

F100-BASED COMPLEMENTARY FEEDING AND LOCALLY MADE FLOUR TO UNDERWEIGHT TODDLERS

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ABSTRACT

Background: The prevalence of undernutrition is relatively higher than malnutrition. Undernutrition is a combination between inadequate nutrition intakes and infectious diseases. Problems of undernutrition can be overcome through the provision of a proper diet to increase weight. WHO has recommended F100 formula as complementary feeding for a quick weight gain in toddlers suffering from acute malnutrition.

Objective: The aim of this study was to know the influence of consumption F100 that be applied by adding carbohydrates food from local ingredients modifications as complementary feeding for underweight toddlers.

Methods: This research adopts quasi experimental pre-post test with control group design. It was conducted in 3 districts in South Tangerang Regency, Banten, Indonesia. There were 2 groups divided in research which were 40 as a treatment/experimental group and 33 as a control group. Data processing and data analysis were carried out using paired t test, and changes in treatment and control groups were tested using T-test independent.

Results: The results showed, there was difference with Weight changes ($p < 0.00$), Height changes ($p < 0.00$) and Z score index W/A ($p < 0.15$), W/H ($p < 0.01$), and H/A ($p < 0.02$) between the treatment group and the control group.

Conclusion: F100 (liquid) or Modified F 100 with locally made flour are used as a complementary feeding for solve the acute malnutrition in children

Keywords: underweight toddlers, consumption F100, complementary feeding, locally made flour, z score index.

INTRODUCTION

Problems of undernutrition in Indonesia haven't shown significant improvement (Loret de Mola C et al, 2014). According to Riskesdas report in 2013, there were considerable increase in the prevalence of underweight toddlers from 17.9% in 2010 to 19.6 % in 2013, while prevalence of stunted toddlers mounted up from 35.6 % to 37.2 % at the same period. Problems of undernutrition, either underweight or stunted toddlers could be used as an indirect measurement of life quality of its society, as well as a basic planning and policy development of country's welfare program. Furthermore, prevalence of stunted and underweight toddlers is a key indicator of future food security information system on national and international level. Underweight toddlers have a high risk of health degradation status, considering that they need adequate nutritional needs during their stages of growth and development. Inadequate nutrition lead to vulnerability to infectious diseases that would interfere nutrients absorption and reduce appetite. Therefore, it could be stated that nutritional status of the underweight toddlers is a sensitive indicator for their life qualities because it possesses transgenerational effect just like an endless spiral (Lopriore C et al, 2007; Bukania ZN et al, 2014). The prevalence of undernutrition is relatively higher than malnutrition. Undernutrition occurs due to substantial imbalance between energy needs and energy as well as nutrients consumptions, causing cumulative macro and micro nutrients deficiency that negatively affects growth, development, and other health aspects. In other words, undernutrition is a combination between inadequate nutrition intakes and infectious diseases. Undernutrition is determined by a Z-score: extremely underweight if the Z-score is less than -3, underweight if Z-score is higher than or equal to -3 and less than or equal to -2, normal if Z-score is higher than -2 and less than or equal to 2, and overweight if Z-score is higher than 2 above the median standard of the World Health Organization (WHO) for children aged 6-59 months (Kouam C et al, 2014).

Several studies in other countries reported that mortality happened frequently for children under-five suffering undernutrition compared to those with normal weight (Olofin I et al., 2013). The main factor that caused undernutrition among children under 2 years of which is the inadequate intake of complementary feeding/weaning in terms of both quantity and quality. WHO and United Nations Children's Fund (UNICEF) have committed to improve the quality of feeding behavior to toddlers in order to achieve optimal growth, development, and health (Fekadu Y et al, 2015). Moreover, freedom from hunger is a fundamental right of all human beings, including children (UNICEF, 1990). Problems of undernutrition can be overcome through the provision of a proper diet to increase weight. A relatively inexpensive, practical, safe, and high nutrient food administration are among strategies to improve catch-up growth on stunted toddler. WHO has recommended F100 formula as complementary feeding for a quick weight gain in toddlers suffering from acute malnutrition (Sethuraman Kavita et al, 2014). Each 100 cc F100 formula contains 100 calories, 3.8 g protein, 7 mg zinc, 7.5 mg magnesium, 60 mg potassium, and 0.9 mg copper. Unfortunately, the disadvantage is its liquidity, whereas the thickened one could generate more energy as well as not only useful as a meal for malnourished children in transition phase, but also works interchangeably as a main dietary meal at the age of 6-8 months and as a complementary feeding for children above 8 months. F100 provision is very excessive at times. It would be better to utilize it, for example by thicken it up. In addition to produce more energy, its consumption also tend to be flexible either as a meal for malnourished children in transition phase, main dietary meals for infants aged of 6-8 months, or complementary feeding for children above 8 months. Energy augmentation through F100 formula administration could be applied by adding carbohydrates food, particularly those derived from local ingredients. Among the local food stuffs that could be used as source of energy are corn, sweet

potato, and cassava. Selection of these food stuffs is constituted by their abilities to grow in all types of land, including on a dry land. However, consumption of F100 or its modification as a complementary feeding for undernourished toddlers still need to be further analyzed, making it easier for health professionals/health care practitioners to find prevention and solution alternatives for undernutrition problems.

MATERIALS AND METHODS

Research Subject

This research adopted quasi experimental pre-post test with control group design. It was conducted in 3 districts in South Tangerang Regency, Banten, Indonesia namely Pamulang, Serpong, and North Serpong Districts. Basis for sample selection was undernourished children who had met inclusion criteria which were undernutrition status (underweight and extremely underweight) based on weight to height parameter, possess no prior complication diseases, both infectious and non-infectious diseases; registered and participated in weighing at posyandu; lactose tolerant, non-allergic to cow's milk, and willing to sign the inform consent. Exclusion criteria were uncooperative parents and ill children.

Sample Size Calculation

Error analysis refers to research of Lamid, Irawati, and Arnelia (2012) by referring to 5% α ($Z \alpha = 1,960$), 90% β ($Z \beta = 1.282$), standard deviation of Z-score (1.30), and desired average changes in Z-score was 0.6, thus obtained minimum number of samples for each group was 25 people. This amount was summed up with drop out estimation as much as 20% or equals to 5 people. Hence, minimum total sample for each group was 30 people.

Data Collection

Collected data were anthropometric data consisted of W/H, W/A, and H/A, consumption data, other supporting data such as characteristics of children and parents, social and economic data, respondent's past medical history, breastfeeding history, and data of first weaning food administered to toddlers. Height data were obtained using infantometer with 0.1 cm precision and weight data acquired using foot tap digital scale with a precision of 0.1 kg.

Research implementation

Research was conducted from August to October 2015. Selection of the sample was assisted by official and 4 enumerators from D4 Gizi program's fresh graduates of Politeknik Kesehatan Jakarta II. Prior to be specified as selected samples, all prospective samples that met the criteria were gathered to be clearly informed about potential interventions, duration, and types of measurement, then were asked to sign the informed consent stating their willingness as well as awareness to potential risks.

Data Analysis

Data processing and data analysis were carried out using Statistical Package For Social Science (SPSS) program ver: 17 for Windows. Nutritional status based on W/H and W/A Z scores were calculated using WHO Antr 2005 software. Meanwhile data of formulation and food intakes were analyzed using nutrisurvey 2005 program. Data were analyzed using descriptive statistics to observe illustration of characteristic, energy intake and nutrients, as well as contribution of complementary feeding and nutritional status. Z score difference before and after the test was calculated using paired t test, and changes in treatment and control groups were tested using T-test independent.

Intervention And Monitoring

Experimental materials were F100-based instant complementary feeding and enriched with locally made flour. F100 were purchased from PT. Bogor, and complementary feeding was formulated by researcher and produced by Laresso catering located in Pamulang.

F100 base contains skim milk, vegetable oil, granulated sugar, and complex minerals comprised of potassium chloride, potassium citrate, magnesium chloride, zinc acetate, and copper sulphate. While instant pulverized foods were thick paste made from milk powder, sugar, and oil diluted in to the water, then boiled and added with locally made flour products (corn starch, cassava starch, sweet potato starch). There are two groups in this research, namely a treatment/experimental group and a control group. Treatment group acquired 2 cups of F100-based instant complementary feeding that was thickened using either corn starch, cassava starch, or sweet potato starch containing 324 energy calories, 6 gr proteins, and vitamins, whilst control group was provided with 2 sachets of F100 containing 200 kcal, 6 g protein, and minerals. Complementary feeding interventions were expected to contribute up to 20-25% of toddler's needs towards energy fulfilment. Composition of F100-based complementary feeding and locally made flour for treatment group and F100 for control group could be seen in Table 1.

Table 1: Nutritional values of treatment and control groups (F100)

Nutrients	Treatment group	Control group (F100)
Energy (kcal)	324	200
Protein (g)	4.5	6
Fat (g)	18.3	12
Carbohydrate (g)	42.9	16
Fiber (g)	0.8	
Calcium (mg)	138.65	
Phosphor (mg)	144.82	
Iron (mg)	0.8	
Natrium (mg)	90.35	
Kalium (mg)	283.23	
Total carotene (ug)	108.3	
Zinc (mg)	8	14

Treatment group acquired 2 cups every day within 30 days which were directly sent to respondent's house. Whereas control group was provided with 12 sachets at once per week. To monitor respondent's compliance, they were visited once a week to gather information regarding their compliance, as well as asked about toddlers' current health conditions e.g. diarrhea, frequency of bowel movements, etc. Additionally, anthropometric measurements that includes weighing, height measurement, and nutritional status measurement (underweight, wasting, and stunting) were also conducted. By the time mother received food formula, she should return the cups and report her compliance, also noted on the form of compliance. Form of compliance were filled out every week and submitted at the time research assistant performed anthropometric measurement.

RESULTS

Initially, 4100 children under five years old (toddlers) of posyandu participants from 3 districts: Pamulang, Serpong and North Serpong were chosen. Following screening process based on undernutrition status using W/H parameter with Z score > -2 SD, 106 toddlers with undernutrition cases were found. Screening was conducted based on age limit under 5 years old until October 2015 and undernutrition status. Out of 106 undernourished toddlers reported by officials, only 76 children were actually fit into the category (undernutrition status) after re-weighing. Mothers and children caretakers were then gathered and given an explanation about potential intervention, as well as asked their willingness to follow the nutrition improvement program. Only 73 respondents agreed to do so. This number was then divided into 2 groups, which were 40 as treatment/experimental group and 33 as control group. During a month treatment turned out there were 4 people from treatment group and 3 people from control group resigned due to migrating parents and due to absent from the last anthropometric measurement. Further details could be seen in Figure 1.

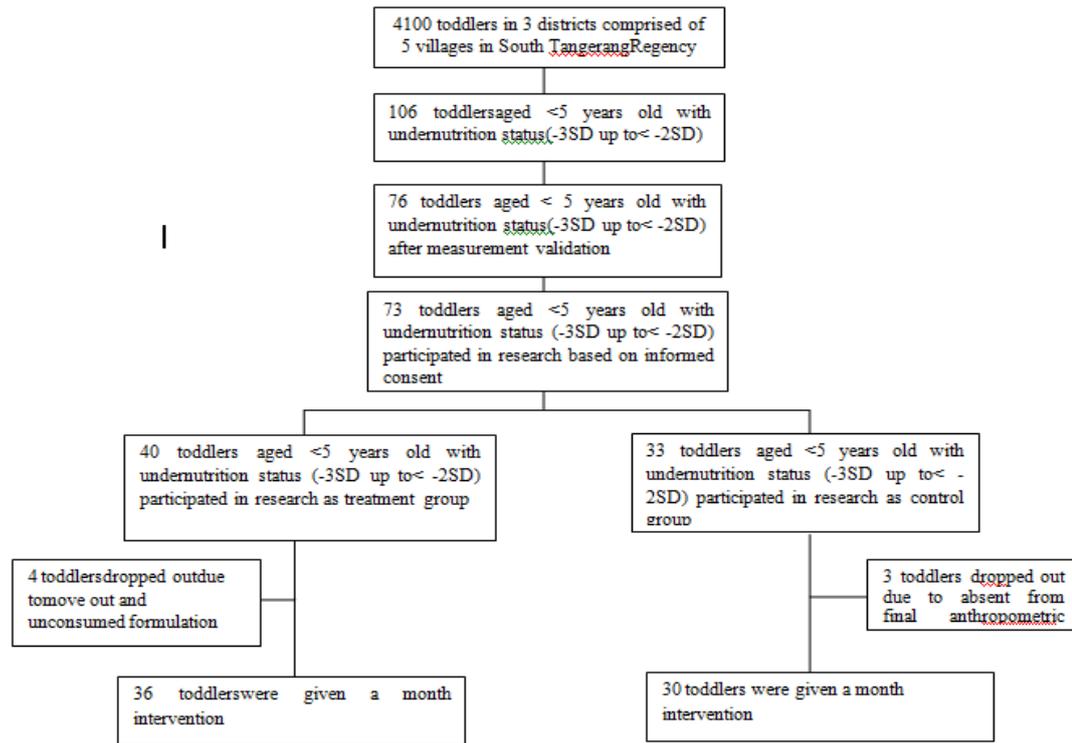


Fig. 1: Flow diagram of identified subject

Table 2: Toddlers' Basic Characteristic Data of Treatment and Control Groups

Characteristic	Treatment Group (n=36) (%)	Control Group (n=30) (%)	p value
<i>Sociodemography</i>			
Age (months)			0,10
• 6-12 months	11.1	3.3	
• 13-24 months	25	36.7	
• 25-29 months	63.8	60	
Sex			0,13
• Female	52.8	51.4	
• Male	47.2	29.7	
At term birth			0,01
• 9 months	83.3	93,3	
• ≥ 9 months or ≤ 9 months	16.7	6,7	
Birth weight			0,11
• Thin (< 2500 g)	16.7	3,3	
• Normal (2500 – 3500 g)	75	96,7	
• Heavy (> 3500 g)	8.3	0	
Birth order			0,125
• First child	47.2	53,3	
• Second child	38.9	43,3	
• Third child	13.9	3,3	
Breastfed children	22.2	43,3	0,01
Weaning food administration (%)			
• < 1 month	2.8	0	
• ≥ 1- < 6 months	44.4	20,0	
• ≥ 6 months - 1 year	52.8	60,0	
Complete immunization	80.6	100	0,00
Children with Posyandu routine	80.6	100	0,00
Children with sickness in the last 3 months	69.4	26,7	0,49
<i>Children nutritional status</i>			
Weight (kg) (mean+SD)	9,45 ± 1,687		0,53
Height (mean+SD)	85,1 ± 8,30		0,51
% stunting on first visit	16,7	3,3	0,19
% wasting on first visit	100	100	0,16
% underweight on first visit	52,8	73,3	0,61

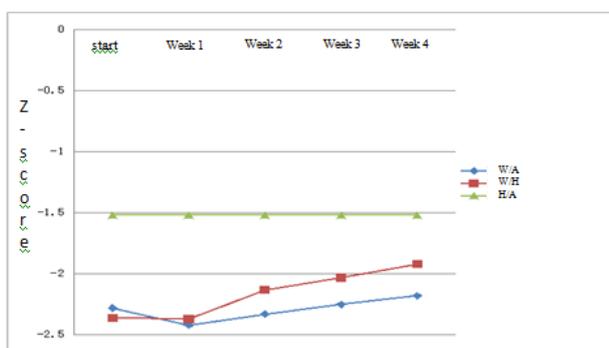
Characteristic of Research Subject

Tabel 2 showed the characteristics of treatment group and control group. Most samples (> 50%) of both the treatment group and the control group were female, 25-29 months old, and normal birth. Characteristics that appear different from the two groups were a treatment group have a habit of drinking milk, complete immunization, and regular went to posyandu better than control groups which was 43.3%, 100% and 100%, respectively, while the treatment group was 22.2%, 80.6% and 80.6%. Nutritional status before the intervention did not differ significantly between the intervention and the control group ie the proportion of H / A was 16.3% vs 3.3%, W / A was 100% vs 100%, and W / H was 52.8% vs. 73.3%. For more details can be seen in Table 2.

The intervention efficiency of F100-based complementary feeding and locally made flour to underweight children.

Table 3 showed, after treatment, weight had changes in treatment groups and control groups which was 0.477 kg ± 0.53 and 0.453 kg ± 0.122. There was no height changes for both of groups. The changes about the nutritional status seen significant especially on indicators W/H which increased Z score of 0.283 ± 0.510 and 0.397 ± 0.183 . While in other indicators W/A and H/A Z score wasn't increase significantly.

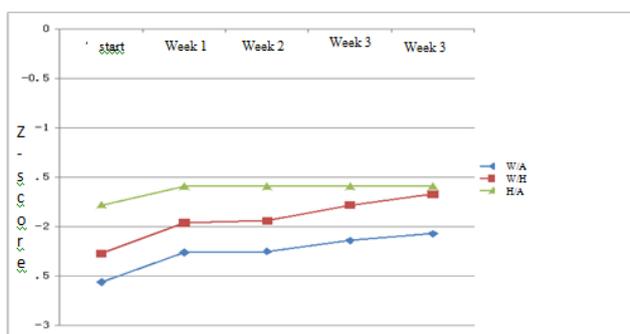
Graphic 1: Z-Score Changes during Intervention on Control Group



Graphic 1 and 2 significantly shows an improvement in nutrition status from the given treatment, as seen from the value of z-score on W/H. While no scores are shown on W/A as well as H/A indicators. When seen in depth, changes occurred differently between solid formula and liquid formula. Where liquid formula shows effective improvement in z-score after the second week of treatment . While

solid formula shows a more consistent pattern of change in improvement ever since the first week of treatment delivery.

Graphic 2: Z-Score Changes during Intervention on Treatment Group



DISCUSSION

Adequate food compliance is among key factors that prevents morbidity and mortality risks especially for children under 3 years old (Penny ME *et al* 2005). Children undernutrition does not solely happen due to lack of food consumption, but also caused by parenting mothers, particularly in the course of feeding practices to infants and children. Their ignorance are mostly about children's growing needs in accordance to growing age, therefore it is very essential to pay attention to its compliance, both in the aspects of quantity and administration frequency (Harbron J *et al.*, 2013). The core research aimed to assess whether complementary feeding between main meals time as much as 200-300 liquid (F100) and solid (modified local foods coupled with milk, sugar, and oil) calories could improve nutritional status of children aged 6-35 months of extremely low and low income families. Findings had shown that complementary feeding in liquid and solid forms equally possess weight gain effect and improve children nutritional status. It corresponds to several previous studies pointing that treatment group who was provided with milk, sugar, and oil-based liquid food has higher effectiveness in weight gain and nutritional status improvement. A study in Malawi administering food intervention as much as 75 kcal/kg per day for 12 weeks reported that oil-based additional food increase higher weight gain than complementary feeding that is derived from locally made flour (Achatia-Armah, RS; *et al* 2015). Result of this study was somewhat different to common research. Complementary feeding interlude in liquid form which was formula F100 with twice administration periods contains only 200 calories, and solid food which was solid formula from local ingredients (corn/cassava/sweet potato) with additional milk, sugar, and oil with twice administration periods within a month contains 300 calories found out to be able to increase weight gain and improve nutritional status of the undernourished. However, even though complementary/additional feeding in liquid form which was Formula 100 (F100) had less effect in increasing weight gain compared to solid food, it could improve undernutrition status relatively higher. It corresponds to some researchers who claimed that instant solid foods had a small chance of bacteria exposure because they did not require some processing prior to consumption. Nevertheless, they had higher viscosity value that caused longer process in the gastrointestinal tract, slower gastric drainage, and causing children to feel full rather longer compared to complementary feeding in liquid form (Marciani *et al* 2000 and L.Anchor *et al* 2001). Thus, the administration of feeding in liquid form would not interfere main dietary intake that was close to complementary feeding time. It was in line with an argument that key recovery of malnourished children ain't replacing regular intake, but rather enhancing the commonly consumed food intake. Other studies also reported that recovery success of the undernourished toddlers would be more effective if complementary feeding administration was combined with counselling to children caretakers and/or parents (Nikema *et al.* 2014). It was in line with research of Phuka *et al* 2009, mentioning that complementary feeding administration to undernourished children in rural areas could only improve nutritional status based on W/A and W/H, but did not cover nutritional status improvement based on H/A (Phuka,JC *et al.*, 2008). The difference only showed in the age range. Phuka's research observed children aged 6-18 months, while this research observed children with age range of 6-35 months. Other causes that were suspected to prompt invisible height gain was that possibly due to intervention period which was only performed for 30 days. Saleem *et al* 2014 reported that height changes was visible and stunting problems were recovered through complementary feeding administration in a longer period (at least 70 days) (Saleem *et al.*, 2014).

Conflict Of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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REFERENCE

- Achour L; MeÅance S; Sand Briend A, Original Communication. Comparison of gastric emptying of a solid and a liquid nutritional rehabilitation food. *European Journal of Clinical Nutrition* 55, 769-772, 2001.
- Ackatia-Armah, RS, MM Donald C; Doumba,S; Erhardt JG; Hamer DH; dan Brown H K: Malian children with moderate acute malnutrition who are treated with lipid-based dietary supplements have greater weight gains and recovery rates than those treated with locally produced cereal-legume products: a community – based , cluster eandomized trial : *AM. J. Clin NUtr.*; 101:632-45, 2015.
- Bukania ZN, Mwangi M, Karanja RM, Mutisia R, Kombe Y, Kaduka LU, et al. Food Insecurity and Not Dietary Diversity Is a Predictor of Nutrition Status in Children within Semi-arid Agro-Ecological Zones in Eastern Kenya. *J Nutr Metab* [Internet]. Hindawi Publishing Corporation; 2014;2014:907153. Available from: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4195253&tool=pmcentrez&rendertype=abstract>
- Briend A, Akomo P, Bahwere P, Pee S De, Dibari F, Golden MH, et al. Developing food supplements for moderately malnourished children : Lessons learned from ready-to-use therapeutic foods. 2015;36(1):54–9. www.cmamforum.org/.../Dev-food-suppls-for-MAM-lessons-from-RUTF-FNB-2015.
- Fekadu Y, Mesfin A, Haile D, Stoecker BJ. Factors associated with nutritional status of infants and young children in Somali Region , Ethiopia: a cross-sectional study. *BMC Public Health* [Internet]. BMC Public Health; 2015;1–9. Available from: <http://dx.doi.org/10.1186/s12889-015-2190-7>
- Harbron J, Booley S, Najaar B, Day CE. Responsive feeding: establishing healthy eating behaviour early on in life. *S Afr J Clin Nutr* ;26(3) :S141-149, 2013.
- Kouam C, Delisle H, Ebbing HJ, Israël A, Salpéteur C, Aïssa M, et al. Perspectives for integration into the local health system of community-based management of acute malnutrition in children under 5 years: a qualitative study in Bangladesh. *Nutr J* [Internet]. 2014;13(1):22. Available from: <http://www.nutritionj.com/content/13/1/22>
- Lopriore C, Dop M-C, Solal-Céligny a, Lagnado G. Excluding infants under 6 months of age from surveys: impact on prevalence of pre-school undernutrition. *Public Health Nutr* [Internet]. 2007;10(1):79–87. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17212846>
- Loret de Mola C, Quispe R, Valle GA, Poterico JA. Nutritional Transition in Children under Five Years and Women of Reproductive Age: A 15-Years Trend Analysis in Peru. *PLoS One* [Internet]. 2014;9(3):e92550. Available from: <http://dx.plos.org/10.1371/journal.pone.0092550>
- Marciani L, Gowland PA, Spiller RC, Manoj P, Moore RJ, Young P, Al-Sahab S, Bush D, Wright J & Fillery-Travis AJ: Gastric response to increased meal viscosity assessed by echo-planar magnetic resonance imaging in humans. *J. Nutr.* 130, 122 ± 127, 2000.
- Nikema L; et al; Treating moderate acute malnutrition in first line health services: an effectiveness cluster – randomized trial in Burkina Faso; *Am. J. Clin Nutr.*: 100:241-249, 2014.
- Olofin I, McDonald CM, Ezzati M, Flaxman S, Black RE, Fawzi WW, et al. Associations of suboptimal growth with all-cause and cause-specific mortality in children under five years: a pooled analysis of ten prospective studies. *PLoS One* [Internet]. 2013;8(5):e64636. Available from: <http://www.scopus.com/inward/record.url?eid=2-s2.0-84878471170&partnerID=tZ0tx3y1Penny> ME; Creed Kanashiro HM, Robert RC; Naro MR; Caulfield LE; Black RE;; Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children a cluster – randomized controlled trial; *Lancet* ; 365; 1863-72, 2005.
- Phuka,JC, Maleta,K, Thakwalakwa,C. et al. 2008. Complementary feeding with fortified spread and incidence of severe stunting in 6 to 18 month-old rural Malawians. *Arch. Pediatr. Adolesc. Med.*, 162, 619-626
- Saleem AL; Machmud S; Ansari NB; Zaidi AKM; Impact of maternal education about Complementary Feeding on Their Infants Nutritional Outcomes in Low and Middle income Households: A community –based randomized Interventional Study in Karachi, Pakistan; *Journal Health Popul. Nutr Dec* 32(4): 623-633, 2014.
- Sethuraman Kavita, Doledec David, Begum Ferdousi, Zahidul MM. 2014. Managing Acute Malnutrition: A Review of the Evidence and Country Experiences in South Asia and a Recommended Approach for Bangladesh. Washington DC:FANTA.
- Stevens GA, Finucane MM, Paciorek CJ, Flaxman SR, White RA, Donner AJ, et al. Trends in mild, moderate, and severe stunting and underweight, and progress towards MDG 1 in 141 developing countries: a systematic analysis of population representative data. *Lancet* [Internet]. Elsevier Ltd; 2012;380(9844):824–34. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0140673612606473>. (tidak ada di jurnal)
- UNICEF. Strategy for Improved Nutrition of Children and Women in Developing Countries. UNICEF Policy Rev. 1–38, 1990.