Effect of Nutrition Education and Multi-Nutrient Biscuit Interventions on Nutritional and Iron Status: A Cluster Randomized Control Trial on Undernourished Children Aged 6–23 Months in Aceh, Indonesia

Aripin AHMAD1, Siti MADANIJAH2, Cesilia Meti DWIRIANI2 and Risatianti KOLOPANGK1

1 Nutrition Department of Aceh Health Polytechnic, Ministry of Health, Aceh, Indonesia
2 Community Nutrition Department of the Faculty of Human Ecology, Bogor Agricultural University, Bogor Indonesia
3 Faculty of Psychology, Syarif Hidayatullah State Islamic University, Jakarta, Indonesia

(Received June 18, 2019)

Summary

Undernutrition and iron deficiencies on under-five children in Indonesia remain high and very closely related to inadequate complementary feeding. This study investigated the effect of weekly nutrition education by home visit using the food monitoring card (FMC) models and daily provision multi-nutrient biscuits and combination on growth and reduction of iron deficiency and anemia among underweight children aged 6–23 mo in Aceh Indonesia. A 6-mo. cluster randomized, control trial was conducted on 121 children received nutrition education (NE), multi-nutrient biscuit (MNB), combination both nutrition education and biscuits (NE+MNB), and control group. The outcome weight gain and prevalence of underweight (weight for age z-score < −2SD) were collected by anthropometric and iron deficiency were serum ferritin measuring with ELISA method. After the 6-mo intervention, the rate of weight gain was higher in combination intervention group 1.51±0.68 kg than multi-biscuit group 1.40±0.72 kg, NE group 1.34±0.66 kg and control group 1.21±0.42 kg, and the rate increase of serum ferritin was higher in combination NE+MNB and biscuit group (2.54 μg/L and 2.17 μg/L). At the end of study there were a significant decrease in prevalence of underweight (p=0.003), the incidence of underweight in NE+MNB (45.2%) lower than NE group (63.3%), MNB group (64.5%) and control group (69.0%) and significant decrease of iron deficiency (p=0.02), the incidence lower in MNB group (6.5%) than NE+MNB (22.6%), NE group (23.3%) and control group (24.1%). The combination of nutritional education and multi-nutrient biscuits intervention improving nutritional and iron deficiency status on undernourished children. These research highlight the need integration of nutrition education and food base intervention to prevent underweight and iron deficiency on children 6–23 mo old.

Key Words  multi-nutrient biscuit, food-monitoring card, iron deficiency, nutrition education, underweight

The undernutrition problems include underweight, wasting, and stunting, as well as micronutrients deficiencies, namely; deficiency of iron, zinc, iodine, vitamin A in children under five is still being global issues, particularly in developing countries. The high rate of undernutrition has pushed WHO (2012) to arrange the resolution for solving the problem of nutrition in pregnant women, infants, and young children. One of the six targets set is the decreasing of stunting number of children (short children). WHO aims to decrease the stunting number of 3.9% each year, thus it has been decreased from 170 million in 2010 to 100 million in 2025 (1). Lintello and Lakshman reported that hunger and undernutrition is still a challenge to global development, an estimated 795 million of children suffer from undernutrition in 2014–2016 or one of nine children suffer from chronic hunger as a result of insufficient food to live actively and healthily (2).

Indonesia Basic Health Research reported that in 2010 and 2013 the prevalence of stunting and underweight are increased. Underweight prevalence is 17.9% to 19.65%, while stunting prevalence is 35.6% to 37.2%. Aceh is a province including in seventh highest number of underweight problem in Indonesia, namely 23.7% to 26.3%, stunting from 38.9% to 41.5% (3). If compared with the standard of undernutrition as a public health problem, the prevalence of undernutrition in Aceh belongs to the category of high prevalence (WHO, 2014). The prevalence of anemia in children under five in Indonesia is also very high, at 28.1% and in the Aceh province is much higher based on World Vision Indonesia survey in four districts showed anemia in infants reached 67.8% (4). Ahmad et al. reported anemia and iron deficiency in children aged 6–23 mo in Aceh Besar district were 46.3% and 35.8%, respectively (5). The others study by Ahmad et al. in undernour-
lished children in Aceh showed 27.3% of children suffered from iron deficiency (ID), 50.7% was anaemic and 19.7% suffered from iron deficiency anaemia (IDA) (6).

Children aged 6–24 mo is a period of transition from exclusive breastfeeding to Complementary feeding. This period is also the largest part of the first 1,000 d of life, which is 18 mo of the 24 mo period after the birth is the key window of opportunity on the prevention of undernutrition and the negative consequences, thereby providing sufficient nutrition during this period is a priority for nutritional problems (7). Undernutrition particularly in developing countries, is mostly happened during the period after birth, especially in the age of 6–18 mo, lack of nutrition at this age have permanent effects both on the growth like stunting, as well as the development stage like brain development capacity which impact to cognitive abilities and education, as well as metabolic syndrome, which causes metabolic disorders with the high risk of various degenerative diseases (8).

The high number of undernutrition and deficiency of macro and micronutrients on infants and toddlers are very closely related to the inadequate complementary feeding and inappropriate practice of breastfeeding. Complimentary food is not enough due to: the fewer nutrients of food (low micronutrients quality, low diversity of foods from the animal, anti-nutritional substances existence, and low energy content, Inappropriate feeding practices include: less frequency, the quality of feeding when sickness period, unbalance consistency and amount of food, the less appetite, food and water quality, including; the contamination of water and food, poor hygiene practices, un-safety food storage, and preparation. Meanwhile, inadequate breastfeeding includes the late period of Breastfeeding Initiation, not giving exclusive breastfeeding and too early weaning (1). Less than a quarter of children aged 6–23 mo in many countries are getting adequate nutrition and safe complementary feeding which fulfill dietary diversity and frequency according to age (9).

In Indonesia, the level of energy and protein intake is still a problem. Total Diet Survey showed 55.7% individual energy intake is less than the numbers of Energy Adequacy, and 34.2% of children under five had a protein intake of protein adequacy rate (10). In Aceh based on the same survey, it showed 24.7% of children aged 0–59 mo have less protein intake (<100% RDA) and 60.4% of energy intake is less than RDA (11).

The intervention to increase the intake of macro and micronutrients and to prevent or increase the growth and micronutrient status on children is needed. A strategy for the micronutrient deficiency prevention is supplementing the mother and child, including nutrition education, food modification (diet), provision of food, agricultural interventions, single or combination supplementation and fortification (12). Beside direct nutrition intervention, other programs can be done to help the main intervention through financial incentives at various levels, utilization of the yard (home gardening) and community-based nutrition education and nutrition mobilization. The program can be made through the healthcare system, market-based approach, and community-based, for example, the use of local food through increasing the nutritional value of food or combination of various nutrients sources to improve the nutritional status of children.

Some studies indicated nutrition education has a positive impact on increasing complementary feeding and micronutrient status and the growth of children. Fabrizio, et al conducted a meta-analysis of the determinant factors that influence the effectiveness of behavior change interventions of complementary feeding in developing countries which showed behavior change intervention (behavior change intervention has an important role in improving feeding practices, growth, and preventing growth disorders (13).

Indonesia already has a Balanced Nutritional Guidance (PGS) as a reference to educate people but PGS should be implemented into society through nutrition education, dissemination, promotion, and scientific activities. However, the result of Balanced Nutritional Guidance implementation and evaluation in Asia is still difficult because of the limitation of media, lack of PGS mobilization in society (14). Implementation of nutrition education in the community is commonly done by counseling through Posyandu activities with the limited media as well as lack skills of educator, thus, the cadre do not have self-efficacy to educate people. It is necessary for the development of educational models include implementation of appropriate media, good mechanism structure and educational skilled workers. Based on the description above, the objective of this research was to analysis effectiveness of nutrition education (NE) model using Food Monitoring Card (FCM) and multi-nutrient biscuit (MNB) to improve growth, nutritional status, iron deficiency status in underweight children aged 6–23 mo old.

MATERIALS AND METHODS

Study design and participants. This study was conducted in four sub-districts, namely Darul Imarah, Baitussalam, Peukan Bada and Darussalam sub-districts in Aceh Besar District, Aceh province. A Cluster Randomized Control Trial intervention design was applied to determine the effectiveness of nutrition education using the FMC model and multi-nutrient biscuit (MNB). The research site is selected by purposively based on: 1. The high prevalence of underweight, Aceh Besar district ranked third of underweight status in Aceh. National Nutritional Status Survey and Monitoring in 2014 reported the prevalence of underweight in Aceh Besar 28.0% higher than the average prevalence of underweight in Aceh province (26.3%) (15). 2. The availability of the health center for the implementation of the intervention study model. 3. The affordability of study site makes it easy to monitor the intervention regularly. The study period is six months of intervention and evaluation, the star from November 2016 to Mei 2017.

The sample size was calculated based on the basis of the expected value of increasing the level of the 5 mo
intervention period. Study of Inayati et al. (16) in Nias Indonesia regarding the effects of Intensive Nutrition education (INE) and INE plus Multinutrient powder supplementation in children under five found an increase in hemoglobin levels of 10 mg/dL with standard deviation (SD) 1.2 mg/dL, so based on these data there was a minimum number of 30 subjects for each treatment group, to anticipate a drop out, then added 30% each group, making 39 samples for each treatment. Sampling is based on inclusion criteria, namely; children aged 6–23 mo, suffer from underweight (WAZ between −2SD to >−3SD, healthy is characterized by the absence of secondary infectious diseases based on the results of the examination by doctors/health personnel, willing to take part in research by signing informed consent.

**Intervention and follow up.** The subject was derived into the following four groups: Nutrition education using FMC only (NE group), Nutrition education plus multi-nutrients biscuits (NE+MNB group), MNB group only and control (regularly NE program in the Public Health Center office and Posyandu). The Nutrition education intervention model is composed of five of component, namely 1). Training Cadres as educator 2). Nutrition education and weekly home visite method for mothers and Food Monitoring by FMC 3). Nutrition information for mothers/caregivers using media (FMC, Booklet and Poster 4). Sensitizing meeting and supervision for cadres (nutrition educator) 5). Sensitizing meeting for mothers. The Nutrition education Model intervention for mothers/caregivers in this study involves; (1) Nutrition education using key message through home visite by cadres (2) Nutrition information using media (FMC, booklet and poster) (2) Monitoring and evaluation Complementary feeding practices using Food Monitoring Card (FMC) (4) Remaidering and motivating of mothers/caregivers to compliance fill the FMC and giving CF practices according to CF standard, form of nutrition education package (Table 1).

Implementing nutrition education conducted by trained cadres, these training involve: 1). Training guide for nutrition educator (cadres) 2). the manual nutrition education process for cadres 3). Media nutrition information (booklet and poster) 4). Food Monitoring card (FMC). The resources contain key message focussing on six aspects/topics on complementary feeding standard, included: Meal frequency of complementary feeding, The diversity of food types, Intake specific food (source of animal protein, fruits, and vegetables), The density of nutrient, Hygiene on preparation and processing of CF, Responsive feeding methods. In nutrition educator (cadres) resources addition topics about communication and counseling skills (Table 2).

The Multi-Nutrients Biscuit fortified by 10 vitamins
and 6 minerals that have been developed by the Nutrition Directorate of Indonesian Ministry of Health license. The composition of the nutritional value of MNB shown in Table 3. The amount of MNB given was based on Indonesian RDA (2013) for children aged 6–11 mo and 12–23 mo who need the energy of 725 kcal and 1,125 kcal, respectively. FCF will be the contribution of energy and protein minimum 30% of recommended dietary allowance (RDA) each day (17), dose/number of MNB each day see 60 g for 6–11 mo and 90 g for 12–23 mo. Multi-Nutrient Biscuits given to children 6–11 mo and to children 12–23 mo old, distribution of MNB 24 times, twice a week. One pack of MNB is consumed by children every day containing 60 g for children aged 6–11 mo and 90 g for children aged 12–23 mo, respectively.

Measurement of outcomes variables. The characteristic of children, their mother and household socio-demographic were collected at the baseline using a structured questionnaire. The outcomes variable were weight gain, mean of increasing hemoglobin and serum ferritin level, the incidence of underweight and iron deficiency status. Weight of children was collected using anthropometric measurements performed by trained enumerator (nutrition graduate). Weight was measured with light clothes and shoes and jacket removed, using an electronic weighing scale (Tanita HD380) and recorded to the nearest 0.1 kg. Weight was measured each month (six times) from baseline to end-line. Assessment of nutritional status using weight-for-age index was expressed z-score using the WHO Child growth standard, underweight was assessed as WAZ score between –2 SD z-score using WHO Antrop plus 2007 software (18). Serum Ferritin (SF) level are serum ferritin level in the blood measured by the ELLISA method, iron deficiency is when the SF, 12 mg/L.

Statistical analysis. The analysis data was carried out univariate to describe the proportion of each variable while to determine the difference between before and after intervention in each intervention group was
paired t-test, while to know the difference between intervention groups, analysis of variance was used. The overall data analysis test uses a confidence level of 95% ($\alpha=0.05$). This research has obtained ethical approval from The ethics committee of the faculty of the Medical University of Indonesia: 452/UN.2.F1/ETIK/2016.

RESULTS

Of the 156 underweight children aged 6–23 who were recruited as the research subject, only 121 chil-

---

**Table 3. Energy and nutrients content Multi Nutrient Biscuits (MNB) and percent to Recommended Dietary Allowance (RDA) of children aged 6–11 mo and 12–24 mo old.**

| Energy and Nutrients | Units | Amount of Nutrient in 60 g MNB for 6–11 mo age Children | Amount of Nutrient in 90 g MNB for 12–23 mo age Children | RDA Children 6–23 mo old | %RDA 6–11 mo | %RDA 12–23 mo |
|----------------------|-------|----------------------------------------------------------|----------------------------------------------------------|---------------------------|-------------|-------------|
| Energy kcal          |       | 240                                                      | 360                                                      |                           | 725         | 1,125       | 33.1        | 32.0        |
| Protein g            |       | 9                                                       | 7.2                                                      |                           | 18          | 26          | 50.0        | 27.7        |
| Total Fat g          |       | 6                                                       | 9                                                        |                           | 36          | 44          | 16.7        | 20.5        |
| Carbohydrate g       |       | 0                                                       | 0                                                        |                           | 82          | 135         | 0.0         | 0.0         |
| Fiber g              |       | 3                                                       | 4.5                                                      |                           | 10          | 16          | 30.0        | 28.1        |
| Sugar g              |       | 18                                                      | 13.5                                                     |                           | —           | —           | —           | —           |
| Water %              |       | 2.4                                                     | 4.5                                                      |                           | 800         | 1,200       | 0.3         | 0.4         |
| Vitamin A $\mu g$    |       | 130                                                     | 315                                                      |                           | 400         | 400         | 37.5        | 78.8        |
| Vitamin D $\mu g$    |       | 4.2                                                     | 4.5                                                      |                           | 5           | 15          | 84.0        | 30.0        |
| Vitamin E $mg$       |       | 2.4                                                     | 4.5                                                      |                           | 5           | 6           | 48.0        | 73.0        |
| Vitamin K $\mu g$    |       | 4.2                                                     | 9                                                        |                           | 5           | 10          | 84.0        | 90.0        |
| Vitamin B1 $\mu g$   |       | 0.18                                                    | 0.54                                                     |                           | 0.4         | 0.6         | 45.0        | 90.0        |
| Vitamin B2 $mg$      |       | 0.18                                                    | 0.54                                                     |                           | 0.4         | 0.7         | 45.0        | 77.1        |
| Vitamin B3 $mg$      |       | 1.5                                                     | 7.2                                                      |                           | 4           | 6           | 37.5        | 120.0       |
| Vitamin B6 $mg$      |       | 0.24                                                    | 0.72                                                     |                           | 0.3         | 0.5         | 80.0        | 144.0       |
| Folate $\mu g$       |       | 24                                                      | 36                                                       |                           | 80          | 160         | 30.0        | 22.5        |
| Vitamin B12 $\mu g$  |       | 0.18                                                    | 0.9                                                      |                           | 0.5         | 0.9         | 36.0        | 100.0       |
| Calciurn $mg$        |       | 120                                                     | 180                                                      |                           | 250         | 650         | 48.0        | 27.7        |
| Fosfor (Cu:P) $mg$   |       | 0.72                                                    | 1.08                                                     |                           | 250         | 250         | 0.3         | 0.2         |
| Iron $mg$            |       | 3                                                       | 5.4                                                      |                           | 7           | 7           | 42.9        | 67.5        |
| Iodium $mg$          |       | 27                                                      | 6.3                                                      |                           | 120         | 120         | 22.5        | 52.5        |
| Zinc $mg$            |       | 1.5                                                     | 2.7                                                      |                           | 3           | 3           | 50.0        | 67.5        |
| Selenium $\mu g$     |       | 11.7                                                    | 10                                                       |                           | 10          | 10          | 60.0        | 68.8        |

---

$a$ 60 g Multi-nutrients biscuit $b$ 90 g Multi-nutrients biscuit $c$ RDA: Recommended Dietary Allowance.
Children were able to take the study to the end and had complete data. There were 35 (22.4%) drop-outs from the study because they did not take the study for 6 mo (24 wk). Reasons for dropouts include not following an intervention procedure (low compliance of biscuit consumption and do not follow regularly nutrition education), diarrhea complaints when consuming biscuits, unwilling to do HB and Serum Ferritin measurements at the end of the study and moving residence or not at the time of measurement. The number of drop-outs is not significantly different (23% NE group, 20.5% NE+MNB group, 20.5% in MNB group and 25.6% in control).

### Table 4. Children characteristic and family socio-demographic.

| Socio-demographic and Children characteristic | NE group n (%) | NE+MNB Group n (%) | MNB Group n (%) | Control n (%) | p |
|----------------------------------------------|----------------|--------------------|----------------|--------------|---|
| **Children ages**                            |                |                    |                |              |   |
| 6–11 mo                                      | 10 (33.3)      | 10 (32.2)          | 7 (22.6)       | 7 (24.1)     | 0.714 |
| 12–23 mo                                     | 20 (66.7)      | 21 (67.7)          | 24 (77.4)      | 22 (75.9)    |   |
| **Children sex**                             |                |                    |                |              |   |
| Female                                       | 20 (66.7)      | 13 (41.9)          | 12 (38.7)      | 18 (62.1)    | 0.065 |
| Male                                         | 10 (33.3)      | 18 (58.1)          | 19 (61.3)      | 11 (37.9)    |   |
| **Birth order of the child**                 |                |                    |                |              |   |
| 1 to 2                                       | 16 (53.3)      | 16 (51.6)          | 20 (64.5)      | 17 (58.6)    | 0.178 |
| 3 to 4                                       | 11 (36.7)      | 12 (38.7)          | 11 (35.5)      | 12 (41.4)    |   |
| 5 above                                      | 3 (10.0)       | 3 (9.7)            | 0 (0.0)        | 0 (0.0)      |   |
| **Birth weight status‡**                     |                |                    |                |              |   |
| LBW (< 2,500 g)                              | 6 (20.0)       | 3 (9.7)            | 3 (9.7)        | 5 (17.2)     | 0.551 |
| Normal (≥ 2,500 g)                           | 24 (80.0)      | 28 (90.3)          | 28 (90.3)      | 24 (82.2)    |   |
| **Mothers age**                              |                |                    |                |              |   |
| < 25 y old                                   | 8 (26.7)       | 4 (12.9)           | 3 (9.7)        | 3 (10.3)     | 0.248 |
| 25–35 y old                                  | 13 (43.3)      | 21 (67.7)          | 22 (71.0)      | 21 (72.4)    |   |
| ≥ 15 y old                                   | 9 (30.0)       | 6 (19.4)           | 6 (19.4)       | 5 (17.2)     |   |
| **Mother’s occupation**                      |                |                    |                |              |   |
| Housewife                                    | 27 (90.0)      | 25 (80.6)          | 26 (83.9)      | 23 (79.3)    | 0.688 |
| Work outside                                 | 3 (10.0)       | 6 (19.4)           | 5 (16.1)       | 6 (20.7)     |   |
| **Mother’s education level**                 |                |                    |                |              |   |
| Elementary school                            | 1 (3.3)        | 5 (16.1)           | 4 (12.9)       | 3 (10.3)     | 0.392 |
| Junior high school                           | 9 (30.0)       | 5 (16.1)           | 5 (16.1)       | 3 (10.3)     |   |
| Senior high school                           | 13 (43.3)      | 15 (48.4)          | 17 (54.8)      | 20 (69.0)    |   |
| Graduate                                     | 7 (23.3)       | 6 (19.4)           | 5 (16.1)       | 3 (10.3)     |   |
| **Number of family members**                 |                |                    |                |              |   |
| 3–4 persons                                  | 8 (26.7)       | 5 (16.1)           | 10 (32.3)      | 4 (13.8)     | 0.051 |
| 5–6 persons                                  | 19 (63.3)      | 23 (74.2)          | 21 (67.7)      | 25 (86.2)    |   |
| ≥ 7 persons                                  | 3 (10.0)       | 3 (9.7)            | 0 (0.0)        | 0 (0.0)      |   |
| **Household income (IDR*)**                  |                |                    |                |              |   |
| < 1.9 million                                | 20 (66.7)      | 19 (61.3)          | 19 (61.3)      | 9 (31.0)     | 0.058 |
| 1.9–3.5 million                              | 10 (33.3)      | 10 (32.3)          | 11 (35.5)      | 16 (55.2)    |   |
| > 3.5 million                                | 0 (0.0)        | 2 (6.5)            | 1 (3.2)        | 4 (13.8)     |   |

|‡ LBW = Low birth weight. |
|* IDR = Indonesian rupiah. |

### Table 5. The average serum ferritin (SF) levels of samples before and after the intervention.

| Intervention‡ | n | Avarage SF levels (μg/L) | p* |
|---------------|---|-------------------------|---|
|               |   | Baseline                | Endline                |   |
| NE            | 30 | 28.22±17.90             | 22.48±11.83             | 0.062 |
| NE+MNB        | 31 | 30.89±22.10             | 33.42±41.55             | 0.751 |
| MNB           | 31 | 35.50±29.60             | 37.67±26.78             | 0.696 |
| Control       | 29 | 29.31±30.59             | 23.89±18.84             | 0.110 |

* p<0.05.

‡ NE: Nutrition education group. NE+MNB: Nutrition education and Multi-nutrient biscuits group. MNB: Multi-nutrient Biscuit group.
The results of the analysis of the characteristics of the research subjects, based on age, sex, birth order of children in the family and birth weight status did not differ significantly between groups ($p=0.714$, $p=0.065$, $p=0.178$, $p=0.551$). Likewise, based on family socio-demographic conditions, namely maternal age, maternal occupation, education level, number of family members and family income did not differ significantly between groups ($p=0.248$, $p=0.688$, $p=0.392$, $p=0.051$, $p=0.058$) (Table 4).

**Table 6. The average increase in serum ferritin levels of samples after the intervention.**

| Intervention‡ | Average increase in serum ferritin levels (μg/L) | $p^*$ |
|---------------|-----------------------------------------------|------|
| NE            | $-5.74 \pm 16.16$                           |      |
| NE+MNB        | $2.53 \pm 43.91$                            |      |
| MNB           | $2.17 \pm 22.85$                            | 0.481|
| Control       | $-5.42 \pm 17.71$                           |      |

* $p<0.05$.
‡ NE: Nutrition education group. NE+MNB: Nutrition education and Multi-nutrient biscuits group, MNB: Multi-nutrient Biscuit group.

**Increased hemoglobin and serum ferritin levels**

The results of the average ferritin serum levels before and after intervention in the NE+MNB and MNB groups increased from 30.89 to 33.42 μg/L, and from 35.50 to 37.67 μg/L, while slightly decreasing in the NE group and controls, from 28.22 to 22.48 μg/L, and from 29.31 to 23.89 μg/L after intervention. The results of the statistical analysis (paired t-test) were not significant differences ($p=0.062$, $p=0.75$, $p=0.60$, and $p=0.11$) and the analysis of variance also showed no significant difference in the level of SF before intervention ($p=0.091$) and after the intervention ($p=0.696$) (Table 5). The average increase in SF levels was higher in the NE+MNB and MNB groups while in the NE education group and the control decreased, the results of statistical analysis (analysis of variance) showed a difference in the increase in SF levels between intervention groups ($p=0.481$) was not significant (Table 6).

**Effect of NE and MNB intervention on iron deficiency prevalence**

The results of the analysis of 121 samples without distinguishing iron deficiency status before the intervention showed the highest prevalence of deficiency in the MNB group (16.1%), NE+MNB group (9.7%) and the control group (10.4%) while FMC education groups did not experience decrease (Fig. 2). While the analysis of 34 baseline samples suffering from iron deficiency
Nutrition Education and Multi-Nutrient Biscuit Intervention

S387

Fig. 4. The Average increased weight gain of children during the intervention. FCM: Nutrition education group using food monitoring card tools, MNB: Multi-nutrients group, FCM+MNB: Nutrition educatio using FMC and Multi-nutrients biscuit group, Control: Nutrition education by regularly program in public health center or posyandu.

Effect of NE and MNB on weight gain and underweight prevalence

The results of the average body weight growth during the 6 mo intervention were 1.34±0.64 kg, the highest weight gain in the NE+MNB group, which was 1.51±0.68 kg, followed by the MNB group (1.40±0.72 kg), NE group (1.34±0.66 kg) and the lowest in the control group (1.21±0.42 kg). Statistic test using analysis of variance test the weight gain different was not significant between the intervention groups (p=0.326), as well as the increase in body weight in 1st, 2nd, 3rd and 4th months (p=0.477, p=0.392, p=0.812 and p=0.621), the difference occurred in the 5th month of the intervention, where the increase in body weight was higher in the MNB group intervention (p=0.012). The average increase in body weight during the intervention was highest in the NE+MNB group, followed by the MNB group, NE group and lowest in the control (Fig. 4). The results of the analysis of the prevalence of underweight after the intervention showed a decrease in underweight (WAZ index) prevalence from 100% at the beginning of the intervention (baseline) to 63.3% in the NE group, 45.2% in the NE+MNB group, 64.5% in the MNB group and 69.0% in the control group. This condition showed there was a change in nutritional status from underweight to normal, that are 36.7% in NE group, 54.8% in NE+MNB, 35.5% in MNB group and only 31.0% in control. The highest decreased in underweight prevalence occurred in the NE+MNB group intervention (p<0.03) (Fig. 5).
iciency prevalence among samples who suffered from underweight and iron deficiency before the intervention (baseline). The results of this study also found that in the underweight sample that had iron deficiency (baseline) there was a significant reduction in the prevalence of iron deficiency after intervention, the largest decrease in iron prevalence occurred in the MNB group intervention, followed by a NE+MNB, the smallest decrease in the NE group, this results showed MNB intervention effectively reduces the prevalence of deficiency in underweight children who suffer from iron deficiency.

The increase in serum ferritin after NE and MNB intervention can be caused by an increase in iron intake from biscuits and diet, the amount of contribution of iron intake from biscuits is 4.5 mg (64.2% RDA) to consume 90 g of biscuits in children 12–23 mo and 3 mg (42.8% RDA) for children aged 6–12 mo. This result is in accordance with the statement of Detzel and Wieser (19), that the use of fortified foods is more effective in reducing anemia and iron deficiency in early childhood in developing countries compared to non-fortified food products. Several other similar studies by Mahfuz et al. (20) in Dhaka intervening in Multi Nutrient Powder (MNP) relatively effectively increasing hemoglobin levels in children aged 6–24 mo, as well as the results of the Wang study, et al. (21) giving supplementary feeding interventions (Yingyangbao) to poor people in China can reduce the prevalence of anemia. Another study in Indonesia by Inayati et al. that the combination of intensive educational interventions and Multi-Nutrient Powder (MNP) can increase hemoglobin levels (16). Dong et al. MP-ASI supplementation in the Wen-chuan earthquake disaster area reduced anemia from 74.3% to 37.4% after 6 mo (22). Other study by Adams et al. In Banglades show fortified biscuits had a significant positive impact on mean levels of iron, folic acid, vitamin B12, retinol and vitamin D in primary school children (23). Study in China by Zhang et al. Study in China showed Community-based complementary food supplements combined with dietary counselling can improve feeding practices and reduce anaemia prevalence in 6–23 mo old (24).

The results of this study also showed an increase in child weight gain after being given an intervention, the average growth of child weight from the results of this study when compared with the minimum standard increase in normal weight of children is appropriate, namely between 1.2–1.8 kg for 6 mo. The normal growth rate of children aged 6–12 mo 0.3 kg per month, at the age of one year and so on until the toddler’s age the child’s weight gain is smaller at 0.2 kg per month (25). The results of this study showed that the highest increase in body weight in the NE+MNB group was followed by the MNB group, then the NE group and the lowest in the control group. This condition can be attributed to the contribution of energy and nutrient intake from biscuits, where 90 grams of biscuits contain 360 kcal energy (32.2% RDA) and protein 7.2 g (27.7% RDA) in children 12–23 mo and 240 kcal energy (33.1% RDA) and 6 g protein (33.3% RDA) plus energy and protein intake from food. The results of this study also found a significant decrease in the prevalence of malnutrition, the largest in the NE+MNB group, followed by the NE group, MNB and the smallest decrease in the control group.

The results of the same study by Huynh et al. showed that the average weight gain of the first 4 wk was 0.5 kg, became 0.8 kg at 8 wk and 1.1 kg 16 wk and became 1.4 kg for 24 wk of intervention, 2.2 kg after 48 wk of intervention (26). The results of a study in Indonesia by Inayati et al. (16) showed that the Intensive Nutrition education (INE) and Multi-Nutrient Powder (MNP) interventions had an effect on body weight growth. Aboud et al. in Bangladesh educational intervention and multi-nutrient sprinkle powder administration can increase body weight (27). Others studied by Zhang et al. in Kenya an 18-mo growth monitoring promotion intervention affected physical growth, namely increased nutritional status based on indicators of WAZ and WHZ index (28). The study conducted by Wang et al. giving supplementary feeding interventions to the poor in China showed a decrease in stunting and underweight (29).

The results of this study showed that there was a decrease in underweight and a decrease in the prevalence of iron deficiency in children after being intervened with nutritional education and biscuits supplement, but not all children who were intervened turned into good nutrition and deficiency status became normal. This condition can be caused by macro and micro-nutritional status, including underweight and anemia and iron deficiency which are strongly influenced by multi-factors. Stewart et al. (1) stated that growth disorders are caused by multi-factors, namely direct and indirect factors. Direct factors include; maternal factors, namely nutritional disorders during conception, growth disorders in the womb or premature birth; home environment factors, including; stimulation, care, water sanitation, environment and personal hygiene, food security and food distribution in the household; low food quality, including; micronutrient quality, dietary diversity, anti-nutrition substances, and lack of energy intake; food delivery practices (frequency, consistency, the child no appetite, insufficient food when sick); the practice of breastfeeding, which is not the initiation of early breastfeeding, exclusive breastfeeding, and weaning too early; the presence of infectious diseases, including helminthiasis, acute respiratory infection, malaria and inflammation. Whereas indirect factors include politics and economics, namely poverty, socio-economic level, health services, education, sociocultural, availability and accessibility of food, water, sanitation and environment, and natural disasters.

Another factor can be caused by the proportion of malnourished children who get exclusive breastfeeding and early breastfeeding initiation and continue breastfeeding for up to 1 y and 2 y are still very low, followed by still low dietary diversity and acceptable diet criteria (30), this condition is related to the socio-cultural aspects of the Acehnese people, namely the existence of
a “peucicap” culture, namely giving food (honey, fruit, sugar and various flavors of food) to newborn children (31), thus affecting the practice of breastfeeding in early childhood.

Nutritional status in children aged 6–23 mo is strongly influenced by the amount of energy and nutrient intake from complementary feeding, the average energy and protein intake in children under five in Indonesia is still low, the results of the Total Diet Survey (SDT) show more than half of the under-five children (55.7%) had less energy intake when compared to the Energy Adequacy Rate (EAR) and 34.2% less protein intake (<100% RDA) (10). The results of the same survey in Aceh showed that 24.7% of children aged 0–59 mo had less protein intake (<100% RDA) and 60.4% less energy intake than EAR (11).

Others factor caused by inappropriate iron intake form the diet, results studied by Ahmad et al. in Aceh shows the level of iron intake from CF in underweight children aged 6–23 mo is still low, most (66.9%) are below 40% RDA and most (75.3%) have iron density from CF less than <7 mg (6). This condition illustrates the still wide disparity in the imbalance of energy and nutrients from food in children. Giving 30% of energy and nutrients from additional food interventions cannot provide higher leverage for improving macro and micronutrients for regions with low intake levels, so it is necessary to improve children’s food consumption patterns and or adjust additional food contributions to interventions.

Nutrition education is essential component to determining food choices and dietary habits (32) and in under two years old will have an impact on complementary feeding practices and nutritional intake of children. Results study by Khan et al. in Tando Jam Pakistan, nutrition education intervention significant to increase the intake of high starch food items, vegetables, and fruits and In Quetta, significant increase the intake of plant protein, dairy foods, and vegetables and combating undernutrition on children (33). Kapur et al. Study in India showed nutrition education effective to improve the iron status possibly by improving the dietary iron intake (34).

Nutrition education has a positive impact in increasing complementary feeding and the growth of children. Fabrizio, et al. conducted a meta-analysis of the determinant factors that influence the effectiveness of behavior change interventions of complementary feeding in developing countries which showed behavior change intervention has an important role in improving feeding practices, growth, and preventing growth disorders (13).

The different of this study from others research are in form of nutrition education model by specifically using food monitoring card (FMC) and other media to improving independently of mothers/caregivers to evaluating and planning their complementary feeding practices combined with multi-nutrient biscuit intervention. Food Monitoring Card (FMC) can be used as a companion of Growth Monitoring Chart (KMS) to become a reference in monitoring children’s food consumption and can be used as self-monitoring by the mother/caregiver followed by mentoring involving cadres or provider so as to encourage community involvement and self-reliance in improvement public nutrition program. Food monitoring card as a model of nutrition education intervention to effort behavioral change and improving the quality and quantity of complementary feeding among children aged 6–23 mo.

Based on the results of this study, it can be concluded that the combination of nutrition education using FMC (NE) and multi-nutrient biscuits supplements (MNB) and both NE and MNB intervention were more effective in increasing serum ferritin and weight gain and decreasing the prevalence of iron deficiency and under-weight in malnourished children who experience iron deficiency. So that it can be suggested that the NE using FMC and MNB combination intervention can be used as an alternative nutrition improvement intervention, especially for malnourished children, but a longer duration is needed. Further research is needed for the educational application using FMC as a monitoring tool and assessing feeding practices through the activities of Posyandu as preventive prevention education for children aged 6–23 mo.

Disclosure of state of COI
All authors declare they have no conflicts of interest.

Acknowledgments
This study is fully funded by the Indonesian Danone Institute Foundation. The views expressed herein are those of the individual authors and do not necessarily reflect those of Indonesian Danone Institute Foundation.

REFERENCES
1) Stewart CP, Iannotti L, Dewey KG, Michaelsen KF, Onyango AW. 2013. Contextualizing complementary feeding in a broader framework for stunting prevention. Matern Child Nutr 9(52): 27–45.
2) Lintelo D, Lakshman RW. 2015. Evidence Report Reducing Hunger and undernutrition: The Hunger and Nutrition Commitment Index (HANCI 2014); Measuring the Political Commitment to Reduce Hunger and Undernutrition in Developing Countries. Institute of Development Studies (IDS).
3) Kemenkes RI. 2013. Laporan Riset Keselhatan Dasar. Badan Penelitian dan Pengembangan Kemenkes RI Jakarta.
4) [WVI] World Vision Indonesia. 2010. Laporan survei anemia di 4 kabupaten Provinsi Aceh. Banda Aceh. WVI.
5) Ahmad A, Zulfah S, Wagustina S. 2014. Iron deficiency anemia among under two years children (6–23 months) in Aceh Besar District Gizi Indon 37(1): 63–70.
6) Ahmad A, Madanijah S, Dwiriani CM, Kolopaking R. 2018. Iron deficiency risk factors in undernourished children aged 6–23 months in Aceh, Indonesia. J Gizi Pangan 13(12): 145–156.
7) Dewey KG. 2013. The challenge of meeting nutrient needs of infants and young children during the period
of complementary feeding: An evolutionary perspective. J Nutr 143(12): 2050–2054.

8) Achadi EL. 2014. Periode Kritis 1000 Hari Pertama Kehidupan dan Dampak Jungka Panjang Terhadap Kesihatan dan Fungsinya. Persagi, editor: Materi Kursus Penyegaran Ilmu Gizi (KPIG); 22 November 2014. Yogjakarta, Indonesia.

9) World Health Organization. 2015. Infant and young child feeding. [Internet]. [Cited: 2015. January 14]. Available on: http://www.who.int/mediacentre/factsheets/fs342/en/

10) Kemenkes RI. 2014. Laporan Riset Kesehatan Dasar. Badan Penelitian dan Pengembangan Kemenkes RI Jakarta.

11) Kartono D, Hermina, Faatih M. 2014. Buku Studi Diet Kemenkes RI. 2014. Laporan Riset Kesehatan Dasar. Jakarta. Balitbangkes Kemenkes RI.

12) Bhutta. ZA, Das JK, Rizvi A, Gaffey MF, Walker. N, Horton. S. 2013. Evidence Base Intervention for improvement of maternal and child nutrition; what can be done and what cost. Lancet 382(9890): 396.

13) Fabrizio CS, Liere MV, Pelto G. 2014. Identifying determinants of effective complementary feeding behavior change interventions in developing countries. Matern Child Nutr 10: 575–592.

14) WHO, FAO. World Health Organization Regional Office For South East Asia, FAO, and Institut of the home Economic University of Delhi. 2010. Regional Consultation on Food-Based Dietary Guidelines for countries in the Asia Region. A Report. New Delhi, India, 6–9 December 2010. WHO.

15) District of Health of Aceh. 2015. Hasil Survei Pemanfaatan Status Gizi (PSG) Provinsi Aceh Tahun 2014: Monitoring dan Evaluasi Program. Banda Aceh. Dinkes Aceh dan Jurusan Gizi Politekkes Aceh.

16) Irnayati DA, Scherbaum V, Purwewestri RC, Wirawan NN, Suryanian J, Harsono S, Bloem MA, Pangaribuan RV, Biesalski HK, Hoffmann V, Bellows AC. 2012. Combined intensive nutrition education and micronutrient powder supplementation improved the nutritional status of mildly wasted children on Nias Island, Indonesia. Asia Pac J Clin Nutr 21(3): 361–373.

17) Indonesia Ministry of Health. 2011. Panduan Penyelenggaraan Pemberian Makatan Tambahan Pemulihan bagi Balita Gizi Kurang. Jakarta (ID). Kemenkes RI.

18) World Health Organization. 2007. WHO Child Growth standard: Lenght/height-for-age, weight-for-age, weight-for-length, weight-for height and body mass index-for-age. Methode and development. Geneva. WHO.

19) Detzel P, Wieser S. 2015. Food Fortification for Addressing Iron Deficiency in Filipino Children: Benefits and Cost-Effectiveness. Ann Nutr Metab 66(suppl 2): 35–42.

20) Mahfuz M, Alam MA, Islam MM, Mondol D, Hossain MI, Ahmed AMS, Choudhury N, Raihan MJ, Haque R, Ahmed T. 2016. Effect of micronutrient powder supplementation for two and four months on hemoglobin level of children 6–23 months old in a slum in Dhaka: a community based observational study. BMC Nutr 2: 21.

21) Wang F, Liu H, Wan Y, Li J, Chen Y, Zheng J, Li D. 2016. Age of complementary foods introduction and risk of anaemia in children aged 4–6 years: A prospective birth cohort in China. Sci Rep 7: 44726.

22) Dong C, Ge P, Ren X, Wang J, Fan H, Yan. 2013. Prospective study on the effectiveness of complementary food supplements on improving status of elder infants and young children in the areas affected by Wenchuan Earthquake. PLoS One 8(9): e72711.

23) Adams AM, Ahmed R, Latif AHMM, Rasheed S, Das SK, Hasib E, et al. 2017. Impact of fortified biscuits on micronutrient deficiencies among primary school children in Bangladesh. PLoS One 12(4): e0174673.

24) Zhang Y, Wu Q, Wang W, et al. 2016. Effectiveness of complementary food supplements and dietary counseling on anaemia and stunting in children aged 6–23 months in poor areas of Qinghai Province, China: a controlled interventional study. BMJ Open 6: e011234.

25) Indonesia Ministry of Health. 2009. Kartu Menuju Sehat (KMS). Jakarta (ID). Direktorat Jenderal Bina Kesehatan Masyarakat.

26) Huynh DTJ, Estorninos E, Capeding RZ, Oliver JS, Low YL, Rosales FJ. 2015. Longitudinal growth and health outcomes in nutritionally atrisk children who received long-term nutritional intervention. J Hum Nutr Diet 28: 623–635.

27) Aboud FE, Akhter S. 2011. A cluster-randomized evaluation of a responsive stimulation and feeding intervention in Bangladesh. Pediatrics 127: 5.

28) Zhang J, Shi L, Chen DF, Wang J, Wang Y. 2013. Effectiveness of an educational intervention to improve child feeding practices and growth in rural China: updated results at 18 months of age. Matern Child Nutr 9(1): 118–129.

29) Wang J, Chang S, Zhao L, Yu W, Zhang J, Man Q. 2017. Effectiveness of community-based complementary food supplement (Yingyangbao) distribution in children aged 6–23 months in poor areas in China. PLoS One 12(3): e0174302.

30) Ahmad A, Madanijah S, Dwiriani CM, Kolopaking R. 2018. Complementary feeding practices and nutritional status of children 6–23 month old: A formative study in Aceh, Indonesia. Nutr Res Pract 12(6): 512–520.

31) Zahirna C. 2007. Ritual Masyarakat Aceh Dalam Memyutut Kelahiran Anak (suatu tinjauan kekinian). [Internet]. [diunduh: 1 Maret 2018]. Tersedia pada http://www.gerbangaceh.blogspot.co.id/2007/12/ritual-masyarakat-aceh-dalam-memyutut.html.

32) Wunderlich S. 2013. The important of appropriate nutrition assesment and nutrition education for older adults. J Nutr Food Sci 3: 5.

33) Khan AZ, Rafique G, Qureshi H, Badruddin SH. 2013. A nutrition education intervention to combat undernutrition: Experience from a developing country. ISRN Nutrition 2013: 210287.

34) Kapur D, Sharma S, Agarwal KN. 2004. Effectiveness of nutrition education, iron supplementation or both on iron status in children. Indian Pediatr 40(12): 1131–1144.