness will experience a 0.56-fold decrease in the likelihood of developing obesity compared to adolescents with a moderate degree of nutritional knowledge (16).

Table 3 Level of Knowledge about Healthy Snacks Before and After Intervention in Research Subjects

Variable	Control				P1				P2			
	Before		After		Before		After		Before		After	
	n	%	n	%	n	%	n	%	n	%	n	%
Knowledge												
Low	0	0	0	0	2	11,1	0	0	2	11,1	0	0
Moderate	7	38,9	6	33,3	10	55,6	2	11,1	8	44,4	0	0
Good	11	61,1	12	66,7	6	33,3	16	88,9	8	44,4	18	100

The Wilcoxon analysis in this study showed a significant influence of education on the knowledge of overweight adolescents. This effect was shown by a p-value of 0.001 in group P1 and 0.000 in group P2, while applying healthy snacks quartets. The research subjects engaged in a 21-day trial of consuming a selection of nutritious snacks. This experiment yielded valuable insights into healthy snacks, resulting in a significant enhancement of adolescents' knowledge on the subject.

The healthy snacks quartet provides information about nutritious snack options and the criteria for identifying unhealthy snacks, aiming to educate overweight adolescents on making healthy snack choices. Education implemented through the use of multimedia quartet enhances the enthusiasm for learning among study subjects, since it employs a gamified approach that reduces any sense of compulsion associated with learning. Implementing interventions to enhance nutritional awareness across different age cohorts is an effective strategy with long-term benefits, as the prevalence of diet-related illnesses continues to rise annually (17).

Healthy Snack Quartet Education on Sodium Intake in Overweight Early Adolescents

Table 4. Differences in sodium intake before and after intervention on research subjects

	n	Mean (mg/day)	Median (mg/day)	Min-Maks (mg/day)	*p*
Control					
Pretest	18	1745,9	1126.8	116-4865	0.948
Postest		1948,5	834.5	72,3-6445	
P1					
Pretest	18	1477	428.9	107,6-4492	0.170
Postest		872	211.75	105,2-4813	
P2					
Pretest	18	1362	838,8	85,8-4127	0.170
Postest		745,8	242	63-2731	

Table 3 shows the difference in sodium intake among overweight early adolescents prior to and following the intervention. The total sodium intake in this study is determined based on the findings obtained from two 24-hour dietary recall assessments. The control, P1, and P2 groups exhibited a reduction in sodium consumption during the posttest. However, this reduction in intake was not statistically significant. The control group had a reduction in sodium consumption of 292.3 mg per day, as indicated by the median sodium intake value. Groups P1 and P2 experienced a reduction in sodium intake by 217.15 mg/day and 596.8 mg/day, respectively. However, there has been no statistically significant decrease in sodium consumption for

the control group (p=0.948), P1 (p=0.170), and P2 (p=0.170), with p>0.05.

Sodium intake is associated with obesity mediated through intake of Sugar-Sweetened Beverages (SSBs) or beverages with high added sugar and energy-dense salty foods (18). Research conducted in several developed countries on adolescents states that there is a significant relationship between sodium intake and obesity. High sodium intake causes leptin resistance through fructose production, increases fasting ghrelin which regulates appetite, causes glucose homeostatis and induces adipogenesis/lipogenesis in adipocytes thus increasing body fat accumulation (19, 20). The healthy snacks quartet contains information to limit the consumption of sweetened snacks and drinks as well as fried processed foods. This had an impact on reducing the average sodium intake in the intervention group, namely 605 mg in group P1 and 616.2 mg in group P2, while in the control group there was an increase in the average daily sodium intake of 202.6 mg.

Table 5 Sodium Intake Level Before and After Intervention in Research Subjects

Variable	Control				P1				P2			
	Before		After		Before		After		Before		After	
	n	%	n	%	n	%	n	%	n	%	n	%
Sodium Intake												
Low	9	50	9	50	10	55.6	13	72.2	9	50	13	72.2
Moderate	0	0	2	11.1	0	0	1	5.6	1	5,6	0	0
High	9	50	7	38.9	8	44.4	4	22.2	8	44,4	5	27.8

Measurement of sodium intake in adolescents before the intervention based on the results of 2x24 hour recall, it was known that adolescents often skipped breakfast and were given additional pocket money to buy breakfast at school. The first break time between 9:30 am to 10:00 am was used by adolescents for breakfast. This behavior of skipping breakfast has an impact on excessive consumption of unhealthy snacks because adolescents become starving and impulsively choose snacks that look attractive but have low nutritional quality such as instant noodles and iced tea. Adolescents with breakfast skipping behavior lead to overconsumption at the next meal. Adolescents who did not skip breakfast had lower snack consumption habits (21).

Consumption of unhealthy snacks in overweight adolescents also occurs on weekends such as contemporary drinks with excess sweetener content, fried foods, chips and junk food (burgers and pizza). Consumption of unhealthy snacks on school days and weekends increases sodium intake in adolescents. Recommended Dietary Allowance (AKG) (2019) recommends sodium intake in adolescents aged 12-15 years is a maximum amount of 1500 mg per day. Approximately 33% of sodium intake in overweight teenagers is derived from food consumed at school, where as 7% comes from fast food. The remaining sodium intake is related to food consumed at home (23).

CONCLUSION AND RECOMMENDATION

Education using healthy snack quartets accompanied by lectures and reinforcement reward and punishment has an effect on overweight adolescents' knowledge related to healthy snacks but has no effect on adolescent sodium intake despite a decrease in daily sodium intake. Utilizing healthy snack quartets as an instrument of education can serve as an enjoyable resource for youth education, ensuring that adolescents do not perceive nutrition education programs as forced. Additional investigation is required to assess the long-term viability of boosting awareness about nutritious snacks on the nutritional well-being of adolescents, with the aim of minimizing adolescent obesity.

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Anthropometric knowledge and measurement evaluation among female volunteer community health workers in Depok

Dian Luthfiana Sufyan, Firlia Ayu Arini*, Ibnu Malkan Bakhrul Ilmi, Avliya Quratul Marjan, Iin Fatmawati

Department of Nutrition, Faculty of Health Sciences, UPN Veteran Jakarta, Jalan RS Fatmawati Pondok Labu, Jakarta, Indonesia

**Correspondence*: ferlifs.ff@gmail.com

ABSTRAK

Latar Belakang: *Pada level komunitas, penilaian status gizi anak dilakukan oleh kader Pos Pelayanan Terpadu (Posyandu) setiap bulan. Berdasarkan observasi analisis situasi, para kader memiliki pengetahuan yang cukup terkait pengukuran antropometri, namun dalam praktiknya masih ditemukan kesalahan, sebab kader tidak menjalani pelatihan secara formal melalui jalur pendidikan, oleh sebab itu kegiatan pelatihan dan penyegaran kembali terkait pengukuran antropometri sangat diperlukan.*
Tujuan: *Kegiatan ini merupakan bagian dari projek Kampung Caraka yang bertujuan untuk meningkatkan kesadaran akan Kesehatan komunitas di daerah Kedaung Depok. Lebih spesifik, studi ini bertujuan untuk mengevaluasi pengetahuan kader serta tingkat presisi dan akurasi pengukuran antropometri.*
Metode: *Tiga puluh sembilan kader berpartisipasi dalam studi intervensi ini.yang berasal dari 13 posyandu di daerah Kedaung Depok. Kriteria inklusi meliputi kader dengan minimal masa kerja satu tahun, dan akan dieksklusi jika tidak mengikuti seluruh rangkaian kegiatan. Edukasi antropometri diberikan sebelum evaluasi dilakukan. Evaluasi pengetahuan diukur menggunakan kuesioner pre-test dan post-test yang terdiri dari 10 pertanyaan. Evaluasi presisi dan akurasi dilakukan untuk pengukuran panjang badan, tinggi badan, lingkar lengan atas (Lila) dan lingkar kepala (Lika). Emergency Nutrition Assessment (ENA) Smart digunakan untuk mengevaluasi presisi dan akurasi. Analisis deskriptif dilakukan untuk menyajikan tingkat presisi dan akurasi pengukuran kader. Uji Wilcoxon dilakukan untuk mengetahui perbedaan median skor pretest dan posttest.*
Hasil: *Hasil menunjukkan persentase kader dengan presisi yang baik pada pengukuran Lila, tinggi, Lika dan Panjang badan masing-masing sebesar 23.1%, 23,1%, 52.8% dan 33.3%. Sebaliknya, hanya 7.7% kader yang memiliki akurasi baik pada pengukuran Lila. Terdapat perbedaan bermakna antara skor media kader sebelum dan setelah diberikan intervensi (p-Value 0.02, CI 95%).*
Kesimpulan: *Kader yang berpartisipasi pada studi ini memiliki presisi yang baik namun akurasi yang kurang. Hal ini berimplikasi pada kebutuhan prosedur standar serta kalibrasi alat sebelum dilakukannya pengukuran antropometri.Pemberian edukasi yang komprehensif diperlukan untuk meningkatkan pengetahuan kader.*

KATA KUNCI: *akurasi; antropometri; emergency nutrition assessment; kader, posyandu*

ABSTRACT

Background: *At the community level, assessment for children nutritional status is measured by female volunteer community health workers (FVCHW) through integrated health post (Posyandu). Based on initial observation, volunteers have sufficient knowledge of anthropometric measurement however, to put it into practice, common pitfalls remain found.Refreshment on basic knowledge and practical training on anthropometric assessment is needed.*

Objectives: *As part of Kampung Caraka Project that attempts to empower locals to be deliberately aware of community health and well-being, this particular study aims to evaluate knowledge of FVCHW as well as their accuracy and precision on anthropometric assessment.*

Methods: *This study is a quasi-experimental study with pre-posttest with control group design. The sample was purposively selected and 54 overweight adolescents were divided into a control group and two intervention groups. Education using healthy snacks quartet was conducted for 21 days from September to October 2023 in Makassar City. Data analysis was performed using Wilcoxon singed ranks test.*

Results: *Results showed women with good precision for MUAC, height, head circumferences and length measurement were 23.1%, 23.1%, 53.8% and 33.3%, respectively. In contrast, only 7.7% of women had good accuracy on MUAC measurement. There is a significant difference of knowledge score before and after the education given (p-value 0.02, CI 95%).*

Conclusions: *The cadre had good precision yet poor accuracy, implying the necessity of standardized procedure and regular equipment calibration prior to anthropometric measurement. There is a difference in mean scores before and after the education given, yet still denoted as low capacity. Further comprehensive education is highly required.*

KEYWORDS*:* *accuracy; anthropometric; emergency nutrition assessment; female volunteer community health workers; posyandu*

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INTRODUCTION

In Indonesia, nutrition surveillance among under-five children highly relies on the Integrated Health Post (Posyandu). Under the auspices of the Community Health Centre (Puskesmas), Posyandu is organized monthly in order to provide nutritional outcomes data, mainly on children (1). The anthropometric measurement on Posyandu is conducted by female volunteer community health workers (FVCHW), who are not trained through formal education and most of the time have diverse backgrounds (2). As such, a regular knowledge refreshment on anthropometric measurement is needed to ensure data quality (3). To date, the role of integrated health post varies from assessing and documenting under-five children nutritional status to providing complementary feeding. Vast number of children within the health center working area, make the job done voluntarily by the locals (4). Most of the time, integrated health post involves stay at home mothers with various educational backgrounds. Monthly, FVCHW will organize the activity of nutritional anthropometric assessment such as measuring weight, height and length as well as taking notes on KIA book (buku kesehatan ibu dan anak). As such, the anthropometric data quality relies upon the capacity of each FVCHW (5).

High quality data to identify malnutrition is inevitable. Therefore, a standardized procedure is needed for anthropometric measurement (6). Short term evaluation can be done through knowledge evaluation, while to be more technical, evaluation on precision and accuracy can be useful for future improvement. Precision is defined as how similar two repeated measurement, while accuracy is how close a measurement to the true value or gold standard (7). Lack of precision can be caused by random error, particularly when the measurer does not apply a standardized

procedure that leads to high measurement variability. Poor accuracy can be caused by systematic error or bias that depend on equipment, such as no calibration prior to measurement (8).

Kampung Caraka is a project funded by Indonesia Ministry of Education, Culture, Research and Technology that aims to improve nutritional outcomes and livelihoods of population in Kedaung Depok. The study conduct is governed by Universitas Pembangunan Nasional Veteran Jakarta. As part of the project, the present study aims to educate and evaluate female volunteer community health workers capacity on conducting nutritional anthropometry.

MATERIALS AND METHODS

The present intervention study involved all integrated health posts in Kedaung Depok. Further, a voluntary sampling was carried out to select three female volunteers in each post. Initially, thirty-nine participants were expected to join the study, however, only 32 who were committed to the end of the program.

Training

The training for FVCHW was took place in Kedaung Depok municipality office for one day on September 2023. We trained a total of 32 female volunteers from 13 different integrated health posts prior to the evaluation. The objectives of the training were to refresh the operational procedure and measurement technique of each measurement and have the participants' oversight be corrected by the trainer. There are four trainers with expertise on anthropometric assessment from Universitas Pembangunan Nasional "Veteran" Jakarta. The training session lasted for 2 hours and ended with a question-and-answer session. Several equipment was used during the training, such as length board, multipurpose height measurer, MUAC tape and head circumference tape.

Knowledge evaluation

Evaluation in terms of knowledge was performed using paper based pre and posttests consisting of 10 multiple choice questions related to the objectives of anthropometry measurement, standard procedure, and common pitfalls. Validity of the questionnaire was checked using biserial correlation ($r>0.27$). Correct answers were coded 1, while incorrect answers were coded 0.

Precision and Accuracy evaluation

After 2 hours of anthropometry training and practice, a two-round independent measurement was undertaken to evaluate precision and accuracy. During the evaluation, participants were grouped based on their post. Thus, they needed to divide roles as measurer, assistant measurer and observer during measurement. The result note taking was conducted by the committee. Measurement was conducted independently to prevent participants being influenced by the previous result. Likewise, the referee (gold standard) performed the same round of measurement. Precision was evaluated based on how close is the first to second measurement result. Accuracy was examined based on how close the participant measurement is to the gold standard.

Statistical analysis

Precision and accuracy evaluation was performed using Emergency Nutrition Assessment (ENA) Smart. Good precision was indicated when the measurer's sum of difference in square was less than twice gold standard's. While Good accuracy was observed when the measurer's sum of difference in square was less than thrice of gold standard's. Then, the result of measurement evaluation was presented using percentage. Wilcoxon test was used to observe the difference between median score of pretest and posttest.

Ethics

The study was ethically approved by the Scientific and Ethical Review Committee at Universitas Pembangunan Nasional "Veteran" Jakarta (Ref:298/VI/2023/KEPK). Informed verbal consent was given by the participants prior to the study conduct.

RESULTS AND DISCUSSIONS

Respondents ranged in age from 25 to 60 years and worked as housewives and cadres at the Kedaung Integrated Healthcare (Posyandu), Sawangan, Depok City. The cadres' highest education is high school. The results of statistical analysis using the Wilcoxon test showed that there

was a significant difference between anthropometric knowledge on the pretest and posttest. Questionnaire questions include anthropometric measurements in children and adults..

Table 1. Result in Anthropometric Knowledge of FVCWH (n = 32)

Variable	Pretest	Posttest	Wilcoxon Result
Anthropometric Knowledge	4,00 (IQR:2)	5,00 (IQR: 2)	p = 0,035

Pretest and posttest score was displayed as median and inter quartile range (IQR) as the data not normally distributed.

Before the training, the median of anthropometric knowledge score was 4, which counted by the correct answer from 10 questions. After the training, the score of anthropometric knowledge had increased.

Tabel 2. Precision and Accuracy of FVCWH (n = 32)

Measurements	Precision (%)		Accuracy (%)	
	Poor	Good	Poor	Good
Head Circumference	46.2	53.8	100	-
Body-length	66.7	33.3	92.3	7.7
MUAC	76.9	23.1	92.3	7.7
Body-height	76.9	23.1	100	0

The research results showed that 53.8% of cadres had good precision but 100% had poor accuracy results. Based on the results of measuring body length, upper arm circumference and body height, it shows that the majority of cadres have poor measurement precision and accuracy.

Knowledge in anthropometric measurement skills for posyandu cadres is very necessary because incorrect anthropometric measurements result in errors in data interpretation. The guidelines for health assessments in the Child Health and Disability Prevention (CHDP) Program recommend that anthropometric measurements should be taken during every preventive visit for children and adolescents to ensure their growth patterns are on track (9). The key element of anthropometry is the accurate and consistent measurement of specific parameters over time. For infants and toddlers under two years old, these parameters include weight, length, and head circumference, while for children over two years, it includes weight and length (10).

To assess these measurements, they should be plotted on gender and age-specific charts provided by the World Health Organization (WHO) or the CDC. This allows for a comparison of the child's measurements to the average values of the general population. Isolated anthropometric measurements have limited utility; it is essential to compare the values to the appropriate population's standards. The CHDP program offers free preventive health exams and immunizations aimed at early detection and prevention of diseases and disabilities for infants, children, and teens who meet the program's criteria. Through CHDP, eligible children receive regular preventive health assessments and immunizations. Children showing signs of potential health issues can be referred for further diagnosis and treatment (10).

It is important to pay attention to precision and accuracy in measurements to obtain measurements that have a high level of validation and reliability. Reliability consists of two elements: Precision, denoting the consistency in measurements over time, and dependability, reflecting physiological variations within an

individual. Accuracy, on the other hand, pertains to how closely a measurement aligns with its 'true' value. The reliability of measurements is affected by random errors, impacting precision, while inaccuracy results from systematic bias. Various factors, such as observer-related issues (e.g., inconsistencies in landmark identification or instrument pressure) and subject-related issues (e.g., influenced by respiration or posture changes), can influence reliability. Inaccuracy may stem from instrument errors or errors in the measurement technique (11).

While complete avoidance of measurement errors is challenging, their mitigation is feasible. We recommend investigators prioritize a quality assurance protocol encompassing six essential steps for anthropometric measurements: Utilizing a certified lead anthropometrist and trainer, adhering to a manual of standard operating procedures, employing robust equipment, regularly calibrating equipment, providing standardization training and certification and implementing resampling (approximately 5-10% (11).

One of the efforts to monitor nutritional status in Indonesia is by mobilizing posyandu activities. Several studies related to measuring nutritional status in posyandu have proven to play a role in improving children's nutrition in Indonesia (12). However, not all FVCHW have good nutritional status measurement capabilities. This could be due to poor availability of measurement tools (13) and poor skills in measuring the nutritional status of FVCHW (14). The results of this research are in line with Suyatno's research at 94 posyandu which showed that the level of ability, thoroughness and accuracy was still very low.

Precision is the degree of closeness of measurement results in repeated measurements of the same variable under conditions that do not change or are not much different. Precision is good if the results of the first, second and so on measurements are almost the same or close together. Meanwhile, accuracy is the level of closeness of the measurement to the true value (15). Precision and accuracy tests really determine the quality of measuring results. Precision and accuracy in measuring nutritional status can be influenced by the person doing the measurement, the instrument used and the subject or respondent (15). If an FVCHW is not trained in measuring precision and accuracy, data will be produced that is at risk of being inaccurate. This will result in errors in determining a child's nutritional status.

This research shows that the level of accuracy in measuring nutritional status in Posyandu is still low. Posyandu assistance and training in stages needs to be carried out regularly to improve the accuracy of FVCHW measurements. One article highlights the issue of low accuracy in measuring nutritional status at Posyandu centers. It points out that the inadequate skills of the volunteers in measuring length and height can lead to inaccurate detection of stunting in children. Consequently, it underscores the need for regular, staged Posyandu assistance and training to enhance the precision of FVCHW measurements. The article underscores the crucial role of training and support in ensuring measurement accuracy. The solution lies in consistent, staged training and support for Posyandu volunteers to enhance the accuracy of FVCHW measurements. Adequate training and guidance can lead to improved precision in anthropometric measurements (16).

CONCLUSION AND RECOMMENDATION

Women participating in this study had good precision yet poor accuracy, implying the necessity of standardized procedure and regular equipment calibration prior to anthropometric measurement. There is a difference in mean scores before and after the education given, yet still denoted as low capacity. Further and more comprehensive education is highly required.

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