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**Food Supplementation, Psychosocial Stimulation and Nutritional Status of Indonesian Children:
The Tanah Datar – West Sumatera Nutrition and Cognitive Development Study**

Helmizar Helmizar[#]

[#] *Departement of Nutrition Faculty of Public Health Andalas University of Padang-25129 Indonesia
E-mail: eelbiomed@gmail.com*

Abstract : The purposes of the study were to evaluated the effect of food supplementation and psychosocial stimulation based on local cultured on growth and nutritional status of children. This study setting was in Tanah Datar District West Sumatera Province Indonesia and the participants amount were 355 infants aged 6 to 9 months at beginning of the study. The children were divided into 4 groups: food supplementation group (F-group), psychosocial stimulation (P-group), food and psychosocial stimulation group (FP-group) and control group (Control). The intervention group received food supplementation *MP-ASI* with local product about 250 to 300 kcal and 6 to 8 gram protein dayly and psychosocial stimulation *Manjujai* based on local culture approach every weeks. After six month of intervention, the children in F-group had significantly increased length $6.86 \text{ cm} \pm 2.08 \text{ SD}$ and for children in FP-group increased $6.66 \text{ cm} \pm 2.41 \text{ SD}$. There was significant in difference Z-score weight for height of nutritional status after six month of intervention are FP-group ($P < 0.001$). From this studi can concluded that combination intervention food supplementation and psychosocial stimulation had strong effect to improvement children's growth and nutritional status.

Keywords: Food Supplementation, Psychosocial Stimulation, Nutritional Status, Children, Indonesia

I. INTRODUCTION

Undernutrition is a prominent global issue that causes a major threat to health, growth and development of infants worldwide. The Lancet's Series on Maternal and Child Undernutrition reported that there is still a high prevalence of child growth disorders, especially in developing countries (WHO,2010). The Basic Health National Survey in Indonesia showed an average of 37,2% of stunting in children under five years of age and 36% of chronic malnutrition in West Sumatera Province (MOH,2013). Nutritional problems that have been experienced at early childhood does not only increase the risk of infant morbidity and mortality, but also will affect long-term growth and development of children (Martorell R et al,2002). Less than two year of age is a period of life that undergoes rapid growth and development of children (Dewey et al, 2011). The period from pregnancy through the first 24 month of life is recognized as a "window of opportunity" for improving child nutrition. Most of the growth faltering happens in the first two years of life, and low birth weight contributes to early faltering. Early life interventions to prevent growth failure and support optimal growth in children is crucially needed (Victora CG et al, 2010).

Both nutritional supplementation and psychosocial stimulation have been conducted in Indonesian children. This study concluded that complete intervention is more effective with social emotional, mental and psychomotor development (Herawati, 2005; Yuliana, 2007). Impact of nutritional supplementation and psychosocial stimulation for growth and development of children still inconsistent until now. There no intervention study with nutritional supplement and psychosocial stimulation base on local culture approach have conduct for infants in West Sumatera Province now. The aim of this study is to investigating the effect of nutritional supplementation and psychosocial stimulation base on local culture approach on growth and development of infants 6 – 9 months of age in West Sumatera province.

II. THE MATERIAL AND METHOD

A. Study design and Subjects

A cluster-randomized control trial was conducted between January until December 2013. The study was conducted in Tanah Datar Distric in West Sumatra Province Indonesia with a high prevalence of stunting in infants 6 – 12 month of age as assessed by the preliminary study. The locations had chosen based on the include criteria; it is located at the central culture of Minangkabau ethnic in West Sumatra Province. The final selection of the study area was choice based on household's from low and middle socio economic status, demographic characteristics, as well as accessibility of the area.

Detail criteria for subject have been described elsewhere. We included infants aged 6-9 months at the start of the study who were apparently healthy, predominantly breast-fed, did not have symptoms of chronic or severe illnesses, severe clinical malnutrition or congenital abnormality. The infants who were low birth weight or growth faltering still included in this study which more intention in the intervention. The sample size was taken are 54 infants calculated 1.5 desain effect for cluster randomized desain, the total sample size is 81 for each group intervention. When taking into account a dropout of 10%, the total sample size for four groups intervention are 356 infants was calculated using sample size formula hypothesis testing between two means (Lemeshow, 1990).

B. Intervention

At the first step, the mothers or caregivers of each infant was invited to Community Health Center together the identification card. They have been received explanation of the purpose of the study as well as the study procedures. Weight and length of the infants was assessed and mothers will be interviewed on characteristics of parents, socio-economic status, health status, food intake and lactation habits. Further, assessment of mental and motoric development is done by using The Bayley Scale of Infant Development, Third edition (BSID-III) and assesment of quality of psychosocial stimulation using the Infant HOME inventory (Bradley and Cadwell, 1984).

Parenting class is provided for teach mothers or caregivers being responsive to their infants to give psychosocial stimulation, in order to promote child development. The parenting class was conducted every weeks in center of early children education or center integration services in each village. Research assistance and community health worker was teach mother or caregiver of infants in stimulation group about material psychosocial stimulation *Manujjai* by using a semi-structured curriculum for psychosocial stimulation that

have been prepared for this study. This parenting class for stimulation of infants is available at least twenty four times along six month intervention of the study.

At intervals of one week, the research assistants and community health workers will visit each infant to monitor compliance and encourage the mother or caregivers of infant by giving psychosocial stimulation *Manujai* at home. Monitoring compliance intake of local MP-ASI and *Manujai* in each day infants will be conducted intensively using a form monitoring at the first month intervention. At each visit, the community health worker will reinforce the importance of stimulation *Manujai* of infants and explain about daily consumption and correct preparation of complementary food. At monthly follow-up, anthropometrics will be assessed as well as possible adverse effects of intervention. HOME assesment will be conducted for monitoring quality of psychosocial stimulation at home and follow-up three months after intervention. After 180 days of intervention, baseline measurements will be repeated.

Food Supplementation:

The product for complementary food will develop in collaboration with Department of Nutrition the Polytechnic of Health (Poltekkes) Ministry of Health Padang. A preliminary study was conducted in 2010-2011 using two approaches: 1) Development of the complementary food source of locally contain; 2) Pilot testing in infants and children (Estuti et al, 2010; Gusnedi et al, 2011). We also conducted trial again to find formula local complementary feeding (Local MP-ASI) by optimal composition of nutritional obtained from previous experiments. Trial manufacture of formula local MP-ASI will be adjusted with the habit of making infant food in location West Sumatra society. This experiment consists of three kinds of formulas will be tested as a treatment and its acceptance by the mother and child. These three kinds of formula local MP-ASI are containing wheat red sweet potatoes, purple sweet potatoes, red rice, red bean, green bean, soy bean and *mujair* fish. All of this formula is also mixed with cooking oil and sugar or salt added such that the obtained three formula MP-ASI milk protein iso-and iso-caloric. The three formula will be used as a slurry with the addition of water, so as to meet the ideal criteria of the WHO in terms of energy density, pH, and viscosity (thickness) it. Viscosity formula will be measured by using a rotation viscosimeter RV no.4 at 50 rpm (40 ° C) and pH formula will be measured using Accumet pH-meter. The nutritional composition will analyses using Nutri Survey Programme and list nutritional composition of local food. The Three formula will be tested to the mother and child to determine acceptability.

During the intervention study, the formula also supplied basen on standard composition of nutrition needed by breastfed infants 6 – 12 months. Each packet the formula provided about 200 - 250 kcal of energy and 6 - 8 gram of protein. The three kinds of formula are provided for infants 6 – 8 months of age, 9 – 11 months of age and more 12 months of age with standart composition of nutrition recommended (WHO/UNICEF,2009). One packet formula red sweet potatoes, purple sweet potatoes, red rice, red bean, green bean, soy bean and *mujair* fish contained 50 g of complementary food was provided for infants below 12 months of age . A guiding hand book for mothers or caregivers also preparing in administering how to prepare the supplementary food and other information about complementary food for infants at home.

Psychosocial Stimulation:

Psychosocial stimulation comprised play session was designed base on traditional plays and songs given to infants in Minangkabau ethnicity. They are played and song to the infants anytime. A hand book Psychosocial stimulation "*Manujai*" included 24 play session mother with infant was designed which is standardised according to task of social emosionl, cognitive and motoric development of children aged 6 – 24 months. The book was designed after discuss with psychologist and antropologist. We also have been developed a semi-structured curriculum that will used for training health worker and community health worker (cadres) in intervention trial. This curriculum contain instrument that will using for intervention for improving skill of health & community worker to teach mother or child giver for psychosocial stimulation at home. This curriculum also contain some material to improve knowledge field worker about growth and development of children and precedure conduct of intervention study. The tranning was conducted for two day effective (16 hours) who teach by reseacher also expertise in parenting and child development. Traned female community health workes conducted play session *Manujai* and parenting class for one hour with every infants and mother on psychosocial stimulation and food supplementation + psychosocial stimulation groups. This was done at at least twenty four times for six month intervention. Mothers or caregiver are expected to practice the play activities *Manujai* at home everyday. Futher more, the field worker was

evaluated the play practised by mothers or caregivers using the form of evaluation every weeks for 6 months of intervention.

C. Measurements:

The following measurements were made at the beginning and the end of the study.

Anthropometry

Two trained research assistants who were graduated Academy of Nutrition Polytechnic of Health in Padang measured anthropometric of all subject. Anthropometric were measurement at baseline (month 0), at middle of intervention (month 3), and at the end (month 6). Lightly clothed were weight without shoes by using an electronic scale with a precision of 0.1 kg. The recumbent length for child <2 y using length board with a precision 0.1 cm. The data antropometry collection under supervision by trained staff using standard techniques as described by Gibson R (2006).

Dietary intake

Dietary intake of infants was assessed by six trained research assistants (nutritionist) by using a 24 hour food recall for all sample of infants at the baseline and the endline. For this, the nutritionist was visit the infants at home on 2 consecutive days and interview the mother on dietary intake of the infant during the previous 24 h. Dietary intake from breastfeeding was not measured in this study. Other nutritional supplementation given by parents will record in the monthly dietary assessment and at final evaluation.

Development Assessment

The cognitive, language and motoric development of infants was assessed by using The Bayley Scale of Infant Development The Third Edition (BSID-III), at the baseline and the end line. Two trained psychologist tester who were blind to the infant's groups. All infants were test in a room in PAUD or Posyandu and the several case the test conducted at infants house who didnot come in PAUD or Posyandu. The Psychologist and partners have collaboration with researcher from Seameo-Recon Jakarta . All items in the Bayley III instrument have been translate in Indonesia language and the testing under supervision by a Psychologis consultant.

D. Ethical Approval:

The study protocol was approved to the Ethical Committee of the Faculty of Medicine at Andalas University Padang, Indonesia. Each mother was received an fully explanation about the purpose and the way of research conducted. Oral and written consent was required of every mother for inform concern . Before the study, the research permit will be requested at Faculty of Medicine, University of Andalas of Padang, government at the district and the Village in the District Tanah Datar West Sumatra Province.

E. Statistical Analysis:

The data were analyzed using the SPSS-Win, version 20 (SPSS Inc, Chicago). After data collecting, cleaning and coding, then, processing data entry was conducted by using computerize. The normally distributed data continuous was check for using Kolmogorov-Smirnov test of normality. Baseline characteristics all subject were examined among the treatment groups compared test with subjects who lost to follow-up by using independent sample t-test. The children's antropometric were calculated according to WHO Athro 2005 software. The results are expressed as means \pm SD of Z-score weight for age (WAZ) height for age (HAZ) and weight for height (WHZ) of nutritional status and means \pm SD of score cognitive, language, and motoric of development.

III. RESULTS AND DISCUSSION

A total of 355 infants age 6 – 9 mo were enrolled from 40 cluster in randomised cluster trial at the baseline. Each cluster consist 6 – 12 infants were randomly allocated to Food Supplementation-Group/FG (n = 98) , Psychosocial Stimulation-Group/PG (n = 87), Both FG + PG-Group(n = 96) and Control-Group (n = 74) and all infants in each cluster were get the same of intervention. 84 infants (23%) were lost the final assessment leaving a total 271 infants included in the analysis (Figure 1). The reasons for loss to follow-up were mainly migration out of the residential are refused from parents infants, migrated other town and 1

infant was died cause sick a long of study. The comparable test result was showed there are no significant differences sample infants available in analysis with sample infants was drop outs.

TABLE 1.
PARENTAL AND SOCIO-ECONOMIC CHARACTERISTICS BY GROUP ON ENROLLMENT

Characteristics	F-Group	P-Group	FP-Group	C-Group	P-value
	(n = 72)	(n=59)	(n=69)	(n=71)	
Mother:					
Age (years)	31.09 ± 5.57	30.10 ± 6.32	30.69 ± 6.02	29.93 ± 5.69	0,163
Duration Education (year)	11.79 ± 2.59	10.71 ± 2.93	11.16 ± 3.21	10.65 ± 2.85	0,085
Weight (kg)	53.19 ± 9.62	50.96 ± 7.77	52.92 ± 9.39	51.45 ± 7.98	0,327
Height (cm)	152.93 ± 5.47	153.34 ± 5.5	152.33 ± 6.03	151.81 ± 6.4	0,832
Parity (person)	2.39 ± 1.46	2.39 ± 1.50	2.22 ± 1.07	2.10 ± 1.10	0,531
Father:					
Age (year)	36.44 ± 7.58	34.51 ± 6.70	34.96 ± 5.93	33.88 ± 6.16	0,522
Duration Education (year)	10.56 ± 3.11	9.36 ± 2.96	10.38 ± 3.04	10.32 ± 2.82	0,119
Number of household member (person)	4.85 ± 1.53	4.83 ± 1.85	4.55 ± 1.33	4.35 ± 1.33	0,186
Low socio economic status (%)	54,2	55,9	52,5	60,6	0,778

Et enrollment, there are similar in all of the parental characteristics and socio economic status for each groups (table 1). The average age is 36.24 years the oldest fathers are those of food group and the average age is 29.83 years old the youngest mothers are in the control group. The average length of time the mother's education are the lowest of 10.65 years in the control group, while the average number of family members as a whole is almost the same as the 4.64. All infants for each groups had low socio economic status and more half percent come from control group but not significant difference according to the characteristics of the parents in each group (P> 0.05).

TABLE 2.
INFANT CHARACTERISTICS BY GROUP ON ENROLLMENT

Characteristics	F-Group	P-Group	FP-Group	C-Group	P-value
	(n = 72)	(n=59)	(n=69)	(n=71)	
Age (mo)	7,5 ± 1,18	7,6 ± 1,12	7,6 ± 1,25	7,9 ± 1,26	0,650
Gender (%),					
boys	51,4	47,5	59,4	59,2	0,772
girls	48,6	52,5	40,6	40,8	
Birth weight (kg)	3,15 ± 0,42	3,06 ± 0,42	3,13 ± 0,44	3,03 ± 0,40	0,393
Birth length (cm)	49,26 ± 2,50	47,55 ± 3,30	47,90 ± 3,55	47,93 ± 4,80	0,191
Birth order	2,29 ± 1,40	2,39 ± 1,50	2,26 ± 1,33	2,06 ± 1,10	0,579
Excusive Breastfeeding (%)	43,1	57,6	55,1	39,4	0,096

The characteristics of the groups at the time of the enrollment are shown in table 2. Difference among groups were examined by one way ANOVA, except gender and exclusive breastfeeding, which was compare by chi-square analysis. In each groups, age of infants average 7,6 month and the proportion of boys are more amount of 55.0% except psychosocial group compared to the proportion of girls in the amount of 45.0% at the enrollment. The proportion of infants with exclusive breastfeeding is more in psychosocial groups or about 57,6 % and food supplementation and psychosocial groups or about 55,1%. There were no significantly difference across groups characteristics of subjects at the time of enrollment.

TABLE 3.
THE ANTHROPOMETRIC INDEXES AND NUTRITIONAL STATUS OF THE CHILDREN
AT ENROLLMENT AND 6 MO LATER*

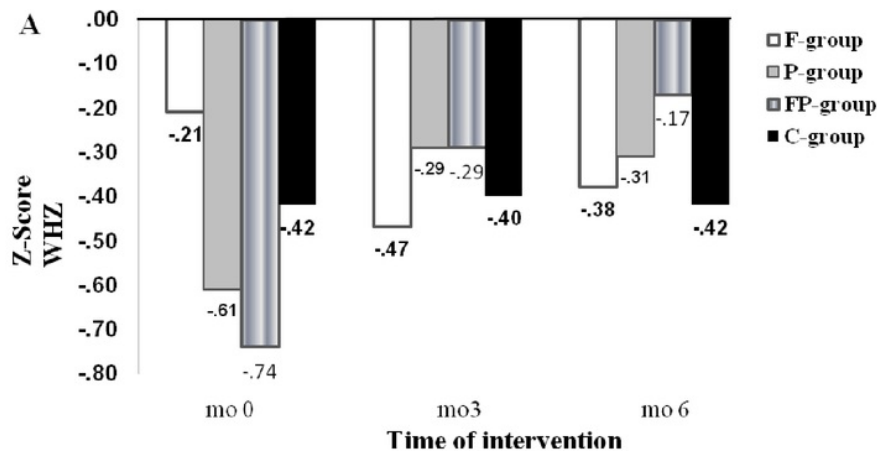
Variables	F-Group (n = 72)	P-Group (n=59)	FP-Group (n=69)	C-Group (n=71)	P-value
Weight (kg)					
Enrollment	7,64 ± 0,84	7,55 ± 0,93	7,52 ± 0,85	7,52 ± 0,90	0,853
6 mo	8,92 ± 1,04	8,89 ± 0,94	9,03 ± 0,86	8,77 ± 0,84	0,850
Delta (Δ)	1,28 ± 0,76 ¹	1,33 ± 0,07 ¹	1,50 ± 0,73 ¹	1,43 ± 0,76 ¹	0,197
Length (cm)					
Enrollment	67,51 ± 2,45	67,98 ± 2,90	68,44 ± 2,97	67,72 ± 2,59	0,219
6 mo	74,38 ± 2,64	74,22 ± 2,77	74,10 ± 2,27	73,52 ± 2,11	0,673
Delta (Δ)	6,86 ± 2,08 ¹	6,24 ± 2,30 ¹	6,66 ± 2,41 ¹	5,81 ± 2,50 ¹	0,013 ²
Weight for length z score/WHZ					
Enrollment	-0,21 ± 0,99	-0,61 ± 0,98	-0,74 ± 1,09	-0,42 ± 0,92	0,449
6 mo	-0,37 ± 1,07	-0,31 ± 0,94	-0,17 ± 0,81	-0,41 ± 0,91	0,011 ²
Delta (Δ)	-0,16 ± 1,12	0,30 ± 0,88 ¹	0,57 ± 1,15 ¹	0,00 ± 0,93	0,001 ²
Length for age z score/HAZ					
Enrollment	-0,61 ± 1,01	-0,36 ± 1,25	-0,24 ± 1,15	-0,78 ± 1,05	0,281
6 mo	-0,86 ± 1,04	-0,89 ± 0,92	-1,11 ± 0,93	-0,80 ± 0,81	0,021 ²
Delta (Δ)	-0,24 ± 0,88 ¹	-0,53 ± 1,17 ¹	-0,87 ± 1,12 ¹	-0,01 ± 0,86 ¹	0,002 ²
Weight for age z score/WAZ					
Enrollment	-0,55 ± 0,83	-0,71 ± 0,93	-0,73 ± 0,99	-0,79 ± 0,93	0,636
6 mo	-0,68 ± 1,01	-0,65 ± 0,88	-0,62 ± 0,78	-0,80 ± 0,81	0,468
Delta (Δ)	-0,12 ± 0,78	0,06 ± 0,76	0,11 ± 0,88	-0,01 ± 0,86	0,368

* All values are $x \pm SD$. Value for z score from World Health Statistics reference data 2005

¹ Significantly difference before and 6 mo later within groups, $P < 0,05$ (Paired t-Test)

² Significantly difference at 6 mo later from each groups, $P < 0,01$ (One way ANOVA)

There was significantly difference before and after 6 mo of intervention within groups in anthropometric measurements were exam by Paired t-Test. Increasing of length was significantly difference among the groups, with more difference in food groups and combination food supplementation and psychosocial groups than psychosocial groups and control groups after 6 month of intervention (table 3). Children who receive intervention psychosocial stimulation only and combination food supplementation and psychosocial stimulation were significantly difference increasing WHZ but in contract with HAZ than control groups.



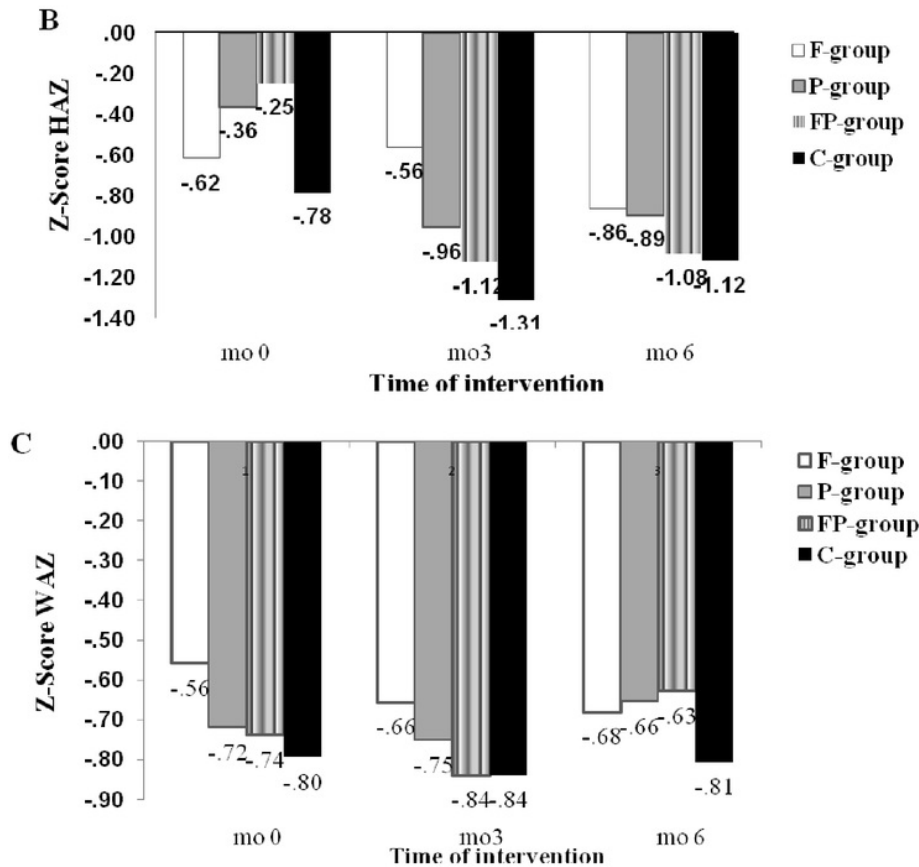


Figure 1. Change of means \pm SD Z-Scores nutritional status of children at difference time measurement for each groups intervention; (A) change in weight for height Z-score, (B) change in height for age Z-score WHZ, (C) change in weight for age Z-score. Each groups ; Food-group/F-group (n=72), Psychosocial stimulation group/P-group (n=59), Food and Psychosocial stimulation group/FP-group (n=69), Control group/C-group (n=71)

The results of this study also found a significant difference in the mean change value delta Z-Scores WHZ is equal to 0.57 (± 1.15) after 6 months of intervention. From the test results obtained the effect size was medium ($d = 0.6$), that means the effect of differences in the average value of the Z-Score WHZ higher with psychosocial stimulation *Manjujai* conjunction with the provision of food supplementation *MP-ASI* compared without giving food supplementation with a value of size great effect. There is also the value of the effect size was small ($d = 0.2$) to changes in the average value of the WAZ between the treatment group. Combination of food supplementation and psychosocial stimulation group had a strong effect to improve of nutritional status of children than control group.

Instead obtained from studies in Indonesia, provision of nutritional supplementation interventions in infants 12-18 months for 3 months only a positive effect on body weight but nutritional supplementation with a longer time (12 months) plus micronutrients give more effect greatly to the body length (Pollit E, 2000). From the results of the study concluded that the short-term effects of greater nutritional supplementation on the rate of linear growth velocity is determined by how long the child nutrition interventions and the amount of extra calories consumed by children can meet the nutritional needs should be. The longer the duration of the intervention given nutritional supplementation and an additional amount of calories that meet the needs of children can provide a greater effect on the growth of children.

¹ In this study, administration of a combination of interventions and complementary feeding *Manjujai* can have a significant effect on the improvement of the nutritional status of children is now indicated by a

decrease in the proportion of underweight children of 14.5% at the end of the intervention compared the control group showed an increase in the proportion of underweight children by 1.4%. Almost the same situation with the proportion of poor nutrition status, giving a combination of interventions also showed no decrease in the proportion of child malnutrition of 11.3% at the end of the intervention compared to the control group were also slightly decreased in the amount of 3.7% . Inversely obtained for the proportion of short children, the effects of a combination of interventions have not been able to improve the nutritional status of the past that chronicles, which showed an increase in the proportion of short children by 13% at the end of the intervention.

As shown in table 3 and figure 1, the average Z-Score WHZ, HAZ and WAZ after 6 months of the intervention of the results of this study are still under-NCHS median WHO standards but there is the presence of short-range distances approaching the standard WHO-NCHS median to provide interventions especially in the combination group of nutritional supplementation and psychosocial stimulation than the control group that is far below the standard median. The decline in the growth of the children based on WHZ, HAZ and WAZ has a condition that is often found in developing countries, including Indonesia. According to the WHO report, decrease the Z-Score HAZ and WAZ has been started since the age of two months until the age of 12 months, after the decline began to decrease (Mora et al., 1990). According to Victora CG (2010), the results of anthropometric data analysis children from 54 countries compared with the 2006 WHO standards described for the average Z-score of WHZ children from all over the country slightly above the standard at the age of 1-2 months, and decreased to children aged 9 months and increased again approaching the standard until the age of 24 months and may continue above the standard until the age of 48 months and decreased back to the age of 58 months. The result of this analysis is the analysis of 54 countries shows lows for the average nutritional status of children in countries of Southeast Asia (SEARO) compared to 4 parts other countries (Euro, EMRO, PAHO & Afro) (Mora et al., 1990, Victora et al., 2010).

The effect of nutritional supplementation interventions combination with psychosocial stimulation of this study can reduce the failure to thrive (growth faltering) in children is happening right now but can not reach the standard optimal growth approaching normal child growth standards issued by the WHO. The results of this study found no significant difference in the effect of the combination of nutritional supplementation and psychosocial stimulation on cognitive development, motor and language of the child after 6 months of intervention. Obtained the biggest improvement in cognitive scores points is equal to 21:37 (+ 12:24 points) with a difference of about 6 points compared with the control group at the end of the intervention. Combined effects of food supplementation and psychosocial stimulation *Manjujai* also significant difference to improving the children's motor scores in the amount of 20.65 points (+ 18:38 points), also greater improvement with a difference of about 9 points compared to the control group after 6 months of intervention.

According to McGregor (1987), environmental practices foster psychosocial stimulation and high child who is positively correlated with cognitive development, motor skills, psychosocial and emotional child who is also better (SG McGregor et al., 1987). According to the Eagle (1996), a sub-scale of the most important indicators in environmental practices foster psychosocial stimulation is responsive parents / caregivers to the needs, emotional and verbal child (Eagle PL et al., 1997).

IV. CONCLUSIONS

The result indicate that combination intervention food supplementation and psychosocial stimulation only had strong effect to improve children's growth and nutritional status . For a sustainable programme, mothers or childgivers need to be empowered through training and supervision holistic and integrated programme by all stakeholders whose to concerning mother and early child education programme. Further studies in different settings are required to identify the best approach of potential local product for food supplementation to improve nutritional status of children in developing countries.

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