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FULL PAPER

Adherence to supplementary feeding biscuits and their effect on haemoglobin levels in underweight children aged 6-23 months: a quasi-experiment in Aceh, Indonesia

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Abstract

This study aimed to analyse compliance with supplementary feeding (SF) biscuits and their impact on haemoglobin levels in underweight children aged 6-23 months. A quasi-experimental of the one-group pre-post only design was used to study 80 underweight children who were taken by the cluster sampling method, SF biscuits was given at a dose of 90 g (12-24 months of age) and 60 g (6-11 months of age) per day for 24 weeks with the assistance of cadres and supervised by nutrition workers. Compliance was measured by interviewing the mother using a form, and haemoglobin level was measured using the spectrophotometric method. Data analysis used a logistic regression test and paired T-test at the 95% confidence level (95% CI). The average adherence to biscuit consumption is 75.7%, SF biscuits consumption compliance has increased from the first to second month (77.2%) to the third to the fourth month (79.2%) and has decreased in the fifth and sixth month (70.7%). Children who had never been sick and suffered from anaemia had higher adherence to biscuit consumption (OR = 5.56; 95% CI: 1.35-22.93) and (OR = 0.12; 95% CI: 0.03-0.5) (p = 0.017 and p = 0.005) than children who are often sick and not anaemic. Most of the mothers stated that their children liked the SF biscuits (43.8%) and the mean increase in Hb levels was higher in children with consumption levels above 70%. The provision of SF biscuits with assistance can increase the compliance level of biscuits consumption, however, after 4 months of provision, it decreases. To prevent children from becoming bored while eating, a combination of biscuit formulations was required, including taste, form, and ingredient composition.

1. Introduction

The problem of malnutrition among children aged 0-23 months is still very high in Indonesia. The results of the 2018 Indonesian Basic Health Research showed the prevalence of underweight and stunting at 14.2% and 29.9%, while in Aceh 20.7% and 37.9% (Ministry of Health Indonesia, 2019). The study by Ahmad *et al*. (2018) in Aceh Besar showed the prevalence of underweight, wasting, and stunting in children aged 6-23 months, at 26.3%, 22.5%, and 27.8% respectively.

The prevalence of anaemia and iron deficiency in children under five in Indonesia is also very high. In 2013 Basic Health Research survey showed that 28.1% of children under five suffer from anaemia (Ministry of Health, 2013). While the South East Asian Nutrition Study reported that 29.7% of children under two years suffered from iron deficiency (Ernawati *et al*., 2013). In Aceh, a study by Word Vision Indonesia (2010) that 67.8% of children under five suffer from anaemia. The results of the study in Aceh Besar, pound 46.3% of children aged 6-23 months suffer from anaemia and 35.8% suffer from iron deficiency (Ahmad *et al.*, 2014).

Interventions to overcome macro and micronutrient deficiency in under-five children can be carried out through three approaches, namely, food base intervention, nutrition education, and a combination of both (World Bank, 2013). Several studies have shown that nutritional education interventions and complementary breastfeeding can have an impact on complementary breastfeeding practices and increase growth, and reduce the prevalence of underweight, anaemia, and stunting. Dong *et al.* (2013) reported supplementary feeding in the Wenchuan Earthquake Disaster Area reduced anaemia from 74.3% to 37.4%

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and reduced the prevalence of underweight, wasting, and stunting after 6 months of intervention. Another study by Wang *et al*. (2017) gave supplementary feeding interventions (Ying Ying Bao) to poor people in China can reduce the prevalence of anaemia, stunting, and underweight. Studies in Indonesia found that a combination of intensive educational interventions and Multi-Nutrient Powder (MNP) can increase haemoglobin levels (Inayati *et al.*, 2012). The results of a study in Madura, Indonesia, showed that children aged 6-12 months who received Small Quantity Lipid-based Nutrient Supplements (SQ-LNS) and SF biscuits a weight growth higher than children in the control group (Muslihah *et al.*, 2016).

For the prevention and control of malnutrition in Indonesia, the Directorate of Community Nutrition at the Ministry of Health has developed Supplementary Feeding Biscuits (SF biscuits) as one of the interventions by providing a buffer stock of complementary foods in the form of SF biscuits for use in emergencies (Ministry of Health Indonesia, 2007). However, the implementation of the intervention was generally not followed by assistance and monitoring to improve SF-biscuit adherence, there was no assistance in distribution, and the effect of the intervention was only short-term and unsustainable. The SF biscuits are commercial biscuits industrially made from a mixture of wheat flour, margarine, sugar, milk, soybean lecithin, bicarbonate of salt, and flavourings. Instant Porridge and SF biscuits are enriched with 10 vitamins and 7 minerals (Ministry of Health, 2007).

One of the important aspects of food-based interventions is the level of compliance and target acceptance of the food products developed, the level of compliance will affect the effectiveness of the intervention. Several studies show that the level of adherence to biscuit consumption varies. The study by Widodo *et al*. (2015), showed that the level of compliance with Blondo biscuit consumption in children 1-3 years is 70.0%, while the study of Muslihah *et al*. (2016) reported the level of compliance with biscuit consumption was very high, at 96.6% at 1st month of intervention, 92.8% at 3rd month of intervention and 91.1% at 6th month of intervention. This study aimed to analyse the compliance level of supplementary feeding biscuit consumption and to analyse the determinants of the compliance level in underweight children aged 6-23 months.

2. Materials and methods

2.1 Design

This study used a quasi-experimental one-group pre-post design, to analyse the compliance with consumption of SF biscuits as an intervention in malnourished children aged 6-24 months. This research was conducted in 5 working areas of *Puskesmas* in Aceh Besar District, namely Puskesmas Darul Imarah, Puskesmas Lampisang, Puskesmas Peukan Bada, Puskesmas Baitusalam and Puskesmas Darusalam for 6 months from November 2016 to April 2017.

2.2 Subject

The study's participants were underweight children aged 6 to 23 months who met the following criteria: Aged 6-23 months, underweight (WAZ of -2SD to>-3SD), and in good health (lack of secondary infectious infections or congenital diseases based on a doctor's assesment), and willing to engage in the study by signing an informed consent form. Minimum samples were calculated based on the average increase in Hb levels from Inayati *et al.* (2012). The confidence level is set at 95%, and the predicted precision is 10%, with 33 subjects in each group. After subtracting 20% for loss of following and multiplying by 2 for the design effect, the total number of children is 78, which has been rounded to 80. Cluster sampling was used to collect data from 20 villages, with an underweight prevalence of 10%. All children in the chosen cluster who meet the inclusion criteria are taken as samples.

2.3 Supplementary feeding biscuits intervention

The SF biscuits used in this study recommended by the Indonesian Ministry of Health as supplementary feeding had been fortified with 10 vitamins and 6 minerals. The number of biscuits given was 60 g/day for children aged 6-11 months and 90 g/day for children aged 12-23 months, according to WHO guidelines, supplementary feeding for children must be able to meet at least 30% of their calorie and protein requirements. The energy and nutrient composition of SF biscuits and the percentage of energy and protein contribution according to the dose administered is 33.1% and 50% in children aged 6-11 months and 32% and 27.7% in children aged 12-23 months. The distribution of SF biscuits to the subject was carried out every 4 days (48 times for 6 months) by cadres who had been trained. Subjects were given two packs of SF biscuits while they were 6-11 months old, and three packs when they were 12 to 23 months old. Each pack contained 12 biscuits, children aged 6 to 11 months should consume 6 pieces (60 g) per day, while children aged 12 to 23 months should consume 9 pieces (90 g) per day.

2.4 Assistance and monitoring of providing supplementary feeding biscuits

Assistance in providing SF biscuits is carried out in

stages, namely the distribution of the stock of biscuits to the community health centre, where nutrition workers act as supervisors, then the supervisor distributes to cadres who act as assisting staff in the field. The process of distributing biscuits is carried out periodically every 4 days by cadres to target mothers of children under two. Furthermore, cadres were asked to motivate mothers to give biscuits to their children daily, based on the recommended dose, timing, and method, as well as provide education with key messages, such as SF biscuits have been enriched with 10 vitamins and 6 minerals, SF biscuits can help children gain weight, and SF biscuits can help prevent anaemia in children.

Every two weeks, nutrition workers supervised the field, and every month, assistants meet to evaluate distribution, adherence, and mothers' experiences when giving complementary foods to their children. The adherence assessment of SF-Biscuit consumption was carried out using a monitoring form, cadres evaluated adherence by recording the number of biscuits given, noting whether the mother has given biscuits to the children, the number of biscuits eaten, and the number of biscuits left every three days once a week.

2.5 Data collection and analysis

The types of data collected were the characteristics of the subject, mother, and father including age, gender, level of education, and occupation. Other data were family socio-demographics; the number of children, the number of family members, and monthly family income. These data were collected using a structured questionnaire. Furthermore, biscuit consumption data includes biscuit distribution, the amount consumed (g), the reasons for giving biscuits and the support of other family members in giving biscuits, and the obstacles in giving biscuits. These biscuit data were collected by trained cadres using a form the consumption of SF biscuits. Haemoglobin levels were collected using the cyanmethemoglobin method using the spectrophotometry, in units of g/dl, anaemia when Hb level <11.0 g/dL (WHO, 2017).

Data processing through stages, checking the questionnaire by the field supervisor to ensure the completeness of the data, consistency, and accuracy of the data, the second is data coding and editing, the third, data entry, and the fourth, data cleaning. Data analysis was performed using the Microsoft Office program Excel and IBM SPS version 21 (IBM Corp). The average biscuit intake can be obtained by adding up the daily intake of biscuits for 168 days or 6 months of intervention, and then the percentage of the number of SF biscuits eaten was compared to the number of SF biscuits that should be consumed. The adherence level of biscuit consumption was calculated from the number of days the children were given biscuits compared to the number of days for the intervention. The level of adherence was divided into 3 categories, high (≥85%), moderate (70-85%), and low (<70%). To determine the level of compliance according to the time of intervention, a paired t-test analysis was carried out.

2.6 Ethical clearance

This study has received ethical approval from the Ethics Commission of the Faculty of Medicine, University of Indonesia number: 452/UN.2.F1/ETIK/2016, and each participant is asked to be approved as a subject by filling out the concentrated information. Written consent was obtained from all subjects before the evaluation and survey. All procedures contributing to this work complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration (2013).

3. Results

3.1 Characteristics of subject

The results showed (Table 1) that most of the study subjects were male (60.0%), aged between 12-23 months (73.8%) and 1st or 2nd children in the family, and had normal birth weight (90.0%). There were 57.5% suffering from anaemia (Hb<11.0 g/dL), 47.5% suffering from fever 1 to 4 times, 43.8% suffering from coughs 1-3 times, 46.3% suffering from colds 1-4 times and ≥5 times, and 36.3% suffering from diarrhoea 1-2 times in last 6 month. More than half (59.7%) of the mothers are aged between 25-35 years, almost all (80.0%) mothers work as housewives, almost two-thirds (63.8%) mothers graduated from junior and senior high school and almost three-quarters (72.5%) have family members of 5-6 people, and around half (56.3%) have an income of less than Rp. 1.9 million/month.

3.2 Adherence to supplementary feeding biscuits

Consumption of biscuits according to the recommended portion in this study, 90 g for children 12-23 months of age and 60 g for children aged 6-11 months. The results of the study showed the average number of biscuits consumed per day was 62.4 g with the average number of days for children to be given biscuits by the mother being 160.9 days out of 168 intervention days. Overall, the average percentage of adherence to biscuit consumption during 6 months of intervention was 75.7±19.9%, while according to the time of intervention, for the first 2 months was 77.2±19.6%, the second 2 months 79.2±24.2% and for the third 2 months 71.6±25.2% (Figure 1).

Table 1. Socio-demographic of subject and family

Variable (N = 80)	Frequency	Percentage
Sex of the child		
Female	32	40.0
Male	48	60.0
Age of the child		
6-11 months	21	26.3
12-23 months	59	73.8
Birth order of the child		
1 to 2	45	56.3
3 to 4	29	36.3
5th and above	6	7.5
Birth weight status		
Low birth weight	8	10.0
Normal	72	90.0
Ages of mothers		
<25 years	75	19.1
25-35 years	234	59.7
≥36 years	83	21.2
Mothers employment status		
Does not work (Housewife)	64	80.0
Work	16	20.0
Mathers education level		
≤ elementary school	13	16.3
Completed Yunior or senior high school	51	63.8
Diploma/Bachelor's Degree	16	20.0
Numbers of family		
3-4 persons	17	21.3
5-6 persons	58	72.5
7 and above persons	5	6.3
Family income (IDR/month)		
<1.9 million	45	56.3
≥1.9 million	35	43.8
Anaemia status		
Anaemia	46	57.5
Normal	34	42.5
Incidence rate Fever in the last 6 months		
Never	7	8.8
1-4 times	38	47.5
≥ 5 times	35	43.8
The cough incidence rate for the last 6 months		
Never	19	23.8
1-3 times	35	43.8
≥ 4 times	26	32.5
The Incidence rate of colds for the last 6 months		
Never	6	7.5
1-4 times	37	46.3
≥5 times	37	46.3
The Incidence rate of diarrhoea in the last 6 months		
Never	47	58.3
1-2 times	29	36.3
≥3 times	4	5.0

IDR = Indonesian Rupiah

The percentage of adherence increased from the 1st to 2nd month to 3rd to 4th month although not significant (p = 0.337), then experienced a significant decrease from the 3rd to 4th month of intervention to the 5th to 6th (p = 0.001), whereas when compared between the 1st to 2nd month of intervention with the 5th to 6th month, there was a significant decrease (p = 0.019), meaning that there was a decrease in compliance with biscuit consumption the longer the intervention time. The level of compliance with biscuit consumption during the intervention from 1-6 months was mostly in the high category (33.8%), If analysed based on at 1st-2nd months (43.8%), 3rd-4th months (52.2%), and 5th to 6th months (38.8%). There was a similar trend with the proportion of adherence, where the percentage of subjects with high adherence (≥85.0%) increased from 1-2 months to 3-4 months and decreased at 5-6 months (Figure 1).

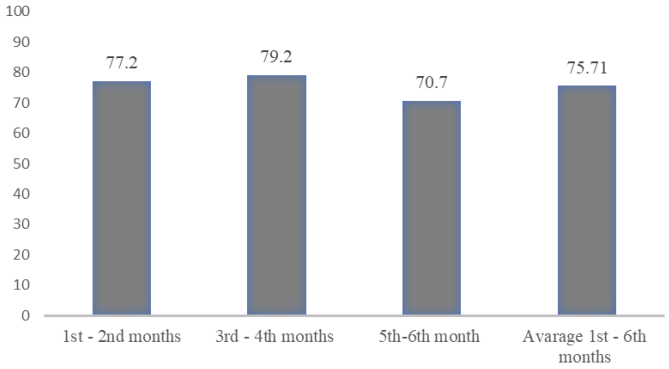

Figure 1. Percentage adherence to SF biscuits during the intervention There was a difference in adherence for the first 2 months vs 6 months (p = 0.001) and 4 months vs 6 months of intervention (p = 0.019).

Most families support the provision of biscuits to children, the largest proportion of support was from husbands (43.8%), as well as other family members, including older children, grandmothers, aunts, grandparents, and siblings. Based on the level of preference evaluation, most of the children liked to consume SF biscuits (63.7%). Some of the obstacles experienced by mothers in giving biscuits were children having no appetite, children feeling bored, and a small part was because of diarrhoea when consuming biscuits.

3.3 Factors affecting compliance with consumption of SF biscuits, and their impact on haemoglobin levels

The results of factors analysis that influenced consumption compliance include child characteristics (gender, birth order, illness incidence, anaemia status) and mother's education as well as the constraints in giving biscuits. The results (Table 2) showed that there was a significant relationship between birth order (p = 0.005), the level of mother's education (p = 0.010), the incidence of fever (p = 0.004), and the presence of obstacles (children felt bored, children had no appetite and children did not like biscuits (p = 0.045) with the level of compliance with biscuit consumption. Meanwhile, the results of the binary logistic regression

Table 2. Factors related to adherence to consumption of SF biscuits

Variable (n = 80)	Compliance of ≥ 85% of SF biscuits consumption % (n)	Bivariate analyse (p-value)	Multivariate analyse AOR 95% CI	p-value
Sex of children				
Female	50.0 (16)		(1)	
Male	31.3 (15)	0.092	0.30 (0.08-1.08)	0.067
Birth order of child				
1 to 2	26.7 (12)		(1)	
3 to 4	62.1 (18)	0.005*	0.16 (0.08-3.56)	0.252
5 and above	16.7 (1)		0.06 (0.003-1.37)	0.079
Mothers education level				
≤ elementary school	23.1 (3)		(1)	
Completed junior or senior high school	51.0 (26)	0.010*	1.009 (0.07-13.66)	0.995
Diploma / Bachelor's Degree	12.5 (2)		0.19 (0.025-1.43)	0.107
Incidence of fever				
5 or above	45.7 (16)			
1-4 times	23.7 (9)	0.004*	0.23 (0.02-2.78)	0.251
Never	85.7 (6)		5.56 (1.35-22.93)	0.017*
Status anemia				
Normal	26.5 (9)	0.053	(1)	
Anemia	47.8 (22)		0.12 (0.03-0.53)	0.005*
Obstacles/complaints				
No complaints	47.1 (24)	0.045*		
There is a complaint	24.1 (7)		0.26 (0.06-1.06)	0.062

*p<0.05; AOR = Adjusment odds ratio

analysis showed that children who had never been sick increased their low adherence to SF-biscuit consumption by 5.56 times compared to children who were often sick (≥5 times during the intervention) OR = 5.56 and p = 0.017. Furthermore, anaemia status reduced the risk of adherence level by 0.12 times compared to children who were not anaemic (OR = 0.12, p = 0.005), meaning that children who were anaemic caused higher consumption compliance. The results showed that there was an increase in haemoglobin levels during the intervention of giving SF biscuits. consumption compliance <70%, but statistically not significant (p>0.05) (Figure 2).

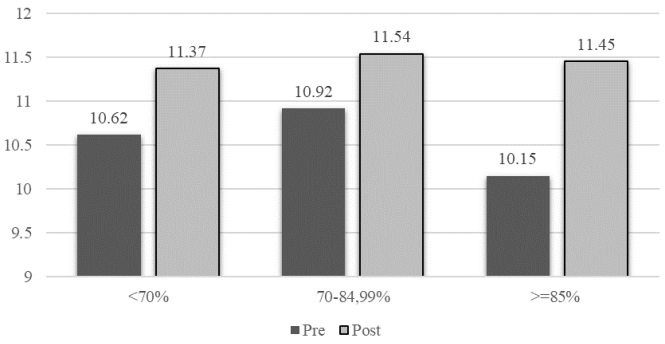

Figure 2. Average levels of Hb (mg/dL) before and after based on the SF biscuits adherence level (p = 0.70), (p = 0.43) and (p = 0.49).

4. Discussion

Based on the results of this study, the level of compliance with SF biscuits consumption in malnourished children who received assistance was 75.7%, and the level of adherence increased in the 3rd to 4th month of assistance (79.2%), then decreased slightly in the 5th to 6th month of intervention (70.7%). Adherence to biscuit supplementary feeding in this study was lower when compared to the results of the study in Madura Indonesia, where the average level of compliance with complementary foods biscuits in children aged 6 months is above 90%, namely 96.6% in the first month, 92.8% at 3rd months and 91.1% at 6 months of intervention (Muslihah *et al.*, 2016). While the results of this study are almost the same when compared to the Widodo study which provided Blondo biscuit intervention to children 1-3 years, where the level of compliance with biscuit consumption was 70.0% (Widodo *et al*., 2015). Likewise, the study in rural Bangladesh that performed the Multi-Nutrient Powder (MNP) intervention in children 6-59 months showed 70% compliance with MNP consumption (Angdembe *et al*., 2015). The systematic review results of Barros and Cardoso regarding fortification of compliance with children's food consumption with multi-nutrient powder (MNP) show that in children aged 6-23 months, that is between 50 to more than 90% and the MNP intervention has good adherence (De Barros and Cardoso, 2016). The results of a study on the provision of Home-based complimentary food fortification in the form of Ying Yang Bao (YYB) in Wenchuan China for children 6-23 months showed the level of compliance with YYB consumption reached 77.2% after 12 months and 72.0% after 18 months (Huo *et al.*, 2015).

The results of this study showed that the compliance level of SF-biscuit consumption was influenced by the incidence of fever, where children who had never had a fever were 5.56 times more obedient to consuming SF biscuits than those who frequently had a fever, likewise children with anaemia had lower adherence. than normal children. Several other studies also show that several factors that influence adherence to consumption of food-based interventions, showing low socioeconomic characteristics and low maternal education, anaemia status, and nutritional status that have higher biscuit consumption compliance (Muslihah *et al*., 2016), and adherence to supplementary feeding influenced by food taste and texture (Setyobudi *et al*., 2020).

The results of this study are the same as several studies that show biscuit giving effects on the increase in Hb levels. The study showed that giving anchovy biscuits increased Hb levels in adolescents (Thalib *et al.*, 2021), and food fortification interventions increased the haemoglobin levels of mothers and children (Dewi and Mahmudiono, 2021). Another study that gave snack bar intervention had increased Hb levels in adolescents (Syahwal and Dewi, 2018). The results of other studies show that nutritional education interventions with the provision of multi-nutrient biscuits can increase Hb and serum ferritin levels in children (Ahmad *et al.*, 2020). The results of a study in Vietnam showed that supplementary food fortified with micronutrients can prevent anaemia and iron deficiency in infants (Van Phu *et al*., 2010). Studies in Karnataka also find that supplementation and fortified biscuits increased haemoglobin levels in infants (Bal, 2016).

The results of this study showed that in the 3rd and 4th months of mentoring there was an increase in adherence to biscuit consumption due to monitoring and motivation of cadres asigned to provide education and assistance to mothers in giving biscuits, once every 4 days for 6 months of intervention. The provision of motivation and education can control and remind mothers of toddlers to keep giving biscuits. However, starting from the 5th-6th month the average compliance decreased slightly, this condition was caused by the saturation factor for biscuits, the results of interviews with mothers of toddlers stated that after a few months of giving children started to dislike biscuits, boredom and also added another factor, namely appetite decreased and the presence of diseases such as diarrhoea. The researcher assumes that if the intervention of giving biscuits is not followed by mentoring and education, there will be a very high decrease in consumption compliance in toddlers. This condition can be seen from the provision of biscuits that are not followed by assistance, the provision of biscuits to children under five is very small and many biscuits are not well-targeted among others consumed by other age children, family members and wasted.

This study was only conducted on children who suffer from malnutrition, due to the lack of other macro and micronutrients that also affect the formation of blood haemoglobin. In addition, the high frequency and duration of illness in children obtained from the results of this study also affect the level of compliance with SF-biscuit consumption so it also affects the increase in haemoglobin levels. The study was also conducted with a limited number of samples, which can affect that the results may not necessarily be generalized to toddlers as a whole or toddlers with good nutritional status.

5. Conclusion

The average percentage of compliance with biscuit consumption reached 75.71% and most of them were in a good category, although there was a significant decrease in compliance after 4 months of provision. Family support, especially for husbands, is very important for giving biscuits to children, and most children like to consume SF biscuits. Several obstacles were found in the distribution of the biscuits, children have no appetite, children feel bored, and a small proportion of children did not like it and experience diarrhoea. Birth order, mother's education level, duration of fever, and the presence of barriers (children feel bored, have no appetite and children do not like biscuits), children who are often sick, and children suffering from anaemia affect the adherence to consume SF biscuits. To increase compliance with SF biscuits consumption as a food base intervention, assistance from trained officers is needed and accompanied by nutrition education activities to increase the motivation of mothers and families in giving SF biscuits. Future studies should be done on the effect of biscuit interventions with variations in taste, shape, and basic ingredients for making different biscuits on consumption compliance in children. It is necessary to study the effect of biscuit interventions with variations in taste, shape, and basic ingredients for making different biscuits on consumption compliance in children.

Conflict of interest

The authors have no conflicts of interest associated with the material presented in this paper.

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