Original Article

Complementary food supplementation with a small-quantity of lipid-based nutrient supplements prevents stunting in 6–12-month-old infants in rural West Madura Island, Indonesia

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Background and Objectives: Stunting during childhood is a common public health problem in Indonesia. Complementary food supplementation with a small quantity of lipid-based nutrient supplements (SQ-LNSs) can promote growth and prevent undernutrition. This study investigated the effects of the daily provision of SQ-LNSs and biscuits on linear growth and reduction in the incidence of stunting among infants in rural Indonesia. **Methods and Study Design:** A 6-month, non-randomised, controlled trial was conducted on 168 infants who received 20 g of SQ-LNSs, 3 pieces of biscuits, or no intervention. The outcome was length gain and incidence of stunting (length-age-z score (LAZ) <−2SD) during a 6-month follow-up. **Results:** After the 6-month intervention, the adjusted length gain and change in the LAZ (8.57 cm and −0.09 z-score unit, respectively) were higher in the SQ-LNS group than in the control (7.15 cm and −0.87 z-score unit, respectively) and biscuit groups (7.79 cm and −0.46 z-score unit, respectively; *p*<0.01). The rate of length gain was significantly higher in the SQ-LNS group (1.43 cm/month; 95% CI: 1.12–1.26) than in the biscuit (1.29 cm/month, 95% CI: 1.23–1.36) and control groups (1.19 cm/month, 95% CI: 1.12–1.26; *p*<0.01). At the end study, the incidence of stunting in SQ-LNS group was lower (1.8%) than in the biscuit group (8.5%) and control group (14.6%). In the SQ-LNS group, the relative risk (RR) of stunting was 0.35 and in the biscuit group (0.94). **Conclusions:** SQ-LNSs improved linear growth and reducing the incidence of stunting over 6-months intervention.

Key Words: complementary food, SQ-LNS, biscuit, stunting, Indonesia

INTRODUCTION

Stunting during childhood is a common public health issue in Indonesia. According to Basic Health Research, 2013, the prevalence of stunting was 37.2% among children aged <5 years.[1] A survey conducted in West Madura Island, Bangkalan Districts, Indonesia, reported that the prevalence of stunting (length-age-z score (LAZ) of less than −2 SD) was 34.7% among children aged 6–23 months.[2] In the study has also informed that prevalence of stunting among children aged 12–23 months (40.8%) was higher than children aged 6–11 months (16.9%).

During infancy and early childhood, growth failure is often irreversible, leading to short stature during adolescence and adulthood.[3,4] Between 6 and 24 months of age during the complementary feeding period, most of the decline occurs in length-for-age.[5,6] Children aged >6 months have the potential to gain height.[7]

Interventions for preventing undernutrition should be implemented during the first '1000' days. The period between 6 and 24 months is crucial because children undergo a transition from breast milk to complementary food in this period and sometimes consume poor food quantity and quality. Poor feeding practice is one of determinant factors for stunting; and this practices along with infection and other health problems rather than shortness. A promising approach is the use of lipid-based nutrient supplements (LNSs), which can be added to complementary food at the time of consumption with multiple micronutrients and extra energy. Complementary food fortified with a small quantity of LNSs (SQ-LNSs) can be designed to promote healthy growth and prevent undernutrition. Some studies have suggested that a small dose of LNSs, such as Nutributter, which is a fortified spread used in Ghana and Malawi, can improve linear growth.[8,9] Another study reported that a low-energy, fortified product improved linear growth in young children in an urban slum setting in Haiti[10] However, in Malawi, the provision of 10–40 g/d of LNSs from 6 to 18 months of age does

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not promote length gain.[11] The above result indicated that the effect of LNSs on growth is inconsistent.

In Indonesia, complementary feeding programmes include fortified blended flour for infants aged 6–11 months and biscuits for children aged 12–23 months.[12] Moreover, studies evaluating the effect of these fortified foods on growth are scant. Therefore, studies investigating the effect of the daily provision of SQ-LNSs and biscuits on the promotion of linear growth and reduction of stunting among infants in rural Indonesia are required.

MATERIALS AND METHODS

Study design and participants

This study was conducted in 50 villages in 8 sub-districts of Bangkalan Districts, West Madura Island, East Java Province, Indonesia, between October 2014 and August 2015. A community-based, non-randomised, controlled intervention design was applied in this study. This design was applied because different types of intervention products were used, such as food supplementation using peanut paste fortified with multiple vitamins and minerals and biscuits (no vitamin and mineral added).

Potentially age-eligible children were identified using infant cohort data from midwives. Infants who met the following inclusion criteria were included in the study: infants who were aged >6 months, had consumed complementary food, reside in the study area, and provided signed informed consent from a legal guardian. The exclusion criteria were as follows: severe stunting (LAZ of less than −3 SD), acute infectious disease (e.g. Tuberculosis/TBC), the presence of oedema, history of peanut allergy, severe illness requiring hospitalisation, and concurrent participation in another clinical trial.

The sample size was calculated on the basis of the expected values of length gain at the 6-month intervention period. In a previous study, the mean length gain was 0.5 (8.3 and 7.8) cm[8]. Assuming a standard deviation of 1.0 with a power test of 80% ($1-\beta=0.84$) and a 95% confidence interval with a one-sided test of 1.645, the required sample size was 50 infants per group. Food security subdistricts were selected this study and then we selected randomly for SQ-LNS, Biscuit, and Control group. All eligible children in those groups were included in study.

Intervention and follow-up

Infants were divided into the following three groups: SQ-LNS, biscuit, and control groups. In the control group, no complementary food supplement was provided during the study period; however, infants were provided delayed supplementation with biscuits for 1-month consumption. In the SQ-LNS group, infants were provided 20 g (one sachet) of SQ-LNSs per day (containing 118 kcal of energy, protein, essential fatty acids, and 22 vitamins and minerals) for 6 months. SQ-LNSs were provided by Nutriset SAS (Malaunay, France). In the biscuit group, infants were provided three pieces or 30 g of biscuits per day (containing 135 kcal of energy, protein, 16 vitamins, and minerals) for 6 months. The biscuits were donated by the Ministry of Health, Indonesia, and were developed for a national supplementary feeding programme. The energy and nutrient contents of a daily ration SQ-LNS and biscuit are listed in Table 1.

During the intervention period, infants could receive vitamin A supplementation and routine vaccinations. All mothers were encouraged to continue breastfeeding on demand and to feed their infants with the usual complementary food available to them. SQ-LNSs and biscuits were delivered by a field team to homes every month during the 6-month intervention period.

Measurement of outcomes variables

The outcomes variables were mean length gain, change in LAZ, and incidence of stunting (LAZ of less than −2 SD) during the 6-month follow-up period. The characteristics of infants, their mothers, and households were collected at the baseline by using a structured questionnaire. Nutritional knowledge was assessed using a questionnaire containing 10 questions on breastfeeding and complementary feeding. Validity analysis performed using product moment testing and 10 questions showed significant correlations ($p<0.01$) and reliability of the instrument used to assess nutrition knowledge (Cronbach's alpha=0.222). The household category based on food security status was assessed using nine questions concerning a household's food access.[13]

Anthropometric measurements of infants, including weight and length, were performed at the baseline, midpoint, and final study point by trained field staff. Length was measured to the nearest 5 mm by using a length board (SECA 210). Anthropometric indices (length-age-z score) were calculated using the SPSS macro for the WHO Child Growth Standards.[14] Stunting was defined as a standard deviation of less than −2 in LAZ.

Data management and analysis

For quality assurance of the data, the completeness, accuracy, and consistency of the data in the questionnaire were evaluated with multilevel checks performed by self-enumerators, other field workers, and field supervisors.

For continuous and categorical outcomes, the means or proportions of the three groups were compared using ANOVA. Data are presented as means±SD. The adjustment for covariates was performed using a general linear model ANCOVA. Values of $p<0.05$ were considered significant for all tests. Differences in the incidence of stunting were compared using logistic regression after adjustment for the respective baseline values.

Ethical approval and consent

This study was approved by the Ethical Committee of Faculty of Public Health, University of Diponogoro (Certificate No. 146/EC/FKM/2014). At least one parent or caregiver of all infants participating in the study provided written informed consent prior to enrolment in the study.

RESULTS

Of the 324 age-eligible infants identified from the birth cohort, 269 were recruited. Furthermore, 67 infants (24.9%) dropped out of the study and 34 were excluded because although they consumed complementary food, they were aged <6 months. The reasons for dropping out included migration to other areas temporarily (n=43), not receiving supplementation for >3 months (n=18), refusal to continue participating in the study because of the child

Table 1. Energy and nutrient contents of daily servings of SQ-LNS and biscuits and percentages of RDA

Nutrient	Unit	SQ-LNS[†]		Biscuit[‡]		RDA for child 7-11 months old[§]
		Total	% RDA	Total	% RDA	
Daily serving[¶]	g	20		30		
Energy	kcal	118	16.3	135	18.6	725
Protein[ii]	g	2.6	14.4	2.4	13.3	18
Lipids	g	9.9	27.5	5.0	13.9	36
Linoleic acid	g	2.8	63.6	0.42	9.5	4.4
σ-linolenic acid	g	0.58	116	0	0	0.5
Vitamin A[i]	µg	400	100	105	26.3	400
Vitamin B-1[i]	mg	0.5	125	0.12	30	0.4
Vitamin B-2[i]	mg	0.5	125	0.12	30	0.4
Vitamin B-3[i]	mg	6.0	150	1.5	37.5	4.0
Vitamin B-5[i]	mg	2.0	111.1	0	0	1.8
Vitamin B-6[i]	mg	0.5	166.7	0.12	40	0.3
Vitamin B-12[i]	µg	0.9	180	0.21	42	0.5
Folic acid[i]	µg	150	187.5	18	22.5	80
Vitamin C[i]	mg	30	60	0	0	50
Vitamin D[i]	µg	10	200	1.5	30	5
Vitamin E[i]	mg	6	120	1.5	30	5
Vitamin K[i]	µg	30	600	3	60	5
Calcium[i]	mg	280	112	60	24	250
Copper[i]	mg	0.34	154.5	0	0	0.22
Iodine[i]	µg	90	75	21	17.5	120
Iron[i]	mg	6	85.7	1.8	25.7	7
Magnesium[ii]	mg	40	72.7	0	0	55
Manganese[i]	mg	1.2	200	0	0	0.6
Phosphorus[ii]	mg	190	76	45	18	250
Potassium[ii]	mg	200	28.6		0	700
Selenium[i]	µg	20	200	3.9	39	10
Zinc[ii]	mg	8	266.7	0.9	30	3

[†]Analysis LNS Infant 20 g (Nutriset).
[‡]Nutrient content of biscuit 'Biscuit MP ASI' (MOH 2007).
[§]RDA Indonesia (MOH 2013).
[¶]Serving portion is 1 sachet per day for LNS and 3 pieces per day for biscuit.
[i]Nutrient type 1 (calcium, iron, copper, selenium, manganese, iodine, and vitamin A, B, C, D, E, K).
[ii] Nutrient type II (protein, magnesium, phosphorus, potassium, zinc).

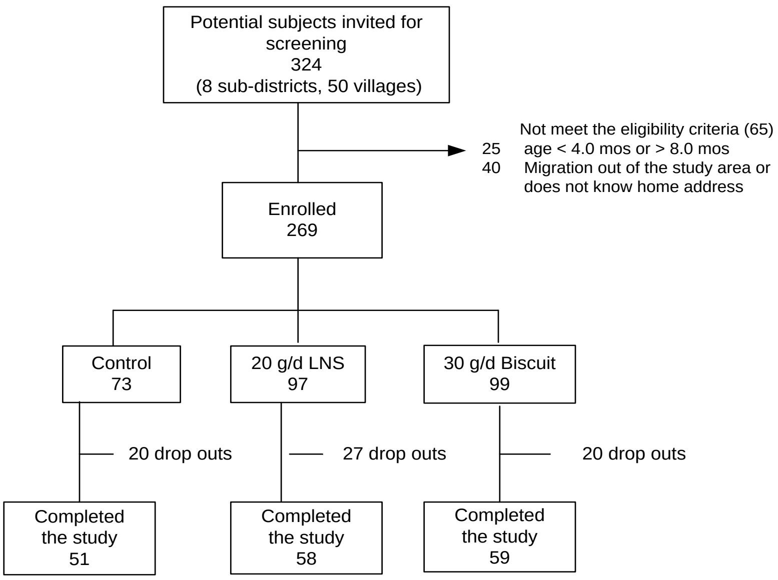

Figure 1. Flow chart of participants

not liking SQ-LNSs or biscuits or vomiting (n=4), the mother being busy (n=1), and the child having severe illness requiring hospitalisation (n=1). The dropout rates in the control, SQ-LNS, and biscuit groups were 27.4%, 27.8%, and 20.2%, respectively; the dropout rates did not differ significantly among the three groups. Potential biases associated with loss to follow-up were assessed. No significant differences in any background characteristic (child, maternal, and household) were observed between the 67 infants who dropped out and 202 infants who completed the study (data not shown). The flowchart for the inclusion and exclusion of the participants is presented in Figure 1.

The mean age of the infants was 6.3±0.3 months, and

Table 2. Baseline characteristic of participants by study groups

Variable	Control group N=51	SQ-LNS group N=58	Biscuit group N=59	*p*-value
Child characteristics				
Sex, boy, % (n)	60.8 (31)	56.9 (33)	47.5 (28)	0.346
Age, month	6.3±0.3	6.4±0.3	6.3±0.3	0.294
Underweight, % (n)	5.9 (3)	15.5 (9)	16.9 (10)	0.183
Wasting, % (n)	8.2 (4)	12.1 (7)	11.9 (7)	0.772
Stunting, % (n)	0	5.2 (3)	8.5 (4)	0.122
Anaemia, % (n)	63.3 (19)	79.5 (31)	75.5 (40)	0.297
Maternal characteristics				
Age, year	27.9±6.0	27.7±6.1	27.8±4.9	0.976
Length of education, years	7.2±3.6	7.1±3.3	7.2±3.4	0.998
Mother with no occupation, % (n)	74.5 (38)	89.7 (52)	86.4 (51)	0.080
Mother with low nutrition education score, % (n)	45.1 (23)	44.8 (26)	44.1 (26)	0.994
Household characteristics				
Household food insecurity, % (n)	58.8 (30)	53.4 (31)	40 (67.8)	0.278
Household with low dietary diversity, % (n)	3.9 (2)	5.2 (3)	1.7 (1)	0.591

Values are expressed as the mean±SD or % (n).
SQ-LNS (small-quantity lipid-based nutrient supplement); mother's nutrition knowledge was assessed using a questionnaire that analyzed validity and reliability from 10 questions on breastfeeding and complementary feeding, household with food insecurity is assessed using nine questions had been developed by FANTA project; low dietary diversity (household member consumed 1 to 3 food groups over the past 24 h preceding the interview

most of the infants still consumed breast milk (78.7%). The average age of the mothers was 27.8±5.8 years. Most of the mothers (68.8%) had low education levels (elementary school), and 83.9% were housewives. The proportion of households with food insecurity was 60.1%. As presented in Table 2, the proportions or means of the characteristics of the infants, mothers, and households did not differ significantly among the three study groups ($p>0.05$).

Adherence to SQ-LNS and biscuits and morbidity status

The mothers reported that the proportions of adherence to SQ-LNSs were 62.9% and 59.5% during the 3- and 6-month intervention periods, respectively, whereas the proportions of adherence to biscuits during these periods were 92.8% and 91.1%, respectively.

On the basis of the mothers' self-reported data on clinical history, the prevalence rates of upper respiratory infection (URI) and diarrhoea did not significantly differ among the three groups during the study ($p>0.05$). The prevalence rates of URI were 36.3%, 35.5%, and 35.6% in the control, SQ-LNS, and biscuit groups, respectively. The prevalence rates of diarrhoea were 19.3%, 22.2%, and 20.2% in the control, SQ-LNS, and biscuit groups, respectively.

Effect of SQ-LNS on linear growth

The mean weight and body length, MUAC, head circumference, or mean WAZ, WLZ, and LAZ did not differ significantly among the three groups at the baseline ($p>0.05$; Table 3). During the 3-month intervention, the length gain was significantly higher in the infants in the SQ-LNS group (4.69 cm) than in the infants in the biscuit (3.77 cm) and control (3.75 cm) groups ($p<0.01$). Furthermore, the length gain was significantly higher in the infants in the SQ-LNS group (0.91 cm, $p<0.05$) and lower in the infants in the biscuit group (−0.03 cm, $p>0.05$), compared with the infants in the control group.

After the 6-month intervention, the adjusted length gain was significantly higher in the infants in the SQ-LNS group (8.57 cm) than in the infants in the control (7.15 cm) and biscuit groups (7.79 cm; $p<0.01$; Figure 2). The length gain was significantly higher in the infants in the SQ-LNS (1.42 cm; $p<0.01$) and biscuit groups (0.64 cm, $p>0.05$) than in the infants in the control group.

The velocity of length gain was significantly higher in the SQ-LNS group (1.43 cm/month; 95% CI: 1.12–1.26) than in the biscuit (1.29 cm/month; 95% CI: 1.23–1.36) and control groups (1.19 cm/month; 95% CI: 1.12–1.26; $p<0.01$).

The mean changes in LAZ during the 3-month intervention were −0.36, −0.07, and −039 z-score units in the control, SQ-LNS, and biscuit groups, respectively ($p>0.05$). The change in LAZ was higher in the SQ-LNS group (0.29 z-score unit, $p>0.05$) and lower in the biscuit group (−0.03 z-score unit, $p>0.05$) than in the control group.

After the 6-month intervention, the adjusted change in LAZ was higher in the SQ-LNS group (−0.09 z-score unit) than in the control (−0.87 z-score unit) and biscuit groups (−0.46 z-score unit; $p<0.01$). Furthermore, the change in LAZ was higher in the SQ-LNS group (0.77 z-score unit, $p<0.01$) and lower in the biscuit group (0.41 z-score unit, $p<0.05$) than in the control group (Figure 3).

Effect of SQ-LNS on the incidence of stunting

During the 6-month intervention period, a higher change in LAZ resulted in a lower prevalence of stunting in the SQ-LNS group (5.5%) than those in the biscuit (13.6%) and control (14.3%) groups. The prevalence rates of stunting increased by 0.3%, 5.1%, and 14.3% in the SQ-LNS, biscuit, and control groups, respectively. Compared with the control group, the relative risk (RR) of stunting was 0.35 (95% CI: 0.08–1.42, $p=0.141$) in the SQ-LNS group and 0.94 (95% CI: 0.32–2.81, $p=0.265$) in the biscuit group at the 6-month intervention.

Table 3. Anthropometric outcome by study group†

Outcomes	Control group N=51	SQ-LNS group N=58	Biscuit group N=59	*p* value
Body weight, kg				
Baseline	6.98±0.11	6.90±0.10	6.92±0.11	0.885
3-month follow-up	7.43±0.07	7.83±0.06	7.79±0.05	0.093
6-moth follow-up	8.38±0.09	8.53±0.09	8.55±0.9	0.828
Body length, cm				
Baseline	66.2±0.36	66.1±0.31	65.8±2.29	0.538
3-month follow-up	69.7±0.30	70.6±0.23	69.7±0.21	0.064
6-moth follow-up	73.1±0.22[a]	74.5±0.20[b]	73.7±0.20[a]	0.022
MUAC, cm				
Baseline	13.6±0.1	13.5±0.1	13.5±0.1	0.852
6-moth follow-up	14.4±0.1	14.4±0.1	14.4±0.1	0.987
Head circumference, cm				
Baseline	42.5±0.2	42.5±0.2	42.3±0.1	0.259
6-moth follow-up	44.7±0.2	44.5±0.1	44.2±0.1	0.061
WAZ				
Baseline	-0.91±0.12	-1.05±0.13	-0.91±0.13	0.849
3-month follow-up	-1.45±0.08[a]	-1.07±0.06[b]	-1.04±0.06[b]	<0.0001
6-moth follow-up	-1.27±0.09	-1.02±0.08	-1.0±0.08	0.051
WLZ				
Baseline	-0.90±0.14	-0.92±0.14	-0.75±0.13	0.865
3-month follow-up	-1.28±0.14[a]	-0.92±0.10[a]	-0.65±0.09[a,b]	0.001
6-moth follow-up	-0.81±0.13	-1.07±0.12	-0.77±0.12	0.137
LAZ				
Baseline	-0.37±0.13	-0.52±0.12	-0.50±0.13	0.724
3-month follow-up	-0.84±0.13	-0.58±0.10	-0.86±0.09	0.093
6-moth follow-up	-1.34±0.09[a]	-0.57±0.09[b]	-0.93±0.08[a,b]	<0.0001
BMIAZ				
Baseline	-0.99±0.14	-1.01±0.14	-0.85±0.13	0.860
3-month follow-up	-1.31±0.14[a]	-0.97±0.11[a]	-0.67±0.09[a,b]	0.001
6-moth follow-up	-0.64±0.14	-1.01±0.13	-0.64±013	0.070

SQ-LNS: small-quantity lipid-based nutrient supplement; WAZ: weight-for-age z-score; WLZ: weight-for-length z-score; LAZ: length-for-age z-score; BMI: body mass index.
Data are mean±SD. Values in the same row with different superscript letters are significantly different (p<0.05).
†Analysis with ANOVA adjusted for baseline.

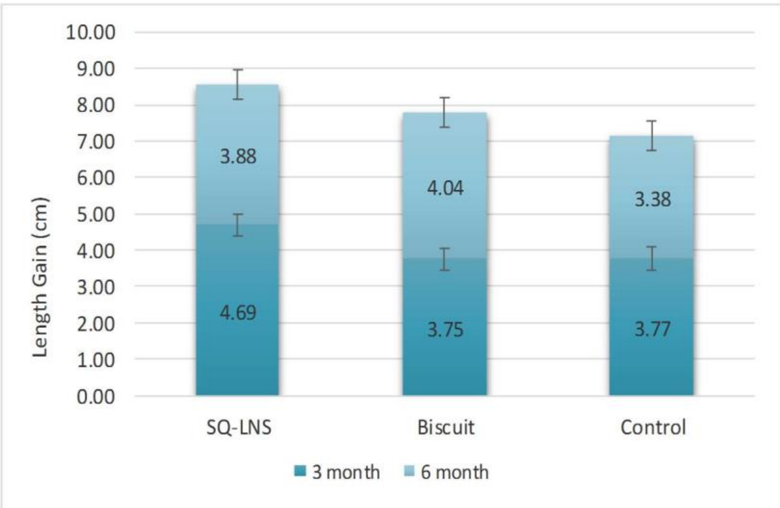

Figure 2. Length gain by study group

After 6-months intervention, the incidence of stunting in SQ-LNS was lower (1.8%(than Biscuit group (8.5%) and Control group (14.6%), In the SQ-LNS group, the RR of stunting (0.35), p<0.05. Furthermore, in the biscuit group, the RR of stunting (0.94), p>0.05.

After the 6-month intervention period, the provision of SQ-LNSs resulted in an 89% reduction in the incidence of stunting (p<0.05), whereas that of biscuits resulted in 46% reduction in the incidence of stunting (p>0.05).

DISCUSSION

This study investigated the effect of the daily provision of SQ-LNSs on linear growth and stunting reduction. We compared this effect with that of biscuits developed by

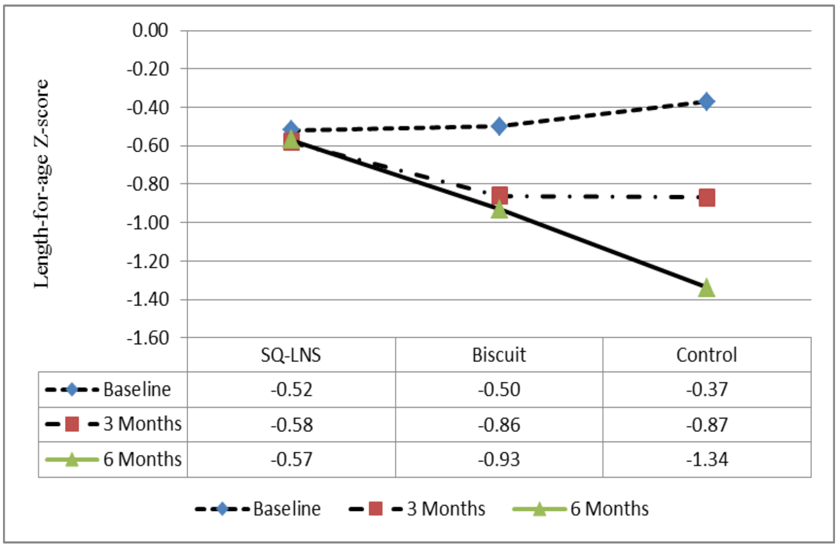

Figure 3. Length-for-age z-score by study group

the Ministry of Health for a supplementary food programme.

The interventions of complementary food supplementation were 20 g of SQ-LNS per day and 30 g of biscuits daily. SQ-LNS are named 'lipid-based' since lipid contents provide the majority of energy content. One daily serving of SQ-LNS (20g) provided 9.9 g lipids, equal to 12.3% of energy requirement. While lipid content in biscuit only provided 6.2% of energy requirement.

The provision of SQ-LNSs to the infants aged 6–12 months resulted in a significantly higher mean length gain (8.57 cm) and change in LAZ (−0.09 z-score unit; p<0.05) after the 6-month intervention. This result supports the following findings of previous studies. A study conducted in Ghana reported that compared with the provision of MNP and crushable Nutritab, the provision of SQ-LNSs for 6 months resulted in a significantly higher change in LAZ.[8] Furthermore, a study conducted in Haiti in children aged 12–17 months reported that the change in LAZ was significantly higher in children receiving SQ-LNS than in the controls.[10]

In this study, after the 6-month intervention, the length gain was higher in the first 6 months of life in the SQ-LNS group but lower in the control and biscuit groups according to an international reference from the WHO (2007). According to this reference, the length gain during the first 6 months of life is 8.1 cm for both boys and girls.

The rate of length gain was significantly higher in the SQ-LNS group (1.43 cm/month, 95% CI: 1.12–1.26) than in the biscuit (1.29 cm/month, 95% CI: 1.23–1.36) and control groups (1.19 cm/month, 95% CI: 1.12–1.26; p<0.0001). This result indicates that the consumption of SQ-LNS can improve the length gain and the velocity of length gain according to the standards of the WHO (2007) and result in catch-up growth. The infants receiving biscuits or no intervention did not have catch-up growth; thus, their length gain highly differed from the reference standard.

In other study in Nias Island, Indonesia informed that local produced Ready-to Used Foods (RUFs) in the form biscuits showed promising for treatment of mild wasting among children both in daily and weekly community-based intervention programs. [15]

The strength of this study is that the characteristics of the participants and of those who dropped out during the 6-month intervention period are similar, which minimised the potential for selection bias. The delivery of complementary food supplements with SQ-LNSs or biscuits by field workers every month ensured that the product was received by the beneficiaries of the study. Field workers assessed compliance with LNSs and biscuits every month and supported the mothers in regularly giving LNSs or biscuits to their children. In addition, they had discussions with mothers to resolve any adverse events because of the consumption of LNSs or biscuits. Trained enumerators with nutrition backgrounds and education obtained the anthropometric data, conducted interviews by using structured questionnaires, and collected diet history, ensuring the quality of the data.

This study has some limitations. The allocation of the participants to the study groups was not randomised; there was no blinding of group allocation and no masking of mothers or field workers regarding who received LNSs or biscuits, which might have influenced the anthropometric measurements and the assessment of development milestones. Hawthorne's effect caused by the monthly home visits in the SQ-LNS and biscuit groups might have influenced the amount of attention paid to dietary intake and caring for children, thus impacting the children's nutritional status.

In conclusion, compared with the other food products, SQ-LNSs were more effective in improving linear growth and reducing the incidence of stunting in children aged 6–12 months over the 6-month intervention period.

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AUTHOR DISCLOSURES

The authors declare that they have no conflicts of interest to declare. This paper is a part of the doctoral dissertation of NM at Bogor Agricultural, University. The abstract was accepted as a poster presentation at the 4th International Conference on Nutrition & Growth, 2017.

REFERENCES

1. Ministry of Health, Republic of Indonesia. National Report of Research on Basic Health 2013. Jakarta: Board of Health Research and Development, Ministry of Health; 2013.
2. Muslihah N. Study on household food insecurity and impacts on child feeding practices, stunting, anemia of children 6-23 months in poor rural, Indonesia. Research Report. 2014. (Unpublish)
3. Martorell R, Khan LK, Schroeder DG. Reversibility of stunting: epidemiological findings in children from developing countries. Eur J Clin Nutr. 1994;48(Suppl 1): S45-57
4. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, Sachdev HS. Maternal and child undernutrition: consequences for adult health and human capital. Lancet. 2008;371:340-57. doi: 10.1016/s0140-6736(07)61692-4.
5. Dewey KG, Huffman SL. Maternal, infant, and young child nutrition: combining efforts to maximize impacts on child growth and micronutrient status. Food Nutr Bull. 2009;30: S187-9. Doi: 10.1177/15648265090302s201.
6. Victora CG, de Onis M, Hallal PC, Blossner M, Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. Pediatrics. 2010;125:e473-80. doi: 10.1542/peds.2009-1519.
7. Golden MH. Proposed recommended nutrient densities for moderately malnourished children. Food Nutr Bull. 2009;30: S267-342. Doi: 10.1177/156482650090303s302.
8. Adu-Afarwuah S, Lartey A, Brown KH, Zlotkin S, Briend A, Dewey KG. Randomized comparison of 3 types of micronutrient supplements for home fortification of complementary foods in Ghana: effects on growth and motor development. Am J Clin Nutr. 2007;86:412-20.
9. Phuka JC, Maleta K, Thakwalakwa C, Cheung YB, Briend A, Manary MJ, Ashorn P. Complementary feeding with fortified spread and incidence of severe stunting in 6- to 18-month-old rural Malawians. Arch Pediatr Adolesc Med. 2008;162:619-26. doi: 10.1001/archpedi.162.7.619.
10. Iannotti LL, Dulience SJL, Green J, Joseph S, François J, Anténor M-L, Lesorogol C, Mounce J, Nickerson NM. Linear growth increased in young children in an urban slum of Haiti: a randomized controlled trial of a lipid-based nutrient supplement. Am J Clin Nutr. 2014;99:198-208. doi: 10.3945/ajcn.113.063883.
11. Maleta KM, Phuka J, Alho L, Cheung YB, Dewey KG, Ashorn U et al. Provision of 10-40 g/d Lipid-Based Nutrient Supplements from 6 to 18 Months of Age Does Not Prevent Linear Growth Faltering in Malawi. J Nutr. 2015;145:1909-15. doi: 10.3945/jn.114.208181.
12. Ministry of Health RI. Spesifikasi Tehnis MP-ASI No. 224. Jakarta: Ministry of Health, Republic of Indonesia; 2007.
13. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide. Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development; 2007.
14. WHO. WHO Child Growth Standards: Methods and Development: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. Geneva: WHO; 2006.
15. Purwestri RC, Scherbaum V, Inayati DA, Wirawan NN, Suryantan J, Bloem MA, et al. Supplementary feeding with locally-produced Ready-to-Use Food (RUF) for mildly wasted children on Nias Island, Indonesia: comparison of daily and weekly program outcomes. Asia Pac J of Clin Nutr. 2012:3:374-79. doi: 10.6133/apjcn.2012.21.3.374-379.