Using Bubble Score Chart as the Main Media in Nutrition Education to Improve Mothers Knowledge and Child Weight Gain in Deli Serdang Distric, Indonesia

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Abstract

Introduction: Growth chart is an essential tool in growth monitoring program for malnutrition prevention among children. The United Nations states that the prevalence of malnutrition is one of the indicator for monitoring of Millennium Development Goals (MDGs), therefore the function of growth chart needs to be strengthened. However, reports from several countries indicate poor use of growth chart by mothers and health workers. A simple and informative growth chart is currently needed to be used as educational tool for mothers to easily comprehend their children's growth. The objective of study is to investigate the impact of nutrition education using bubble score chart on mothers' knowledge and child weight. **Materials & Methods :** Mothers in intervention group received nutrition educationand use bubble score chart. Mothers in control group did not received nutrition education but use the normal growth chart. To measure the knowledge level, sixteen written questions were designed and tested. Participants included 107 mothers consisted of 54 mothers in intervention group and 53 mothers in control group. The study was a quasy experimental with the non equivalent control group design approach. **Results :** Before intervention, there was no significant difference of mothers' knowledge, comprehension and application(p>0.05) and child weight (p>0.05) between intervention and control group. After interventions, there was significantly different of high knowledge (86% vs 54%); high comprehension (78% vs 46%) and high application (88% vs 52%, p<0.01) respectively for intervention and control groups. Children aged 9-12 months were more vulnerable to low weight gain (9.55±0.69 vs 8.48±1.15kg, p<0.05) respectively for intervention and control groups. **Conclusions** : Nutrition education using bubbles score chart effectively improved mothers' nutrition knowledge and child weight gain.

Key words : Bubble Score Chart, Nutrition Knowledge, Child Weight Gain

1. Introduction

Growth chart is an essential tool in growth monitoring program for malnutrition prevention among children while United Nations (UN, 2003) states that the prevalence of malnutrition of under-five year children is one of the indicator for monitoring the Millennium Development Goals (MDGs). Therefore, the function of growth chart needs to be strengthened. The graph of children growth is shown every month and the trend of growth can be used to encourage mothers to do positive practices, motivating the changes, giving rewards and to do innovative health behavior (Griffiths *et al,* 1996). However, the interpretation of a child growth trajectory is highly dependent on the growth chart used (Julia, 2009).

Although growth charts are recommended for monitoring children, the recent reports from several countries indicate poor use by mothers and health workers (Adenike *et al*, 2010, Senanayake *et al*, 1997). A study reported by Roberfroid *et al.* (2007), the doctors had limited knowledge on the interpretation of the growth chart though they considered it is a good tool for diagnosis. Roberfroid also reviewed 20 studies on growth chart from Asia, Africa and Latin America concluded that 30-75% mothers had low understanding in interpreting the children growth chart. Thus, several countries have been modifying their own growth charts. It has been estimated that 200-300 kinds of growth chart currently are used by more than 80 countries in the world, some are quite similar to the original while others are considerably modified. Several countries that have ever published their modified chart are Philipines, Mexico, India, Lesotho, Nigeria and Indonesia (Brownlee, 1990).

Experiences from several countries proved that introducing revised growth charts together with education might have enhanced mothers' knowledge, understanding, interpretation and comprehension on growth chart (Martinez *et al*., 1988; Senanayake *et al.,* 1997; Sohal *et al*., 1988; Ruel *et al.,* 1990).

Recent evidence related child mortality proved that 60%of all deaths among children under five years is directly or indirectly to malnutrition annually and over 2/3rd of these deaths are associated with inappropriate feeding practices and occur during the first year of life (Nawaz *et al*., 2014).

In the year 1980-90's, Indonesia had successful experiences in implementing growth monitoring program through integrated health post (Posyandu). Posyandu is a place to run monthly growth monitoring for under five year children conducted by community health caders and village midwives, in which the growth chart is used as the growth monitoring tool (Sulistiyorini *et al.,* 2010; Kementerian Kesehatan RI, 2006).

Indonesia had a successful experience in implementing growth monitoring program. Hendrata (1984) recorded that Indonesia can cover 30,000 villages in expanding the growth monitoring program in Posyandu in less than five years.

However, in the year 2000's Indonesia was not so successful in applying the growth chart as the growth monitoring nutritional educational tool (Kementerian Kesehatan RI, 2008). The Basic Health Research, 2007 revealed that only 23.3% mothers possessed growth chart and kept the chart at home, while 41.7% of mothers let their childs' cards kept by Posyandu cadres and the rests, 35% did not have growth charts.

Whereas the function of chart is supposed to be an education tool for parents and caregivers and the end they can take action related child growth status (Griffiths *et al.,* 1996). It is therefore, the more simple, understandable and informative growth chart need to be created as the WHO suggested (Joseph *et al*., 2009).

In this paper, the authors introduce a bubble scored chart as a simple and informative growth chart. The chart is a modification of the new WHO-2005 growth chart. First, the lines along vertical axis replaced by bubbles in order to make it easier to do plotting. Second, along the right side in between the color tapes presented scores/numbers 5,6,7,8 and 10. These scores will guide the end users (mothers and Posyandu caders) to do interpretation based on children weight status. Score 5 means Abnormal Weight, score 6 means Less Normal, score 8 means Normal and score 10 means Absolutely Normal Weight. To make mothers easily understand the meaning of scores a jingle is also composed. The detail explanation on how to interpret the child weight status and guidelines on the appropriate food is attached on the back of bubble score chart. The size of bubble score chart is bigger than normal growth chart. See appendixes. 1

To measure the effectiveness of bubble score chart in improving mothers knowledge and child weight gain, an intensive nutritional education is conducted. Therefore, the results presented in this paper specifically addressed the comparison of the maternal knowledge and children weight gain between mothers in intervention group who use bubble score chart and control group that use the recent growth chart.

2. Material and Methods

2.1. Subjects

The study included 107 mothers/caregivers (54 mothers in intervention group and 53 mothers in control group) with their children aged 0-12 month recruited from 8 integrated health posts (Posyandu) selected from two sub-districts. Mothers were identified from the Posyandu register book. The inclusive criteria   were set to select the subjects; mothers aged 20-27 years, minimum nine years followed the formal education, babies' birth weight 2600-4000 grams and breastfed.

2.2. Calculation of Sample Size

It was assumed that there would be a 30% difference of proportion of high nutrition knowledge forthe intervention group after receiving intensive nutrition education. Using the formula n = $\{Z_{1-\alpha/2}\sqrt{2PQ} + Z_{1-\beta}\sqrt{[P_1(1-P_1) + P_2(1-P_2)]}\}^2 /_{(P_1-P_2)^2}$, n = 50. Then 10% is added for drop-out possibility in each group; so, the total sample size was 55 persons. Based on this calculation, 10-15 mothers in each Posyandu were recruited.

2.3. Data Collection

There were two phases implemented in data collection of this study. Phase I was collecting the base data on mother's nutritional knowledge and children weight using the written questionnaires. Prior to answering the questionnaires, mothers were asked for responding to demographic questions.

Phase II was the final data collection using similar questionnaires. This was done a month after the interventions ended. Children weight were taken every month during five months of study.

2.4. Intervention

There were ten lessons delivered during the four months interventions. As it has been presented in proposed framework (fig. 1), there were several preparations including the monthly targets, and evaluation process established to be used as the guidance for the team in delivering the messages.

The ten topics are; 1) function of the growth charts 2) function of curves 3) function of color tapes 4) monthly minimum weight gain 5) function of bubbles 6) function of scores   7) plotting and graphing 8) interpreting the weight status 9) appropriate food for children aged 0-12 months 10) singing the jingle "Let's study bubble chart ". All information are taken from the bubble score chart (see appendix 2, 3 and 4).

While the control group - mothers did not receive intensive nutrition education, but they were encouraged to weigh their children every month to Posyandu and to use the normal growth chart. (see appendix 5)
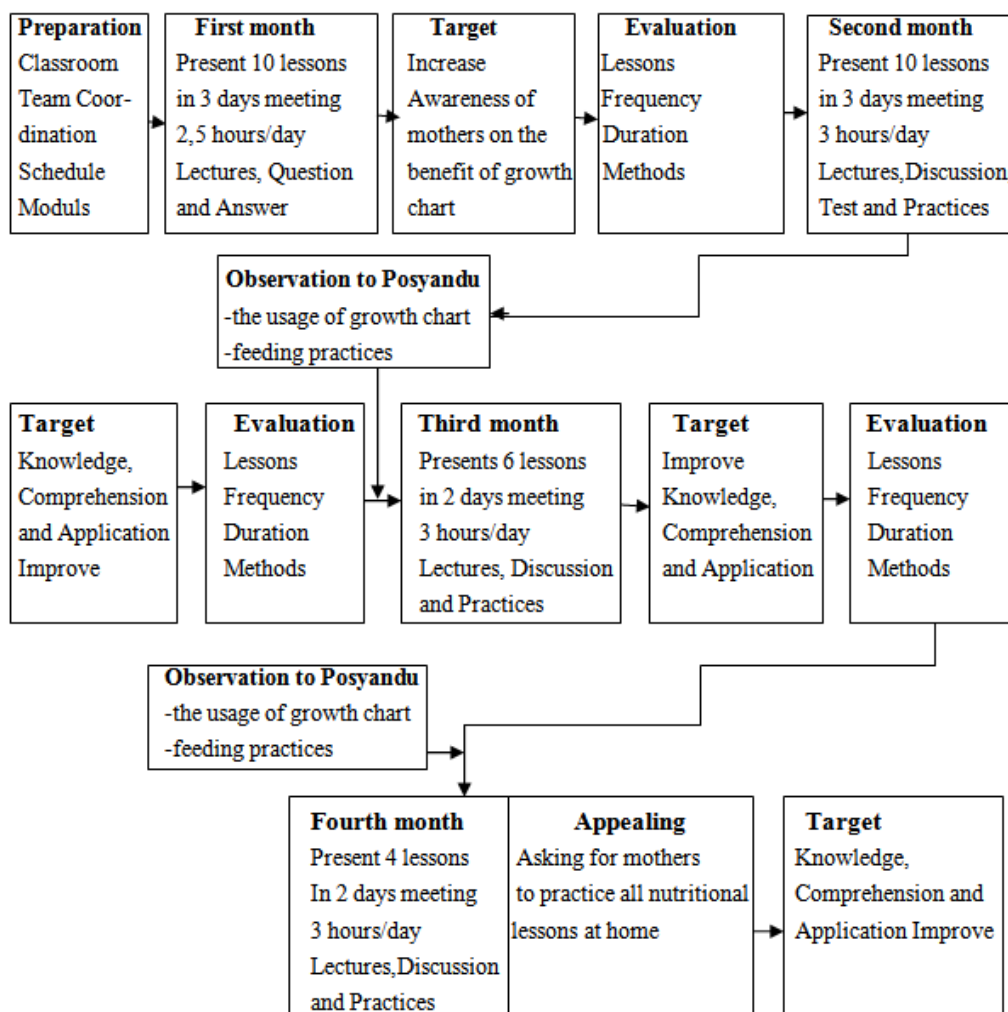

Figure 1. Framework for Bubble Score Chart based Nutrition Education Programme in Changing Maternal Knowledge.

3. Observation the Usage of Normal Growth Chart in Posyandu

Prior to modify bubble score chart, the authors conducted a field observation. The objective was to find the problems in using the normal growth chart at community level. The application of recent growth chart in growth monitoring program did not run as expected. There are several problems found such as caders could not do plotting properly because the graphic lines too small, caders found it difficulties to give counseling to mothers because there was no nutritional guidance, mothers hardly ever been involved in growth chart activities and distribution of the new growth chart without explanation.

4. Bubble Score Chart Trial

Prior to the conduct of the main research, a pilot project was conducted to measure the level of the acceptance and mothers' ability to use bubble score chart. Thirty mothers in two Posyandus were recruited. The results showed that 93.4% mothers agreed to use bubbles and scores in the chart. Only 16.5% did not agree with bigger size (A3 size) and in terms of practicing, 83.4% of them found it easier to plot and interpret babies growth status (Sinaga, 2012).

5. Research Implementation

The study was conducted on May-October 2013. Four researchers assisted by four enumerators from Academy of Nutrition to collect the data from 107 mothers in eight Posyandus (weighing post). The schedule of Posyandu was taken from Public Health Center. Two researchers with two enumerators were responsible for one Posyandu. If the selected mothers could not be met or not present in Posyandu, the team visit them to their house.

6. Data Analysis

The two possible scores were score 1 = the answer is wrong, score 2 = the answer is right. The written questionnaires was designed by researchers based on the nutritional related information that available in the bubble score chart. Type of questionnaires were closed ended question. Example : 1) What is the function of growth chart ? a. to record child weight and to monitor child growth b. to record immunization date and child weight. 2) Why baby should be weighed every month ?a. to get immunization and supplementary food. b. to know baby's weight development.

The level of knowledge was divided into two categories; high knowledge and low knowledge. If the total score $\geq$ mean score=high knowledge ; < mean score = low knowledge.

Statistical analyses were conducted using the SPSS for Mc, version 17 used to test statistical significance of differences between two groups used t-independent test for numeric variable. Chi-squares test and relative risk for categoric variables.

7. Results

Table 1. Demographic characteristics of subjects and families

Characteristics	Intervention Group (N=54)		Control Group (N=53)		p-value
	Mean±SD	n (%)	Mean±SD	n (%)	
Birth weight (kg)	3.2±0.38		3.2±0.45		0.78
Baseline weight(kg)	6.5±1.90		6.1±1.67		0.21
Age (months)	5.19±3.54		4.6±3.83		0.40
0-5 month		27(50.0)		30(56.6)	
6-8 month		13(24.1)		12(22.6)	
9-12 month		14(25.9)		11(20.8)	
Mother's Age (year)	27.8±4.44		27.9±4.59		0.93
Mother's Education					0.69
Grade 7-9		17(31.5)		15(28.3)	
Grade 10-12		32(59.2)		37(69.8)	
Above grade 12		5(9.3)		1(1.9)	
Mother's Occupation					0.20
Household workers		46(85.2)		49(92.4)	
Agricultural/skill labour		2(3.7)		2(3.8)	
Private sector		6(11.1)		2(3.8)	
Fathers Education					0.37
Primary(Grade1-6)		4(7.4)		3(5.7)	
Grade 7-9		7(6.4)		11(20.7)	
Grade 10-12		37(68.5)		37(69.8)	
Above grade 12		6(11.1)		2(3.8)	
Fathers Occupation					0.28
Government workers		2(3.7)		3(5.7)	
Agricultural/skill labour		8(14.8)		3(5.7)	
Private sector		42(77.7)		45(84.8)	
Others		2(3.7)		2(3.8)	
Household member (person)	4.02±0.94		4.04±0.99		0.91

Demographic characteristics information for subjects and families is shown in Table I. Of ten characteristic variables presented, three variables were belonged to child ; birth weight, age and current weight and other seven variables belong to parents. Based on statistics calculation all characteristics variables were comparable (p-values>0.05). The average of child birth weight between two groups of study was quite similar (3240±0.38 and 3213±0.45 for intervention and control group respectively). The base line weight, there was 300 grams different of children weight between the two groups but it was not statistically different (p>0.05).

Most parents in the two groups of study had high education level, since more than half of them had completed grade 9-12 (59.2% and 68.5% ; 69.8% and 69.8%). Household worker was the main job of mothers (85.2% and 92.4% for intervention and control group respectively), while fathers mostly worked in private sectors and only around 5% was government workers. Through this kind of occupation the family earned Rp. 1.5-2.0 million rupiahs/month (1USD=11.600 IDR). This amount was similar to the regional minimum salary determined by the local government. The *p values* of all characteristics were >0.05, means that the characteristics of respondents between the groups of study was comparable.

7.1 The Changes of Nutrition Knowledge

To present the changes of mothers' knowledge between intervention and control groups, two types data were presented, first, the changes of answers' status and second, the prevalence of the three knowledge level.

Table 2. Changes of Answers Status Before and After intervention

Questions	BEFORE INTERVENTION				P Value	AFTER INTERVENTION				P Value
	Intervention Group (N=54)		Control Group (N=53)			Intervention Group (N=50)		Control Group (N=50)		
	Number of Answer					Number of Answer				
	Wrong n (%)	Correct n (%)	Wrong n (%)	Correct n (%)		Wrong n (%)	Correct n (%)	Wrong n (%)	Correct n (%)	
Knowledge										
1.What is the function of growth chart ?	29(53.7)	25(46.3)	31(58.4)	22(41.5)	0.69	12(23.4)	38(76.0)	17(34.0)	33(66.0)	0.17
2. Untill what age babies should be weighed ?	38(70.4)	16(29.6)	42(79.3)	11(20.7)	0.57	8(16.0)	42(84.0)	19(38.0)	31(62.0)	0.02
3. What is the function of curves ?	42(77.8)	12(22.2)	37(69.8)	16(30.2)	0.40	24(48.0)	26(52.0)	31(62.0)	19(38.0)	0.02
4. What is the function of colour tapes ?	44(81.5)	10(18.5)	45(84.9)	8(15.1)	0.54	22(44.0)	28(56.0)	36(72.0)	14(28.0)	0.00
5. What's the min. weight gain birth to 0-6 month?	45(83.4)	9(16.7)	45(84.9)	8(15.1)	0.30	15(30.0)	35(70.0)	30(60.0)	20(40.0)	0.01
6. What's the right foods for babies aged 6-10 months?	32(59.3)	22(40.7)	33(62.3)	20(37.7)	0.96	31(62.0)	19(38.0)	37(74.0)	13(26.0)	0.01
Comprehension										
7. Why babies to be weighed every month ?	17(31.5)	37(68.5)	11(20.7)	42(79.3)	0.22	11(22.0)	39(78.0)	18(36.0)	32(64.0)	0.30
8. Why the plots should be connected ?	34(63.0)	20(37.0)	33(62.3)	20(37.7)	0.99	15(30.0)	35(70.0)	27(54.0)	23(46.0)	0.03
9. What is meaned if plot on the green ?	32(59.3)	22(40.7)	33(62.3)	20(37.7)	0.94	17(34.0)	33(66.0)	33(66.0)	17(34.0)	0.00
10.What's meaned if plots on upper yellow	45(83.4)	9(16.7)	46(86.8)	7(13.2)	0.17	26(52.0)	24(48.0)	41(82.0)	9(18.0)	0.02
11. What's meaned if no gain weight for 2 months ?	41(75.9)	13(24.1)	45(84.9)	8(15.1)	0.44	26(52.0)	24(48.0)	36(72.0)	14(28.0)	0.06
Application										
12. Is the chart plotted and connected every month?	45(83.4)	9(16.7)	49(92.5)	4(7.5)	0.08	22(44.0)	28(56.0)	35(70.0)	15(30.0)	0.01
13. Frequency of weighing babies to Posyandu ?	40(74.1)	14(25.9)	44(83.0)	9(17.0)	0.17	17(34.0)	33(66.0)	24(48.0)	26(52.0)	0.28
14. What foods given when aged 6-7 months ?	41(75.9)	13(24.1)	43(81.1)	10(18.9)	0.31	25(50.0)	25(50.0)	31(62.0)	19(38.0)	0.00
15. What foods given when aged 8-10 months ?	31(57.4)	23(42.6)	33(62.3)	20(37.7)	0.10	22(44.0)	28(56.0)	36(72.0)	14(28.0)	0.00
16.What is the frequency of breastfeeding ?	43(79.6)	11(20.4)	45(84.9)	8(15.1)	0.70	21(42.0)	29(58.0)	32(64.0)	18(36.0)	0.01

7.2. Changes of Answers

Table 2 shows the comparison of answers status of sixteen questions between two groups of study before and after intervention.

Before intervention, of 54 respondents only around 15-46% of mothers in intervention group aswered the first six knowledge questions correctly. Question no. 4 (*What is the function of colour tapes?*) and 5 (*What's the min. weight gain birth to 0-6 month?*)had the lowest percentage (18.5% and 16.7% in intervention group and 15.1% and 15.1% in control group). The *p values* of all answers were > 0.05, it means that level of mothers' knowledge, comprehension and application between the two groups was not significantly different. However, after intervention the answers' status changed. In intervention group, 52-84% of mothers had correct answer, except question 6 (only 38% correct). While in control group, the prevalence of correct answer was only 26%-66%. Question 6 (*What's the right foods for babies aged 6-10 months?*) was also had the lowest correct answer, 26%.

Before intervention, *p* values showed that there was not significantly different of any answer status between the two groups of study, but after intervention question no. 2-6 had significantly different answer (*p*>0.05), only question 1 (*what is the function of growth chart?*) that was not meaningfully different (*p=0.17).* This results

suggested, though the knowledge of growth chart function was high but not affected to mothers' knowledge on the right foods for baby age 0-12 month.

In terms of comprehension, before intervention,of five questions (*question no. 7 – no. 11*), the lowest percentage of correct answerwas for question no. 10 (16.7% and 13.2%, for intervention and control group respectively).

After interventions the answers' status of five comprehension questions moved. Of 50 mothers in intervention group, around half to two thirds of them (48-78%) had the correct answers. In contrary, mothers in control group only around 18%-64% had the correct answer. Questions no. 10 (*what's the meaning if plotted line on upper yellow tape ?*) still had the lowest percentage that was only 18%. After intervention, the statistical calculation proved that most of answer status between intervention and control group was significantly different (question no 8-10, *p<0.05*) except for question no. 7, *p=0.30*. The figures suggested that it needs more efforts to enhance mothers comprehension on the meaning of different colour tapes. While for application terms, of five questions (no.6-12) administered question no. 12 (*Is the chart plotted and connected every month*?) had the lowest percentage of correct anwer (16.7% and 7.5%) followed by frequency of breastfeeding (20.4% and 15.1%) for intervention and control group respectively. After intervention those activities were improving not only in intervention group but also in control group. 56% and 30% of mothers in intervention and control group respectively did plotting and connecting the dots on their child growth chart every month. The application of feeding child age 6-7 months was the most problem in both groups since the percentage of correct answer for this questions was 50% and 38%). The *p-values* proved only answer of question no. 13 (*frequency of weighing babies to Posyandu*) that was not meaningfully different (*p*>0.05) while the other four answers were significantly different (*p*<0.05). It means that the presence of mothers in Posyandu could not enhance the application of giving the appropriate foods to child.

Table 3. Changes of Knowledge Level Before and After Intervention

Variabel	BEFORE INTERVENTION					AFTER INTERVENTION					
	Intervention Group N=54		Control Group N=53		*P*-value	Intervention Group N=50		Control Group N=50		*p*-value	Relative Risk (RR) (Lower-Upper)
	High n (%)	Low n (%)	High n (%)	Low n (%)		High n (%)	Low n (%)	High n (%)	Low n (%)		
Knowledge	30(55.6)	24 (44.4)	24(45.3)	29(54.7)	0.29	44(88.0)	6(12.0)	26(52.0)	24(48.0)	0.00	3.1(1.5-6.5)
Comprehension	31(57.4)	23(42.6)	29(54.7)	24(45.3)	0.78	43(86.0)	7(14.0)	27(54.0)	23(46.0)	0.00	2.6(1.3-5.2)
Application	27(50.0)	27(50.0)	20(37.7)	33(62.3)	0.09	39(78.0)	16(32.0)	23(46.0)	27(54.0)	0.00	2.2(1.3-3.7)

7.3. Changes of Knowledge

The changes of three level of knowledge : knowledge, comprehension and application of mothers in two groups of study are shown in **Table 3.** Before intervention, around half of respondents in intervention group had high knowledge, comprehension and application (55.6%, 57.4% and 50% respectively). Even though the prevalence of those three variables were not so similar with control group but the *p* values showed that they were comparable (*p-value* >0.05). In other words when both groups used the normal growth charts, their knowledge, comprehension and application level on growth chart and appropriate food for children was in middle level. After interventions or when mothers in intervention group utilized bubble score chart, their knowledge improved in which most mothers (78.0-88.0%) had high knowledge, comprehension and knowledge on the function of growth chart, curves, color tapes and minimum weight gain and right foods increased, while the knowledge level of mothers who used normal growth charts was stagnant.

A slightly improvement of high knowledge was also found in control group mothers after intervention (from 45.3%to 52%). This was because several mothers might had learnt the function of growth chart from Maternal and Child Health Book (*Buku KIA*) that they had. However, the statistical analysis proved that there was significantly difference of mothers' knowledge between intervention and control group (*p*<0.01). The effect of bubble score chart was three times higher to make mothers had a high knowledge.

After interventions, high comprehension level was significantly higher in intervention group compared to control group (86% vs 54%). Mothers' understanding on the reasons of weighing baby and to plot the chart regularly was much better than the meaning of color tapes and the meaning of no gain weight for two months. As seen in **Table 3**, most mothers in two groups of study still found it is difficult to comprehend the meaning of upper yellow tape. However, the relative risk (RR) calculation proved that using bubble score chart in intensive nutrition education could improve mothers' comprehension 2.6 higher compared to those who used normal growth chart and not received formal nutrition education.

In this study the application level is an important part in measuring knowledge. Before intervention, high application category was higher in the intervention group than control group (50% vs 37.7%),but it was still comparable. After intervention, even though the percentage of high application existed in both groups (78% and 46%, in intervention and control group respectively) the *p*-values proved they were not comparable. More mothers in intervention group brought their child to Posyandu, fill their child growth chart, feeding the right food for child aged 6-7 month and 8-10 month and more mothers frequently to breastfed their child.

Tabel 4. Changes of Mean Weight (in kg) Before and After Interventions

Age Group	BEFORE INTERVENTION			Age Group	AFTER INTERVENTION		
	Intervention Group N=54	Control Group N=53	*P*- value		Intervention Group N=50	Control Group N=50	*p*- value
	Mean(kg) ±SD	Mean(kg)±SD			Mean(kg) ±SD	Mean(kg) ±SD	
0-5 month	5.10±1.31	5.14±1.55	0.91	5-10 month	7.42±0.69	7.32±0.93	0.66
6-8 month	7.50±1.08	6.95±1.04	0.17	11-13 month	8.80±0.81	8.35±0.62	0.14
9-12 month	8.34 ±1.33	8.14± 1.36	0.72	14-17 month	9.55±0.69	8.69±1.01	0.04

Table 4 shows that before intervention,the mean weight of three age groupsin the two groupsof study was not significantly different (each age-group had *p-values*>0.05). The results suggested that the normal growth chart gave similar weight gain to the three age groups. However, after intervention (five months later) when intervention group used bubble score chart, the similar weight gain only existed in the age group 0-5 month and 8-6 month. As shown in **Table 4**, for age group 5-10 month gained 2,32 kg and 2,18 kg, p>0.05 and age group 11-13 month gained 1,30 kg and 1,35 kg, *p*>0.05. While for age group 14-17 month, only child in intervention group had significantly weight gain compared to child in control group (1,2 kg vs 0.55kg, p<0.05). The results inferred that bubble score chart positively worked for the three age groups and normal growth chart did not work for child aged 14-17 month.

8. Discussion

This study investigated the impact of using bubble score growth chart on mothers' nutrition knowledge and children weight gain. The background of this study was the reality that most countries including Indonesia had poor experiences in improving mothers' knowledge on the function of growth chart and in interpreting the child weight status presented on the growth chart (Roberfroid *et al*., 2007; Kemenkes RI 2008). This study showed that before intervention implemented or when mothers used the normal growth chart, 42-50% had low knowledge on the function of growth chart. Similar findings found in Asia, Africa and Latin America, in which 30-75% mothers had low comprehension in interpreting growth chart (Roberfroid *et al*., 2007) and 77% American parents found difficulties in interpreting their child growth chart (Joseph *et al*., 2009).

This study proved that after intervention, mothers who used bubble score chart had two to three times more likely to have higher knowledge, comprehension and application compared to mothers who used normal growth chart. In other words, the revised chart was significantly improved mothers' knowledge on the function of growth chart. Our findings documented that mothers could plotted the chart, connected the plots and fed baby with appropriate foods due to mothers participation in monthly growth monitoring program in Posyandu. The attendance of the educators team in Posyandu might have affected mothers' skill in filling the chart and feeding

baby with appropriate food. The findings are consistent with the results of several studies on the application of modification and revised growth charts that introduced with creative teaching aid and training to mothers in Mexico, Colombo, Srilanka and Kwa Zulu and Lesotho, Africa (Martinez *et al*., 1988; Senanayake *et al*., 1997; Sohal *et al.*, 19987).

This can be explained that modification chart might have enhanced mothers eagerness and willingness to study and understand more about growth chart components. In this study, replacing along vertical lines by the bubbles and the application of scores 5, 6, 7, 8 and 10 as frequently used by teachers in school to evaluate students might have motivated mothers to understand the growth chart. The bigger size of bubble score chart made it easier for mothers to plot and connecting the dots. In fact using numbers, percent and ratio was frequently applied in changing health behavior (Fargelin *et al.*, 2007). A study in Mexican-American population proved that inserted numbers in health advices improved caring to their health (Schapira, *et al.,* 2011). But this study also found several mothers seemed still confused in interpreting the meaning of plotted on the upper yellow tape, since only 48% of mother knew that a plotted line deviates upwards above green tape means the child is gaining overweight. 54% mothers knew that the higher the position of plots the better the weight status. Similar finding also observed in Nigeria showing 53.8% respondents knew plotted above upper limit means excess weight (Adenike *et al.*, 2001).

In this study found only 58%, the frequency of exclusive breastfeeding practice was seven times per day (as presented in **Table 3** question 16). This result was in line with mothers in Goba district, South East Ehtiopia, in which the mean frequency of breastfeeding was six times (Setegn *et al.*, 2012)
Difficulties in comprehending and application the normal chart was because in the normal growth chart can not be found the information on how to interpret child weight, steps on appropriate feeding guidelines and mothers have never been involved in filling and plotting the growth chart. In contrary, the appearance of bubble score chart is following to WHO, Treversky and Morison suggested. The appearance of growth chart should be simple and informative (Josep *et al*., 2009) and mothers should be involved in plotting (Griffiths *et al*,.1996)

The potentially reasons to apply bubbles and scores, inserting the interpretation and feeding guidelines in this new bubble score growth chart because that simpler and more informative growth chart will be practical and powerful tool in teaching mothers with relative high education and economic level. Using growth chart alone, without combining with nutrition education will not be effective in changing mothers' knowledge and child nutrition status.

In term of weight gain, among three age groups, the effect of using bubble score chart in growth monitoring program was positive only for age group 9-12 month, in which children in intervention group more weight gain compared to children control group, while for other two groups, 0-5 month and 6-8 month, the mean weight gain of those children during five months study were not significantly different. This might due to breastfeeding practices for children aged 0-8 months was similar in the two groups of study. The changes of feeding could happen when the child aged 9-12 months. As seen in **Table 2** (question no. 16) 58% mothers in the test group breastfed child more than seven times per day, in contrast only 36% did the same in control group. It seemed that aged 9-12 months was the crucial period for attaining the normal weight. Riviera *et al,* (1997) found in their study in Guatemala that 40-80% child aged 9-12 month experienced growth failure. In Indonesia the prevalence of malnutrition of child age 11-12 months was 10% (Kementerian Kesehatan RI, 2008). This study concludes that children aged 9-12 months is a vulnerable group. For Indonesian, one implication of these findings, government should put children aged 9-12 months into high consideration in every nutrition promotion program particularly in growth monitoring and feeding program.
Three topics introduced in this study might have related to the weight gain achievement, they are the minimum weight gain (MWG), interpretation guidelines and steps of appropriate feeding. After understanding the MWG of child aged 0-3 months should get at least 800 grams and aged 4-6 months the minimum weight gain is 500 grams, mothers make extra efforts through appropriate feeding practices. If a child cannot reach the MWG or the weight decrease, mothers will follow the explanation presented and try to feed child as suggested in feeding guidelines. By knowing the score and MWG make mothers aware of the important of growth monitoring then they will make extra efforts to get higher score and to prevent child from lower scores or from abnormal weight.

The process of delivery the interventions might have significant role in achieving the objectives of this study. As it has been presented in **figure 1**, there were several preparations including the monthly targets, and evaluation

process established to be used as the guidance for the team in delivering the messages. Our study focus on mothers' child but not to Posyandu caders and health workers. It is because that educating mothers directly about growth chart and appropriate food will be more effective in preventing malnutrition rather than expecting Posyandu caders to do it. This findings suggest that the public health workers who work at community level should have creativity and innovation particularly in preparing and running the community nutrition program at community level.

9. Conclusion

The present study was designed to investigate the effect of nutrition education using bubble score chart as the main media on maternal knowledge, comprehension and application and children weight gain. Our findings suggest that bubble score chart is more effective media in improving mothers' knowledge and child weigh gain. Creativity and innovation of health workers need to enhance particularly in revising and modifying the existing health promotion medias based on the local needs.

The implication to the present growth monitoring program that currently running in Indonesia is the recent growth chart need to be modified as the local needs. Children aged 9-12 month should be put into high concern. The supervision of health workers to Posyandu should be focus on improving mothers' knowledge on the function of growth chart and appropriate foods for child. The weakness of study was the number of subjects participated too small. Further studies need to recruit bigger participants and started from birth and followed up until 12 months. In teaching the interpretation of weight status should be slow and more practices and for appropriate foods should be followed with cooking demonstration.

10. Acknowledgements

11. Conflict of Interest

The authors declared that there is no conflict of interest for any of the authors with regard to the content of this paper.

12. References

Adenike OB, Esther AO (2011). Primary Health Care Workers' Role in Monitoring Children's Growth and Development in Nigeria, West Africa. *Global Journal of Health Science*. Vol. 3, No. 1

Brownlee, A (199). Growth Monitoring And Promotion: The Behavioural Issues in Child Survival Programs. The Office of Health US. Agency For International Development. *Monograph Number Six*.

Fargelin A, Ubel PA, Smith DM, *et al.,* (2007). Making Numbers Matter: Present and Future Research in Risk Communication. *American Journal Health Behavior*: 31(Suppl 1):847-856

Gopaldas T (1988). Field-level Health Worker's Skill in Detection of Growth Retardation and Faltering in Young Children. *Indian Journal Pediactric* ;55:55-8.

Griffiths M, Dickin K, Favin M (1996). Promoting the Growth of Children : What Works. Rationale Guidance for Programs. Human Development Department. The World Bank.

Hendrata L (1984). Growth Monitoring. Basic Concept, Management and Operational Issues In : Growth Monitoring as a Health Care Activity. Workshop Proceeding. Yogyakarta

Joseph BEP, Downshen SA, Izenberg N (2009). Do Parents Understand Growth Charts ? A National, Internet-Based Survey. PEDIATRICS. *Official Journal of The American Academy of Pediatrics*.

Julia M. (2009). Adoption of The WHO Child Growth Standards to Classify Indonesian Children Under 2 Years of Age According to Nutrition Status: Stronger Indication for Nutritional Intervention. *Food and Nutrition Bulletin, Vol. 30, no. 3*. The United Nation University.

Kementerian Kesehatan Republik Indonesia (2006). Peraturan Menteri Kesehatan No. 155/Per/I 2010 tentang Kartu Menuju Sehat (KMS).

Kementerian Kesehatan Republik Indonesia (2008). Hasil Riset Kesehatan Dasar (Riskesdas) Tahun 2007. Badan Penelitian dan Pengembangan, Jakarta.

Martinez H, de Chavez MM, Guarneros N (1996). Mother's Knowledge, Understanding and Use of the Bubble Chart in a Rural Area of Central Mexico. *Food and Nutrition Bulletin*. 17(3) Sept. 241-247

Nawaz SN, Mane A, Paul N, Kumar A (2014). Study of Infant and Young Child Feeding Practices in a Rural Area in North Karnataka. *Journal of Community Nutrition & Health*, Vol.3, Issue 1,

Roberfroid D, Pelto GH, Kolsteren P (2007) Plot and See!.Maternal Comprehension of Growth Charts Worldwide. T*ropical Medicine Int. Health,* 10(11): pp 1121-1133.

Riviera J, Ruel MT (1997). Growth Retardation Starts in the First Three Months of Life Among Rural Guatemalan Children. *European Journal Clinical Nutrition*, Vol. 51(2):92-96

Ruel MT, *et al* (1990). Comparison of Mothers' Understanding of Two Child Growth Charts in Lesotho. *Bulletin of the Worl Health Organization*, 66 (4): 483-491

Schapira MM, Fletcher KE, Ganschow PS, *et al*., (2011). The meaning of Numbers in Health: Exploring Health Numeracy in a Mexican-American Population. *Journal Gen Intern Med*. 26(7):705-11

Setegn T, Belachew T, Gerbaba M, *et al.,* (2012). Factors Associated with Exclusive Breastfeeding Practices Among Mothers in Goba district, South East Ethiopia: A Cross-Sectional Study. *International Breasfeeding Journal* 2012, 7:17

Senanayake MP, Gunawardena MKS, Peiris DSP (1997). Maternal Comprehension of Two Growth Chart Monitoring in Sri Lanka. Archieves of Diseases in Childhood;76;359-361

Sohal H, Wilkinson D, Morley D (1998). The 'Growth Monitoring Teaching Aid' Rapidly Improves Mothers Understanding of Growth Curves. *Trop. Doct*.28(3):160-162.

Sulistiyorini C I, Pebriyanti S, Proverawati A (2010). Posyandu dan Desa Siaga. Panduan untuk Bidan dan Kader. Mulia Medika.

Sinaga H (unpublished, 2012). Pilot study on Bubble Score Chart at Posyandu Melati I dan II Lubuk Pakam Sub District, Deli Serdang Regency.

United Nations (2003). Indicators for Monitoring the Millennium Development Goals (MDGs). Definitions, Rationale, Concepts and Sources. New York

Appendix 1. Bubble Score Growth Chart (A3 size)   Appendix 2. Bubble Score Growth Chart (Front -s**ide)**
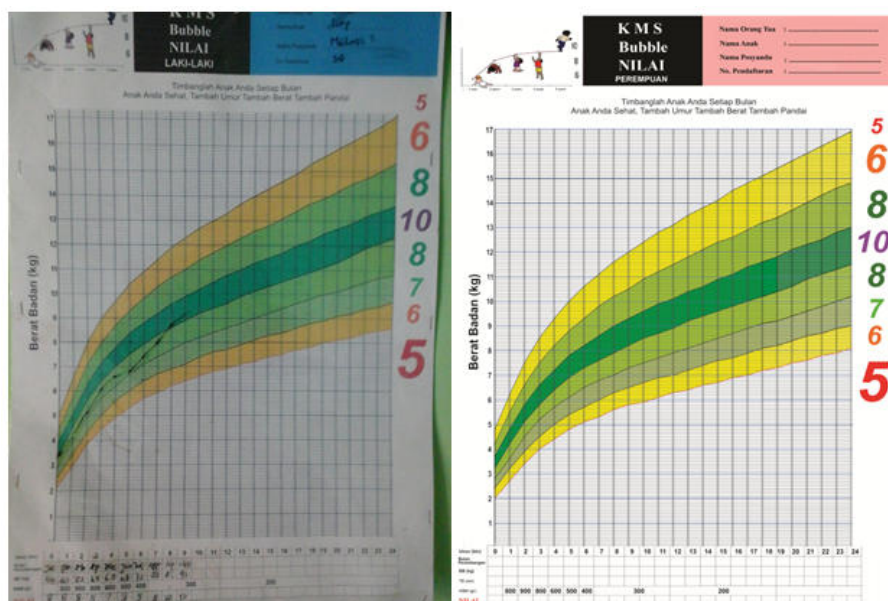
Appendix 3. Steps on Feeding Appropriate Foods for Child Age 0-24 Months (Back-Side)

Age (Month)	Textures	Portion and Frequency
0-6 month	Feed baby only with breast milk- no other milk, food, drinks not even water. In case mother has to give formula milk, consult with nutritionist or doctor the appropriate formula milk to be fed for your baby.	Breastfeed baby frequently at least 8 times per day. Prepare formula milk as instructed. Use clean bottle and boil the bottled after using.
6–7 month	Keep breastfeeding and start introducing semi solid complementary foods such as mashed cereal rice, pumpkin, alvocado, banana, green leafy vegetables mixed with breast milk or formula milk. Introduce one stuff for 2-3 days until the baby get the taste then change to another foods.Then introduce milk porridge, start with thinner porridge and gradually to thicker porridge. Avoid giving eggs, fish and meat.	Breastfeed baby frequently at least 8 times per day. Give complementary foods 2-3 times per day. Start with 2-3 tablespoons and gradually improve to 6-7 tablespoons per day.
8-9 month	Keep breastfeeding and start introducing the solid complementary foods such as : cereal rice porridge, pure carrot mixed with eggs, tempeh, tofu, fish, meat. Introduce 2-3 kinds of stuff for 2-3 days untill the baby get the taste then change to another foods. Let the baby taste the original taste and do not give sour taste foods and sugar	2-3 meals plus frequent breastfeeding. Start with 4-5 tablespoons and gradually improve to be 8-10 tablespoons. Offer nutritious snack between meal such as sweet orange juice, papaya, banana two times per day.
10-12 month	Keep breastfeeding and more variation of solid complementary foods such as soft rice mixed with 2 kinds of vegetables and 1 protein source such as egg, tempeh, tofu, fish, meat, peanuts. Introduce 3-4 kinds of stuff for 4-5 days until the baby get the taste then change to another stuffs. To enhance the energy content and taste, add coconut milk, a teaspoonful of fried oil. Sugar, honey can be added to child's food.	3-4 meals per day plus frequent breastfeeding. Start with 6-7 tablespoons and gradually enhance to be 10-12 tablespoons. Offer nutritious snacks in between meal such as fruits soup, green peanut porridge, biscuits, breads two times per day.
12–24 month	Keep breastfeeding baby until aged 2 years. Family foods have been able given to child. Plain rice with 2 kinds of vegetables and 2 protein source such as egg, tempeh, tofu, fish, meat, peanuts. Don't give child the strong spicy food.	3-4 meals per day plus breastfeeding. Offer nutritious snacks in between meal such as fruits soup, formula milk. cheese, biscuits, breads two times per day.

Appendix 4. Guidelines on Interpretation of Child's Growth Status and Advices for Parents (Back-side)

Weighing Status	Score	Interpretation	Advices for Parents
Three months Not Increase	3	Child's growth is in "dangerous" because body weight not increase during three months.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep every things given to child clean and safe.
Two months Not Increase	4	Child's growth is failure because body weight not increase during two months.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep everythings given to child clean and safe.
Increase	5 upper	Child's growth is extremely fast and suffer from Obese. The child might be having hormonal disorder	Check your child's health to hospital to ensure the cause of obesity. Limited the fatty foods and improve child activities and follow foods guidelines.
Decrease		Child's growth is extremely fast and suffering from Obese, but tends to be overweight.	Check your child's health to hospital to ensure the cause of obesity. Limit the fatty foods and improve child activities.
Increase	6 upper	Child's weight is Overweight and tend to be obese.	Check your child's health to hospital to ensure the cause of obesity. Limit the fatty foods and improve child activities.
Decrease		Child's weight is Overweight but to be normal.	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child weight decreasing slowly
Increase	8 upper	Child's weight is Normal but tend to be overweight	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child health in order to gain or decrease weight slowly
Decrease		Child's weight is normal and tend to be quite normal.	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child in order to gain or decrease weight slowly.
Increase	5 lower	Child's weight is extremely Less but tend to be normal.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep everythings given to child clean and safe. Improve mothers' caring and feeding .
Decrease		Child's growth is in Dangerous and Abnormal tend to be severe malnutrition.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep everythings given to child clean and safe.
Increase	6 lower	Child's weight is Less Normal and tend to be normal.	Your child needs more nutritious foods. Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep everythings given to child clean and safe.
Decrease		Child's growth is in Dangerous and tend to suffer from severe malnutrition.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep everythings given to child clean and safe. Improve mothers' caring and feeding .
Increase	7	Child's weight is Less Normal but tend to be Normal	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child health in order to gain weight rapidly.
Decrease		Child's weight is Less Normal and tend be failure and suffering from malnutrition.	Your child could be suffering from chronic and infectious disease. Bring the child immediately to hospital/public health center to get doctor's diagnose. Keep everythings given to child clean and safe. Improve mothers' caring and feeding.
Increase	8 lower	Child's weight is NORMAL and tend to be Quite Normal.	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child health in order to gain more weight.
Decrease		Child's weight is NORMAL and tend to be Less Normal.	Keep feeding your child with appropriate foods and follow the steps as in the guidelines. Keep the child health in order to gain more weight.
Increase	10	Child's growth and the weight is quite Normal. The child is in optimum nutrition	Your baby is in optimum nutrition. Keep what you have done in caring and feeding your baby.
Decrease		Child's growth and the weight is quite Normal but tend to decrease	Your baby is in optimum nutrition. Keep what you have done in caring and feeding your baby. Avoid of losing weight

Appendix 5. Normal Growth Charts

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