The Effects of Multiple-Nutrients Fortified Biscuits and/or Psychosocial Parenting Education Intervention Programs on Anthropometric and Cognitive Measures of Toddlers

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Summary Poor nutritional status or stunting still becomes a public health problem in Indonesia, with prevalence of 37.2% in 2013. Some research results show that stunted children have lower cognitive development than normal children. This study aims to assess whether there is an effect of giving multiple-nutrient biscuits and psychosocial parenting education on height and development of children under the age of three (toddlers). This study used quasi experimental design. The treatment was given for 2 mo to 28 stunted children who were divided into 3 groups, namely: (1) multiple-nutrient biscuits (2) psychosocial parenting education (3) multiple-nutrient biscuits and psychosocial parenting education. Multiple-nutrients biscuit was given 12 pieces a day for 2 mo. Meanwhile, psychosocial parenting education was given directly by psychologist in the form of lectures, brainstorming and role play. In order to identify the effect of treatment on children’s height and development, the data obtained was analyzed using paired t-test, while the analysis of differences between treatment groups was carried out using analysis of variance (ANOVA).

The results showed that giving psychosocial parenting education significantly increased height, children’s nutritional status based on height by age index, and improved cognitive development among toddlers. Giving multiple-nutrient biscuits and psychosocial parenting education significantly increased height and cognitive development among toddlers. In order to overcome children’s growth and development problem, nutrition interventions need to be carried out along with the provision of education about maternal parenting to children.

Key Words development, height, multiple-nutrient biscuit, psychosocial parenting, toddlers

Stunting is children with shorter height compared to other normal children in the same age group. The stunting prevalence in Africa was 38.2%, Latin America was 13.5%, and Asia was 27.6% (1, 2). In 2012, according to WHO (2013), the stunting prevalence in Asian countries was as follows: Thailand was 15.7%, Malaysia was 17.2%, Philippines was 32.3%, and Indonesia was 39.2% (3).

Result of Basic Health Research (Riskesdas) in 2013 showed that 20.2% of babies were born with a stunting condition, namely height was <48 cm. However, there was a change in the number of stunting until the age of five from year to year, in 2007 was 36.8%, in 2010 was 35.6%, in 2013 was 37.2%. This situation indicates that stunting is still a public health problem in Indonesia (4, 5). According to WHO (2013), stunting is a public health problem if the number of stunting exceeds 20% (3).

Nutritional problems in children can be caused by several factors, including diet, sleep pattern, infectious diseases, and daily activities carried out by children. A good diet will affect children’s nutrition, the parent role is very important in regulating children’s diet and parenting. Based on Total Diet Survey data in 2014, 55.7% of energy intake was less than the recommended Energy Adequacy Rate (6). Of the various factors, the main factor resulting in stunting is insufficient nutrient intake for growth and development, especially in children. One effort to overcome the lack of energy intake in children is providing primary and supplementary nutritional intake to children.

The supplementary food is often provided in the form of local based family food with recommended recipes and biscuit forms. The provided biscuits have special formulation and are fortified with vitamins and minerals. The biscuits were initially given to underweight children. Supplementary feeding in the form of WHO formula and biscuits in malnourished infants successfully improved nutritional status based on the index weight for height and weight for age (7). Edvina’s study showed a weight gain of 6.81% after giving supplementary feeding for 3 mo in the form of instant milk for malnourished toddlers aged 6–11 mo or biscuits for toddlers aged more than one year in the Sei Tatas Community Health Center in Kapuas Regency (8). The possibility of providing biscuits to stunted children under

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two years (toddlers) has a positive impact on changes in height and cognitive abilities. The biscuits contain enough energy, carbohydrate, fat, protein, vitamins and minerals.

Nutrition deficiencies in stunted children at early age can affect their growth and cognitive development. Stunting in children aged 5 y tends to persist throughout life, failure to grow in early childhood continues in adolescence. Growth failure is an intergenerational problem, women with poor nutritional status and short stature have a greater risk of giving birth stunted children (9). According to Uauy et al., stunted children have a relatively low level of cognitive intelligence (2). A study conducted by Drewett in Ethiopia showed that malnourished children had lower psychomotor and mental development than normal children (10). Similar results are found in Crookston et al. in 2011 and 2013 in Ethiopia, India, Peru, and Vietnam. The results showed that stunted at the age of 6–18 mo and age of 4–6 y affected children’s cognitive abilities at school (11, 12).

The relationship of psychosocial parenting with cognitive development in children aged 3 y shows that learning stimulation, language stimulation and academic stimulation have a significant relationship with children’s cognitive development (13). Research by Andrade et al. (14) and Khomsan et al. (15) observationally showed a positive correlation between psychosocial parenting and cognitive development. Low cognitive development was found in children with low psychosocial parenting.

In connection with the foregoing description, this study was then conducted about the effect of giving multiple-nutrient biscuits and psychosocial parenting education on the height and cognitive abilities of stunted children under the age of 3 in Cimahi City.

MATERIALS AND METHODS

Study design and participants. This study design was quasi-experimental pre and post-test with measurement of height and development of stunted toddlers before and after treatment. The treatment given was provision of multiple-nutrient biscuits and psychosocial parenting education.

Population in this study was all toddlers in North Cimahi Health Center Working Area. The sample was stunted toddlers (Z-score of Height/Age was \(< - 2 \) SD) based on the inclusion criteria that was randomly selected. The sample size was determined based on intervention design formula by considering the developmental measurement standard deviation of \( 8.7 \) and developmental improvement target of \( 15 \) points. Results of the sample calculation plus a response rate of \( 25\% \), 10 children were needed for each group, therefore the total sample was at least 30 toddlers (16).

Inclusion criteria included: 1) children aged 12–35 mo; 2) has Height for Age Z-score \(< - 2 \) SD; 3) has a normal diet; 4) willing to participate in the study and willing to sign an informed consent. While the exclusion criteria included: 1) suffering from infectious diseases; 2) suffering from congenital diseases; 3) allergic to certain food ingredients, especially dairy products.

The sample was divided into 3 groups, namely: 1) Given a multiple-nutrient biscuits treatment; 2) Given a psychosocial parenting education treatment in the sample’s parents; 3) Given treatments of multiple-nutrient biscuits and psychosocial parenting education in the sample’s parents.

The multiple-nutrient biscuits intervention group received 12 pieces of biscuits a day was carried out for 60 d. The biscuits provided are biscuits used by the Ministry of Health as supplementary food for wasting under five children. The nutrient composition per 12 pieces biscuit was 540 calories of energy, 16.8 grams of fat, 10.8 grams of protein, and 85.2 grams of carbohydrate, and was equipped with 10 types of vitamins (vitamin A, B1, B2, B3, B6, B12, D, E, K, folic acid) and 7 types of minerals (Fe, Zn, P, Se, Ca, K, Na, I) (17, 18).

In the second group, psychosocial parenting was given directly by psychologists on the topic: 1) Parenting principles 2) Development and stimulation needed to be done by toddlers’ mothers. The material was given in the form of lectures, question and answer, brainstorming, and role play. The provision of psychosocial parenting for toddlers’ parents was carried out in collaboration with Swaparinama Psychology and Management Bureau.

Data type and collection methods. The collected data included 1) Height of the children was measured using a microtoice with 0.1 cm accuracy, measured before and after treatment; 2) Cognitive development was measured using Denver II Test modified before treatment and 2 mo after treatment was given (19); 3) Other supporting data included: maternal education and occupation status, and morbidity rate obtained by interview using questionnaire which were carried out before treatment.

Statistical Analysis. Data of height for age (Height/Age) indicator was calculated based on Z-score using WHO 2005 standard (20). Development data was assessed based on suitability between children’s development level and age.

In order to identify the treatment effect on height and development was analyzed by paired t-test, while in order to identify the difference in height and development between treatment groups was analyzed by analysis of variance (ANOVA). Statistical analysis is performed using parametric tests because the normality test showed that data is normally distributed.

RESULTS

Sample overview

The total sample of 30 children was distributed into 3 groups, each of 10 children. When the intervention was given there were 2 children dropping out due to moving house, therefore the total sample until the end of the study amounted to 28 children. Data of mother characteristics based on education and occupation levels showed that 42.9% had basic education, namely
Table 1. Characteristics of mother and children.

| Characteristics         | Category       | Group 1 Biscuit Program | Group 2 Parenting Program | Group 3 Combined Biscuit and Parenting |
|-------------------------|----------------|-------------------------|---------------------------|----------------------------------------|
|                         |                | n | % | n | % | n | % |
| Mother Characteristics  |                |   |   |   |   |   |   |
| Education               | 1. Elem and JHS | 3 | 37.5 | 4 | 40.0 | 5 | 50.0 |
|                         | 2. SHS and HE   | 5 | 62.5 | 6 | 60.0 | 5 | 50.0 |
| Occupation              | 1. Not working  | 6 | 75.0 | 10 | 100.0 | 9 | 90.0 |
|                         | 2. Working      | 2 | 25.0 | 0 | 0.0 | 1 | 10.0 |
| Children Characteristics|                |   |   |   |   |   |   |
| Gender                  | 1. Male         | 3 | 37.5 | 5 | 50.0 | 3 | 30.0 |
|                         | 2. Female       | 5 | 62.5 | 5 | 50.0 | 7 | 70.0 |
| Age Group               | 1. 12–23 mo     | 1 | 12.5 | 1 | 10.0 | 0 | 0.0 |
|                         | 2. 24–35 mo     | 7 | 87.5 | 9 | 90.0 | 10 | 10.0 |

Table 2. Mean height and height for Age Z Score before and after treatment.

|                  | Height (cm) | Height-for-age Z score |
|------------------|-------------|------------------------|
|                  | Base line   | End trial              | Base line | End trial | Percentage | Percentage  |
|                  | Mean±SD     | Mean±SD                | of change | of change | p value | p value     |
| Group 1          | Biscuit program (n=8) | 77.1±5.90 | 79.7±5.59 | 3.35 | 0.000 | -2.67±0.47 | -2.40±0.71 | 11.25 | 0.292 |
| Group 2          | Parenting program (n=10) | 77.6±5.99 | 81.5±5.76 | 5.02 | 0.000 | -2.83±0.91 | -2.28±0.57 | 24.12 | 0.000 |
| Group 3          | Combined biscuit and Parenting (n=10) | 79.8±3.69 | 82.7±4.00 | 3.63 | 0.000 | -2.25±0.65 | -2.11±0.43 | 6.63 | 0.112 |

Fig. 1. Change in Height Before and After Treatment.
graduating elementary and junior high school and 82.1% did not work. The sample consisted of 17 (60.7%) girls, and 18 (64.3%) aged between 24–35 mo, the data can be seen in Table 1.

Height before and after treatment

In all groups, the mean Height and Height for Age Z Score after increased after the intervention. The highest increase in height was found in the group that received psychosocial parenting which was 3.9 cm (from 77.6 to 81.5 cm) for 2 mo, as well as an increase in the mean of Height for Age Z Score after in the same group which was 0.56 (from $-2.83$ to $-2.28$ SD), data can be seen in Table 2.

Result of bivariate analysis using dependent t test showed that the increase in mean height for the three treatment groups showed a significant difference ($p$ value $<0.001$), see Fig. 1. While the increase in mean Height for Age Z Score was significantly only found in the group that received psychosocial parenting treatment ($p$ value $=0.05$). While in the group that received biscuits and a combination of biscuits and psychosocial parenting showed an increase in Height for Age Z Score but were not strong enough to show significant results (Fig. 2).

Although the analysis of each group between before and after intervention found significant change in height and nutritional status of height based on age, analysis between groups showed that there was no significant change in height and nutritional status of height based on age of the three treatment groups.

Children’s development status before and after treatment

Children’s development status in this study was seen from the presence or absence of developmental delay experienced by children. The delay experienced by children was categorized into $>$ 3 mo, between 1–2 mo, and normal if the children did not experience delay. Before intervention, the biggest developmental delay was found in the group receiving psychosocial parenting and the group receiving biscuits and psychosocial parenting, which was 70% (Table 3).

Of the three groups, the majority of children experienced an increase in development status. The biggest increase was found in the group that received psychosocial parenting, before the treatment there were 7 children (70%) who experienced developmental delay, it decreased to 1 child (10%) who experienced developmental delay after the intervention. The result of statis-
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The results showed that there was a significant difference in the increase in mean height for the three treatment groups (p value<0.001). When viewed further, the increase in height for 2 mo of intervention ranged from 2.6 cm (1.3 cm per month) in the group given only biscuits up to 3.9 cm (1.95 cm per month) in the group given psychosocial parenting.

The mean increase in height achieved by the sample in this study had exceeded the mean increase in height according to WHO standard for ages 12–36 mo, which is 0.85 cm per month (20). However, if seen based on Z score of Height/Age, a significant change was only found in the group that received psychosocial parenting treatment (p value=0.05). The increase in height in the group given biscuits in this study was lower than the other groups due to the low compliance factor in consuming biscuits so that the nutrient intake obtained was not in accordance with the recommended adequacy.

The analysis result of each group between before and after intervention found an increase in toddlers’ development, however the analysis result between groups showed that there was no significant difference in development increase in the three treatment groups.

**DISCUSSION**

Data of occupation status of toddlers’ mothers showed that 89.3% were housewives who did not work out of their house, and 42.9% of pregnant women had low level of education (the highest education level was junior high school). Mothers who do not work are expected to have plenty of time to take care of their children, however the low level of maternal education does not guarantee that sufficient time is used properly for the purpose of improving nutrition and health for children (21, 22).

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Result of the study by Pusparini et al. (23) in Bogor Regency, West Java, showed that children with stunted from birth had the opportunity to pursue the best catch-up growth at the age of 0–6 mo and if the children failed to reach the optimal growth within that range, it would be difficult to achieve normal nutritional status. According to Victoria et al. (24), growth is a continuous process that occurs in each phase of life, if there is a growth disruption in one phase it will have an impact on further growth if it is not balanced by catch-up growth. Height increase in this study was quite great but had not been able to change the nutritional status of toddlers. This is because the sample in this study was toddlers with stunting criteria (Height for Age Z Score <-2 SD) and aged over 1 y. Therefore, it is necessary to give supplementary food at an early age that is >6 mo when the children growth rate is faster. Moreover, it takes longer to get a significant change in nutritional status. In line with Nurina’s research result (25) in Karawang Regency, West Java, giving supplementary food in the form of complementary feeding biscuits to toddlers, change in nutritional status based on Height/ Age index significantly occurred in the third month of supplementary food provision.

The development status of children in this study had increased, before the intervention it was found 53.6% of children experienced developmental delay, while after the intervention it dropped to 17.9%. Significant developmental improvement was found in the group that received psychosocial parenting and the group given biscuits accompanied by psychosocial parenting. This result is in line with the research of Khomsan et al. (15) in Indonesia which proved that low cognitive development was found in children under five with low psychosocial parenting. Likewise, a research in Brazil (14), showed a positive correlation between psychosocial parenting and cognitive development scores.

Cognitive formation in children occurs gradually starting in the womb until the age of a toddler, followed by the process of maturation of physiological functions. Children can coordinate hand and foot movement after the nerves and muscles of the organ have well developed. Many factors influence intelligence naturally which is derived from parents, obtained from learning process, or stimulated by the environment (26). Psycho-

| Group                          | Development Status | n  | %   | p value |
|--------------------------------|--------------------|----|-----|---------|
| Biscuits                       | Increasing         | 3  | 37.5| 0.739   |
|                                | Decreasing         | 3  | 37.5|         |
|                                | Unchanged          | 2  | 25.0|         |
| Psychosocial Parenting         | Increasing         | 8  | 80.0| 0.010   |
|                                | Decreasing         | 0  | 0.0 |         |
|                                | Unchanged          | 2  | 20.0|         |
| Biscuits and Psychosocial Parenting | Increasing | 6  | 60.0| 0.027   |
|                                | Decreasing         | 1  | 10.0|         |
|                                | Unchanged          | 3  | 30.0|         |

Table 4. Statistical analysis result of children’s development status before and after treatment.
social parenting is a determinant of cognitive development factors, because it can provide an overview of the mother’s interaction, response, and emotions to the children, whether or not there is a gift or praise for the children’s good behaviors, restriction on behavior or punishment for wrongdoing by children, provision of physical environment and material to play and learn, and mother’s involvement in providing care that supports the children to learn (27).

The relationship of psychosocial parenting with cognitive development in children aged 3 y shows that 3 of the 8 subscales, namely learning stimulation, language stimulation, and academic stimulation have a significant relationship with children’s cognitive development. The learning stimulation carried out by parents is to provide tools for children to play and learn, language stimulation is the ability of parents to teach children to recognize letters, say words, and give children the opportunity to talk, while in academic stimulation, parents teach children about differences in color, dimensions, and numbers and teach children to sing.

The conclusion of this study is the provision of multiple-nutrient biscuits accompanied by psychosocial parenting significantly increases toddlers’ height, status, and development. Based on the conclusion, in order to overcome the problem of children growth and development, nutritional intervention needs to be carried out by being balanced with the provision of education about maternal parenting to children.

Disclosure of state of COI
No conflicts of interest to be declared.

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Statement of ethics
In this study, parents signed an informed consent as their agreement to be the subjects. The research protocol has received approval from Ethics Commission of Bandung Health Ministry of Health Polytechnic.

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