IMPROVING IODINE STATUS OF CHILDREN

at Rural Area in West Java, Indonesia

Iodine deficiency is a major global public health problem, particularly for young children and pregnant women. Iodine has significant roles in developing immunity and cognitive function, especially among children, who were still in the growth period. The most important effect of iodine deficiency is irreversible impairment of neurocognitive development; and the most serious one is mental retardation and brain damage. This study was aimed to analyse effectiveness of nutrition promotion in improving iodine status of children at iodine endemic area. Subjects involved were elementary school children, teachers, and mothers of school children, salt producers, salt traders, and District Governmental Offices Staffs. Nutrition promotions delivered were nutrition education, focus group discussion, seminar, and intensive advocation. This book discusses the root problem and solutions of iodine deficiency, including the impact of the nutrition promotion in tackling iodine deficiency problems comprehensively from supply side until consumption. Furthermore, it also discusses the sustainability of the nutrition promotion program.

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SUMMARY

Iodine deficiency is a major global public health problem, particularly for young children and pregnant women. According to WHO (2010), around 16 million people in Indonesia suffered from iodine deficiency. Iodine has significant roles in developing immunity and cognitive function, especially among children, who were still in the growth period. Study in Indonesia revealed that iodine deficiency disturbed intelligence growth, mainly on the school age children and caused lower learning output and school performance (Mutalazimah & Asyanti 2009). Out of 20 million people suffering from Iodine Deficiency Disorder (IDD) in Indonesia, the IQ loss is equivalent to 140 million points (Bappenas 2004).

The general objective of this study was to analyse effectiveness of nutrition promotion in improving iodine status of children at iodine endemic area. Specifically, the objectives of this study were: (1) to analyse the iodine content of salt circulated in markets and consumed by households, (2) to identify the root problems of unstandardized iodized salt circulated in markets, (3) to analyse nutritional knowledge, attitude, and practice of school children, mothers, and teachers, especially related to iodine, (4) to analyse iodine and other nutrients intake of children, and (5) to analyse the effects of nutrition promotion on iodine status of children, nutritional knowledge, attitude and practice related to iodine of children, mothers, and teachers.

The design of this study was pre-post test and control experimental design. The study was conducted at 8 sub-districts in Bogor District. From every sub-district, one elementary school with high iodine deficiency prevalence were selected. In total, the study was conducted at 8 elementary schools. This study

was conducted for 23 months, starting from October 2015 until August 2017. Simple random sampling technique was used to select the samples. Early on, there were 196 students, 192 mothers, 39 teachers, and 37 salt traders selected for this action research. However, due to several incomplete data, at the end of the baseline and endline study the samples consisted of 181 students and mothers, 38 teachers, and 32 salt traders.

The data collected were students' characteristics, nutritional status, food consumption, nutritional knowledge, attitude, practice (KAP), Urinary Iodine Concentration (on spot and 24-hour collection); socio-economic characteristics of family, mothers' nutritional status, food consumption, and KAP; teachers' characteristics and KAP; salt producers' and salt traders' characteristics; and iodized salt distribution and monitoring. Intervention of nutrition promotion were done in three major activities, namely nutrition education, Focus Group Discussion (FGD), and Seminar. To analyse the effect of intervention (nutritional education), several data were collected before and after nutritional education. The data consisted of urinary iodine excretion of children, nutrition knowledge, attitude, and practice of children, mothers, and teachers.

Statistical data analysis was based on the aims of the research and available data to answer the research problem objectively. This includes predictions of mean, standard deviation, minimum value, maximum value and proportion. The first four statistics (mean, standard deviation, minimum value, and maximum value) were calculated for all continuous variables and the estimation of proportion is made for all categorical variables. The estimation results were then presented in tables and diagrams. Difference test was done to analyse the effect of intervention on iodine status of children, and on nutritional knowledge, attitude, and practice, among subjects of children, mothers, and teachers. The research results are:

1. Most of salts sold by traders (75.0%) had an iodine content <30 ppm, while the rest of salt sold by traders (25%) had sufficient iodine content (30–80 ppm). Most of households (78.8%) consumed salt with iodine content <30 ppm, 20.1% of households consumed salt with sufficient iodine content based on SNI (30–80 ppm), and a few households (1.1%) consumed salt with iodine content more than SNI recommendation (>80 ppm).

2. The root problems of unstandardized iodized salt circulated in markets were lack of monitoring and supervision on the salt for consumption. Most of salt circulated in the market were produced by home industry. Although there is regulation that iodized salt must meet the SNI requirement and be registered in the National Agency of Drug and Food Control, there is no punishment for those who produce and sell unstandardized iodized salt.
3. Before nutrition education, the majority of students had poor nutrition knowledge and attitude and moderate nutrition practice. The majority of mothers had poor nutrition knowledge and practice and moderate nutrition attitude. The teachers' nutrition knowledge, attitudes, and practices had been relatively good.
4. The children's average intake of iodine was not adequate (less than 77% of RDA). The average intakes of energy, carbohydrate and fat were adequate (almost or more than 90% of RDA). However, the average protein intake was below the adequacy level (less than 90% of RDA). The average intake of minerals (calcium, phosphorus, and iron), vitamin B1 and vitamin C among these children was also inadequate (less than 77% of RDA). On the other hand, the average intake of vitamin A was adequate.
5. Independent t-test comparing the increase in students' nutrition knowledge score of the control group versus the intervention group showed a very significant difference ($p<0.01$) and also for students' nutrition attitude ($p<0.05$). It meant that intervention activities conducted in the form of nutrition education had succeeded in increasing nutrition knowledge and attitude of the elementary students. However, independent t-test showed no significant difference ($p>0.05$) in the increase of students' nutrition practice scores in the control group and the intervention group.

   Independent t-test showed that changes in baseline-endline mothers' nutrition knowledge and attitude scores in the intervention group were significantly much higher ($p<0.01$) than the control group. However, independent t-test showed that the changes in nutrition practice score in the control group were not significantly different ($p>0.05$) from the changes in nutrition practice score in the intervention group.

   Independent t-test showed that changes in teachers' nutrition knowledge scores in the intervention group were significantly higher ($p<0.01$) than the ones in the control group but not significant in nutrition attitudes and practices (p>0.05).

After the intervention, in the form of 2-month public education, there were changes in median values of urinary iodine of on spot urine collection. In the control group, there was a slight decrease in median value of UIC to 191 μg/l although this number (-0.6 μg/l) was not significant (p>0.05). Meanwhile, in the intervention group the UIC increased to 184 μg/l after the intervention. Eventhough there was an increase of 7.6 μg/l, but it was not significant (p>0.05).

After the intervention, there was an increase in UIC at 24-hour urine collection, either in the control group or the intervention group; i.e. 3.9 μg/l and 15.7 μg/l, respectively. There was no significant difference in the increase in UICs between the two groups (p>0.05). And according to independent t-test, there was not significant difference between the UIC of on-spot urine and 24-hour urine (p>0.05).

In this study, we found that the root problem of the unstandardized iodized salt circulated in the market is lack of monitoring and supervision from the government. Therefore, Industrial and Trade Office should increase monitoring and supervision to the salt industry and salt trader. There also should be a severe sanction for those who still produce or sell unstandardized iodized salt. It is better if this office also work together with other related offices, such as Health Office, the District Police Unit, and Regional Development Planning, Research and Expansion Agency (RDPREA) and form an IDD team.

We also found that with nutrition education, the nutrition knowledge and attitude of children and mothers significantly increase but not the nutrition practice. Teachers have opportunity to deliver nutrition education through various courses (e.g. biology, science, and sport).

ACKNOWLEDGMENT

This project consumed huge amount of work and dedication. Still, the research would not have been possible if we did not have support from many individuals and organizations. Therefore we would like to extend our sincere gratitude to all of them.

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INTRODUCTION

1.1 Background

Iodine deficiency is a major global public health problem, particularly for young children and pregnant women. Iodine is required for the synthesis of thyroid hormones, which in turn are needed for the regulation of metabolic activities of all cells throughout the life cycle. They are also required to ensure normal growth, especially of the brain, which occurs from foetal life to the end of the third postnatal year (Delange 1994). The most important effect of iodine deficiency is irreversible impairment of neurocognitive development; and the most serious one is mental retardation and brain damage. Lack of iodine resulting in hypothyroidism during the vulnerable period of brain development, that is, at foetal life and the first year, can cause irreversible impairment in brain structure and function (Zimmermann 2007). Mild and severe iodine deficiency cause low motivation in taking classes, and also weaken mental and motoric functions. Meta-analysis of 18 studies revealed that IQ score decreased by 13.5 point among children with iodine deficiency (WHO 2001).

Extensive studies throughout the world over the last 20 years have revealed that 130 countries are affected by iodine deficiency, with a total population of 2.2 billion at risk of the occurrence of varying degrees of brain damage (WHO/UNICEF/ICCIDD 1999). Zimmermann (2003) also mentioned that from Urinary Iodine Excretion (UIE) test, there were 2 billion people all over the world suffered from iodine deficiency, and around 285 million of them were school children.

Around 16 million people in Indonesia suffered from iodine deficiency. Iodine has significant roles in developing immunity and cognitive function, especially among children, who were still in the growth period. Study in Indonesia revealed that iodine deficiency disturbed intelligence growth, mainly on the school age children and caused lower learning output and school performance (Mutalazimah & Asyanti, 2009). Out of 20 million people suffering from Iodine Deficiency Disorder (IDD) in Indonesia, the IQ loss is equivalent to 140 million points (Bappenas 2004).

According to Harahap (2004), next to low in iodine intake from food, the other cause of iodine deficiency is due to several kinds of foods consumed in the developing countries that contain goitrogenic substance, which inhibits the iodine absorption by thyroid. The goitrogenic substance can be found in some kinds of foods, such as cassava, and vegetables belonging to various kinds of cabbages. In Sarawak (Malaysia), the consumption of cassava was found correlated with goitre and cretin prevalence.

IDD mapping in 1982 and 1998 have shown an encouraging decrease in prevalence rate, namely from 27.7% to be 9.8%. Although there was a significant drop, IDD was still considered as the society's health problem, because in general the prevalence was still above 5%. From the results of a national survey conducted in 2003, it was known that IDD prevalence as indicated by TGR (Total Goitre Rate) of the school children was still around 11.1%. The survey also showed that 35.8% of the districts in Indonesia was slightly endemic, 13.1% of them was moderately endemic, and 8.2% of them was severely endemic (Bappenas 2004).

To overcome iodine deficiency, Indonesian government has already implemented salt iodization as mandatory fortification since 1975 to eliminate iodine deficiency among the people. A National Action Plan on IDD 2005-2010 stated that indicators used to monitor and evaluate IDD were the household consumption of iodized salt and the median of the people UIE as much as 100-299 μg/L. Meanwhile, TGR was not applied anymore due to its low sensitivity and specificity as well as the change of TGR occurrence requiring a long time. In 2005, one of the National nutrition programs of universal salt iodization (USI) was to increase the number of households consuming iodized salt to be 90%. However, the results of Indonesia Basic Health Research (IBHR) (MoH 2013[a]) showed that the program is still less successful, indicated by only 77.1% households at national level and 68.6% in West Java Province consuming salt with adequate amount of iodine. Indeed,the achievement is lower than expected, whereas the iodized salt consumption is one of the main channels that can be utilized to overcome the IDD problem.

Coverage of households with adequate iodized salt consumption varied among provinces in Indonesia, namely ranged from 27.9% (province of West Nusa Tenggara) and 98.7% (province of Bangka Belitung). Provinces with low coverage consisted of West Nusa Tenggara (27.9%), East Nusa Tenggara (31%), and West Sulawesi (34.2%). Provinces with moderate iodized salt coverage were West Java (58.3%), DKI Jakarta (68.7%), and Bengkulu (69.7%), whereas provinces with high iodized salt coverage were West Kalimantan (84.4%), North Sulawesi (89.2%), and Bangka Belitung (98.7%) (MoH 2009).

Our previous study in 2 districts of iodine endemic areas (Amalia *et al.* 2012) showed that the coverage of household consuming iodized salt adequately (30-80 ppm) was only 14.8% in highland and 8.8% in lowland areas. In addition, the average amount of iodine content in salt consumed by households in the highland and lowland areas was still lower than recommended, namely 21.8 ppm and 13.0 ppm respectively. This could indicate that salt distributed in community and consumed by people was mostly containing iodine lower than recommended amount. Other related studies also show the similar result. Other study in Minahasa (North Sulawesi), Bukittingi (West Sumatera), and Gunungkidul (Central Java) in 2007 indicated that the average iodine content of salt consumed by subjects were only 17.7 ppm, 16.8 ppm, and 21.6 ppm, respectively (Budiman & Sumarno 2007). In addition, Rasidi (2008) stated that 62.5% salt circulated in Temanggung city contained less than 30 ppm of iodine.

There are several factors that might be affecting this failure, such as low control of government on salt production and distribution with adequate amount of iodine, and low awareness of people on the importance of iodine for health so that low desire in selecting and purchasing iodized salt rather than non-iodized salt, etc. Our previous study also found that only 50% mothers knew the importance of iodized salt and only 75.2% mothers realized that iodine deficiency will impair cognitive development of children.

Regarding those previous studies, this study is aimed to improve nutrition knowledge, attitude and practice related to iodine among children, mothers, and teachers by nutrition education intervention. The intervention is expected to improve the iodine status. Since the vulnerable people of iodine deficiency are children, the subjects selected for the indicator of iodine status in this study are elementary school (ES) students. Attention to school children needs emphasizing as school children are still in growth phase and really need good intelligence. Children are easily affected by the iodine status in their body. In addition, the study is also intended to increase awareness of related stakeholders to control salt distributed in community.

1.2 Objectives

The general objective of this study was to analyse effectiveness of nutrition promotion in improving iodine status of children at iodine endemic area. Specifically, the objectives of this study are:

1. to analyse the iodine content of salt circulated in markets and consumed by households
2. to identify the root problems of unstandardized iodized salt circulated in markets
3. to analyse nutritional knowledge, attitude, and practice of school children, mothers, and teachers, especially related to iodine
4. to analyse iodine and other nutrients intake of children
5. to analyse the effects of nutrition promotion on iodine status of children, nutritional knowledge, attitude and practice related to iodine of children, mothers, and teachers.

2

METHOD

2.1 Research Design, Location and Time

The design of this study was pre-post test and control experimental design. The design was chosen because this study was aimed at analysing effectiveness of nutrition promotion to increase nutritional knowledge, attitude, and practice related to iodine among subjects and to improve iodine status of children. The study was conducted at 8 sub-districts in Bogor District, which were categorized as low coverage of iodized salt consumption, based on data and information obtained from Health Office of Bogor District. From every sub-district, one elementary school with high iodine deficiency prevalence were selected, based on information from Education Office of Bogor District. Hence, in the total, the study was conducted at 8 elementary schools. This study was conducted for 23 months, starting from October 2015 until August 2017.

2.2 Sampling

The sample populations from eight elementary schools were 423 students. Sampling was done based on the sampling frame obtained from the schools. Simple random sampling technique was used to select the samples. Early on, there were 196 students, 192 mothers, 39 teachers, and 37 salt traders selected for this action research. However, due to several incomplete data, at the end of the baseline and endline study the samples consisted of 181 students and mothers, 38 teachers, and 32 salt traders.

2.3 Data Collection

The data collected were primary data. The detail data that were collected from every subject and the methods of data collection are presented in Table 1.

Table 1. Type of data collected and the method of data collection from every subject

No	Subjects	Variable of Data	Method of Data Collection	Instrument Required
1.	Elementary school children	Individual characteristics (sex, pocket money, order of child in family)	Interview	Questionnaire
		Body Weight (BW)	Weighing	Digital weighing scale
		Body Height (BH)	Direct assessment	Stature meter
		Food consumption	Interview	Questionnaire, with technique of 2 days 24 hour recalls
		Food consumption of iodine source	Interview	Questionnaire, with technique of SQ-FFQ containing the list of iodine food source
		Nutritional Knowledge, Attitude, Practice (KAP) (pre- & post- intervention)	Interview	Questionnaire
		Urinary iodine excretion (pre- & post- intervention)	on spot urine collection, collected in the morning	Small tube
		24-hour urinary iodine excretion (pre- & post- intervention) of the low iodine urine status based on UIE analysis result of on spot method	24 hour urine collection (sub sample)	Urine plastic bag

Table 1. Type of data collected and the method of data collection from every subject (Continued)

No	Subjects	Variable of Data	Method of Data Collection	Instrument Required
2	Mothers of children	Socio-economic characteristics of family (education, occupation, income)	Interview	Questionnaire
		Body Weight (BW)	Weighing	Digital weighing scale
		Body Height (BH)	Direct assessment	Stature meter
		Food consumption	Interview	Questionnaire, technique of 2 days 24 hour-recall
		Nutritional Knowledge, Attitude, Practice (KAP) (pre- & post- intervention)	Interview	Questionnaire
3	Teachers of elementary schools	Characteristics of teachers (education, length of teaching)	Interview	Questionnaire
		Nutritional Knowledge, Attitude, Practice (KAP) (pre- & post- intervention)	Interview	Questionnaire
4	Salt producers	Salt production, iodine requirement, fortification technique, constrain/ problems during production & distribution	Interview at visit time	Questionnaire
5	Salt traders	- Number of salt sold per month and price of salt. - Iodine content on salt	- Interview - Sampling	- Questionnaire. - Container for salt
6	Staffs of District Industrial Office	Mechanism and constrain on production and supervision of iodized salt production	FGD	Form FGD
7	Staffs of District Trade Office	Mechanism and constrain on distribution and supervision of iodized salt trading	FGD	Form FGD

Table 1. Type of data collected and the method of data collection from every subject (Continued)

No	Subjects	Variable of Data	Method of Data Collection	Instrument Required
8	Staffs of District Health Office	- Mechanism of handling/ storing iodized salt - Mechanism of supervision of iodized salt utilisation at household level, to obtain data on household coverage	FGD	Form FGD
9	Staffs of District Education Office	Material enrichment with teaching tools related to salt and iodized salt	FGD	Form FGD

Before implemented, the questionnaire were tested on specified persons that represented subjects of this study to confirm the validity of the data collected. Data on nutritional knowledge, attitude, and practice (KAP) related to iodine and iodized salt were collected from subjects of children, mothers, and teachers. The data of pre intervention were collected before the initial nutrition education started, whereas the data of post-intervention will be collected one or two day after completion of nutrition education. The data were collected by interview using a questionnaire. The questions and statement written on questionnaire to examine the nutritional knowledge, attitude, and practice of the subjects were in line with the material presented at nutrition education intervention.

Salt sample were obtained from salt traders and households of the subjects. The salt sample and the urine sample were analysed at a specific laboratory, namely Laboratory of IDD research in Magelang, Central Java.

The urine sample were collected and further analysed for iodine level and the iodine status of the children. The urine sample collection were conducted by on spot method and 24-hour method. The on spot method were done for all subjects (181 children). The 24-hour collection method were applied to half of the subjects. We chose 2 control schools and 2 intervention schools which were nearer and more accessible from campus to collect the 24 hour urine. The urine of pre-intervention were collected before the first meeting of nutrition education intervention, whereas the urine sample of post-intervention were collected at one or two days after the final session of nutrition education completed. The urine sample were put in a small tube (for on spot method) and in urine plastic bag (for 24-hour method), be sealed, and be coded according to the subject identity. The urine sample were collected in the morning.

To analyse the effect of intervention, several data were collected before and after intervention. The data consisted of urinary iodine excretion of children, nutrition knowledge, attitude, and practice of children, mothers, and teachers.

2.4 Implementation of Intervention

Intervention of nutrition promotion were done in three major activities, namely nutrition education, Focus Group Discussion (FGD), and Seminar. Focus group discussion and seminar were intended for salt producers, staffs of local government of ministry of industry, ministry of trade, ministry of health, and ministry of education. To prepare and to enrich the pre-material for FGD, visit to several salt producers was needed in advance. Then, to monitor the application of ideal universal salt iodization (USI) as were discussed on FGD and seminar, the follow up activity such as advocation was required.

A. Nutrition Education

Nutrition education was delivered to 94 students, 94 mothers, and 21 teachers of intervention group. Nutrition education for students, mothers and teachers were conducted separately. The nutrition education was consisted of four topics related to nutrition and iodine, namely 1) Macronutrients, 2) Micronutrients, 3) Balanced Nutrition, and 4) Iodine and Iodized Salt. Degree of participation along with 4 sessions of nutrition education was:

a. Students : 93% - 100% (87-94 participants)
b. Mothers : 87% - 94% (82-88 participants)
c. Teachers : 95% - 100% (20-21 participants)

The media used for nutrition education for every subject were:

a. Students : powerpoint (slide), leaflet, poster, and booklet
b. Mothers : powerpoint (slide), leaflet, booklet
c. Teachers : powerpoint (slide), leaflet, poster, and booklet

The topics of nutrition education were given in four non-consecutive days, approximately every two weeks. The participants' enthusiasm was relatively high. This can be seen from the high degree of participation.

B. FGD for Stakeholders

Prior to focus group discussion, the researchers made visitation to several salt industries which were iodized salt suppliers in Bogor District as the area of this study. The producers were located in Bogor, Karawang and Tangerang. The visitation were accompanied by Staffs of District Industrial Office. The result of the visitation had been discussed on the FGD.

Focus group discussion (FGD) was designed and intended to improve the awareness of the stakeholders. The FGD deeply discussed any aspects related to iodized salt utilization on community.

Focus group discussion were conducted one time in Bogor District. FGD were held in Fave Hotel Bogor on November 15th 2016 and were participated by Food and Drug Administration, Province and District Industrial and Trade Office, District Health Office, and District Education Office. Through FGD, the data that had been collected were:

1. Mechanism and constraint on iodized salt production
2. Mechanism and constraint on iodized salt distribution
3. Mechanism of supervision on iodized salt production
4. Mechanism of supervision on iodized salt distribution
5. Mechanism of handling and storage of iodized salt
6. Enrichment of curricula containing material of nutrition and iodized salt
7. Mechanism of supervision on iodized salt utilization at household level, to obtain data on coverage of iodized salt

C. Half-day Seminar

The half-day seminar were conducted once, in Bogor District, on February 9th 2017. The seminar was intended to socialize and convince the importance of iodized salt for health and cognitive, which must be supported by every related aspect, starting from production, distribution, consumption; and to succeed the Universal Salt Iodization program in Indonesia. The speakers were: District Health Office, Psychologist, and academician. The participants were: District Industrial and Trade Office of Bogor District, District Education Office of Bogor District, District Health Office of Bogor District, and School Teachers who participated as subjects in this study.

D. Intensive Advocation

As the following of the result of the FGD and the half seminar above, the researchers conducted an intensive advocation to assure that the government will change the monitoring process of iodized salt which is produced (containing minimum 30 ppm), distributed (well packaged), and consumed in the community. The intensive advocation is intended to and was participated by District Government, Regional Development Planning Agency, the District Industrial Office, District Trade Office, District Health Office, District Education Office, and District Legislative of Bogor. In their formal function, the District Legislative has an apparent role in controling the related stakeholder performance and implementation.

Before starting the advocation, on February 3rd 2017 the research team had a discussion with Mr. Rozy Afrial Jafar, Program Officer of Iodine Deficiency Disorders Program for Micronutrient Initiative (MI) in Indonesia. The discussion was to plan the strategy for intensive advocation and how to approach the District Government to establish an IDD team.

The first approach was to have a meeting with District Health Office. After that, a staff from District Health Office was assigned to help the team in approaching the Regional Development Planning Agency.

In the meetings several issue were discussed:

- Monitoring process of iodized salt at production, distribution, and consumption level.
- The importance of law enforcement for violations related to the production and distribution of iodized salt in the community.
- Proposing and initiating local/district regulation to support Universal Salt Iodization (USI).

2.5 Data Analysis and Management

A. Data Cleaning

The data collected will be checked to see whether it is complete and clean**.** If it is incomplete, the data must be completed and cleaned immediately.

B. Data Processing

Processing will include coding, entry, editing, combining sheets, and generating variables. For the data entry, a sheet structure is formerly prepared, containing names of variables, types, and decimal. After the data entry is done, editing begins, i.e. checking the data already entered with the data obtained from the questionnaire. A correction is made if there are some differences. For the purpose of analysis, the data in the form of sheets (using Excel) is imported to SPSS files.

Table 2. Type of data and processing

No	Type of Data	Data Processing
1	Iodine content of salt	Classifying a) <30 ppm b) 30-80 ppm c) >80 ppm
2	Individual characteristics (age, sex, pocket money)	Descriptive
3	Anthropometry (BW,BH) &age of children	BMI/A
4	Anthropometry (BW,BH) & age of mothers and teachers	BMI = BW (kg)/BH^2 (m^2)
5	Food consumption of children	Processed using Food Composition Table to be intakes data of energy, carbohydrate, protein, fat, vitamin A, vitamin C, calcium, Fe
6	Nutrient intake of children	Compare with RDA to be adequacy nutrition level
7	Food consumption of iodine source, excludes salt	Processed using Food Composition Table to be intakes data of iodine
8	KAP of children, mothers, teachers	Low : score<60 Moderate : score>60-79 High : score ≥80

Table 2. Type of data and processing (continued)

No	Type of Data	Data Processing
9	Urine of children	Determining median value
10	Socio-economics characteristics of family	- Education : Elementary school, junior high school, senior high school, universities - Occupation : private, government, fisherman, trader, labourer, farmer
11	Characteristics of teachers	Education, length of teaching
12	Teaching material enrichment with nutrient and iodine, aided by teaching tools	Descriptive
13	Salt production, iodine requirement, constrain/ problems during production, distribution	Input, process, output analysis
14	Mechanism and constrain during supervision of iodized salt production	Descriptive
15	Mechanism and constrain on distribution and supervision for iodized salt distribution	Descriptive (Input, process, output analysis)
16	Mechanism on handling/ storage of iodized salt	Input, process, output analysis
17	Mechanismon supervision and usage of iodized salt at household level,to obtain data on household coverage using iodized salt	Input, process, output analysis

C. Data Analysis

This includes predictions of mean, standard deviation, minimum value, maximum value and proportion. The first four statistics (mean, standard deviation, minimum value, and maximum value) were calculated for all continuous variables and the estimation of proportion was made for all categorical variables. The estimation results were then presented in tables and diagrams. Difference test was done to analyse the effect of intervention on iodine status of children, and on nutritional knowledge, attitude, and practice, among subjects of children, mothers, and teachers.

3

DESCRIPTION OF THE STUDY SITES

3.1 Geographic Condition of Bogor District

Bogor District has a diverse morphological type of area, ranging from the relatively low plains in the north to the highlands in the south. Approximately 29.28% of Bogor District areas are at an altitude of 15-100 m above sea level (a.s.l), 42.62% at an altitude of 100-500 m a.s.l, 19.53% at an altitude of 500-1,000 m a.s.l, 8.43% at an altitude of 1,000-2,000 m a.s.l and 0.22% at an altitude of 2,000-2,500 m a.s.l (BPS 2016[a]).

Bogor District is geographically located at position of latitude 6^{0}19’N and 6^{0}47’S, as well as longitude 106^{0}01’E and 107^{0}103’E. It is a very strategic area because it is adjacent to the capital city of Republic of Indonesia (Jakarta); thus, it becomes the buffer area of Jakarta. The total area of Bogor District is 2,663.81 km^2. At the end of 2015, its administrative area consisted of 40 sub-districts. Based on the total area, Jasinga Sub-district is the largest (208.06 km^2) and the second largest area is Cigudeg Sub-district (158.89 km^2). Meanwhile, the sub-district with the smallest area is Ciomas Sub-district (16.30 km^2) (BPS 2016[a]).

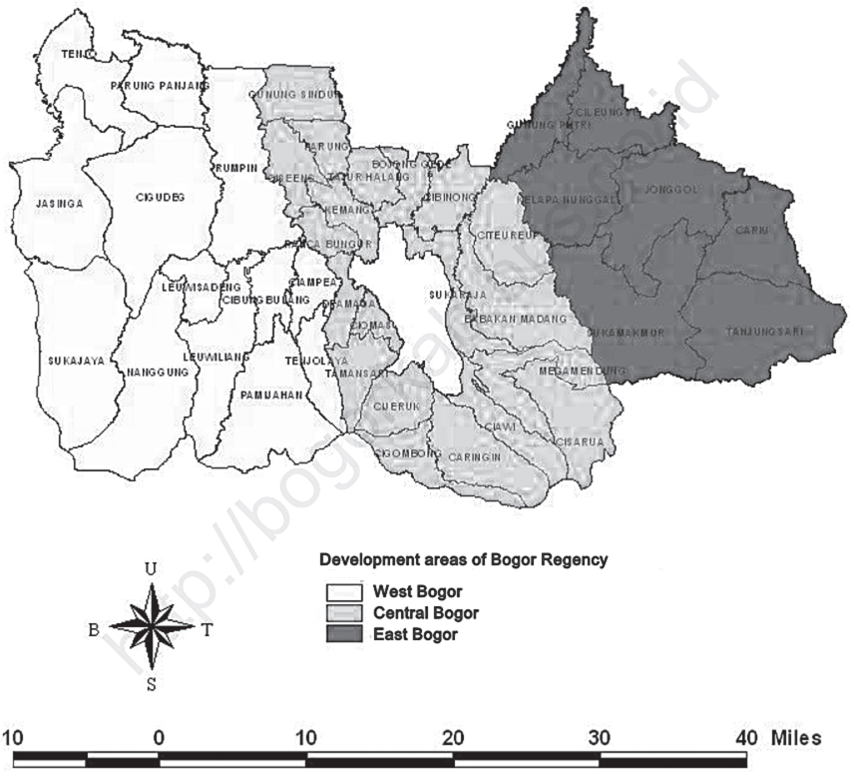

Figure 1. Map of Bogor District Area

3.2 Education

Good-quality human resource (HR) is one of the main factors of successful development in a region. Therefore, through education channels, the government consistently strives to improve the human resources of the population through various programs. One of the indicators used to see the success in the field of education is illiteracy rate; meaning that low illiteracy rate indicates the success of illiteracy alleviation program, and it must be supported by adequate educational facilities to achieve this program's goal. The number of elementary schools in various sub-districts in Bogor District in 2015 were as follows: 47 schools in Nanggung Sub-district, 60 in Leuwiliang Sub-district, 35 in Parung Sub-district, 64 in Rumpin Sub-district, 54 in

Cigudeg Sub-district, 60 in Jasinga Sub-district, 36 in Tenjo Sub-district, and 49 in Parungpanjang Sub-district (BPS 2016[a]).

In Bogor District, there are still 2.05% of people at the age of 15 and above who are illiterate and one-third (33.57%) of people aged 7-24 years are no longer attending school. In Bogor District, education level of the people is still very low. Based on National Socio-Economic Survey in 2015, almost two thirds (73.80%) of the people aged 15 years and above in Bogor District had a maximum education as junior high school graduates/equivalent. Only 4.88% of people aged 15 years and above in Bogor District who were diploma/ university graduates. The level of education completed is an indicator of the quality of human resources in a region (BPS 2016[b]).

3.3 Health Facilities and Status

Health is one of the important parts in order to improve human resources of the people in Bogor District. Therefore, health programs have been initiated or prioritized on future generations. With the program, a good degree of community health is expected to be achieved that will eventually increase productivity. One of the efforts to improve the degree of public health is by the addition of medical personnel. Puskesmas (public health center) is the closest health facility to the community (BPS 2016[a]).

The number of Puskesmas in Bogor District in 2015 were 101 Puskesmas, 117 health outposts (Pustu) and 37 mobile public health centers (Pusling). The number of health workers in Bogor District in 2015 consisted of 279 medical personnels, 835 midwives and 492 nurses (BPS 2016[a]).

Most (94.25%) of the children under two years of age (0-23 months) have been breastfed. Based on sex, the percentage of male children under two years who have been breastfed is lower than the female ones. Of the breastfed children under two years, half of them (56.40%) were breastfed for less than 12 months and 14.22% of them were breasfted until 20-23 months. Mean duration of breastfeeding in male children under two is lower than the female ones (BPS 2016[b]).

4

SOCIOECONOMIC DEMOGRAPHY

4.1 Characteristics of Mothers

Table 3 shows that most of the mothers aged around 30-40 years with mean maternal age of 37.5 years in the control group and 38.1 years in the intervention group. In both groups, it can be seen that 5.5% of the mothers are widows.

In this study, most of the maternal education were still relatively low. It can be seen in Table 3 which shows that 43.7% of the mothers were elementary-school graduates and 34.8% of them did not complete the elementary education. This shows that most of the mothers did not fulfill the basic education level, because basic education level – according to Law No. 20 Year 2003 Article 17 – is the education level that underlies the level of secondary education. Basic education is in the form of elementary school and junior high school or other equal forms.

Table 3 shows that most of the mothers, either in the control group (84.8%) or the intervention group (83.2%) worked as housewives. Meanwhile, 15.2% of the mothers in the control group and 16.8% of the mothers in the intervention group worked as traders/entrepreneurs, laborers/farmers, or teachers/employees.

Table 3. Distribution of mother's characteristics

Variables	Control (n=92)		Intervention (n=89)		Total (n=181)	
	n	%	n	%	n	%
Maternal Age						
<30 years	10	10.9	9	10.1	19	10.5
30-40 years	57	62.0	49	55.1	106	58.6
>40 years	25	27.2	31	34.8	56	30.9
Mean±SD (yo)	37.5±7.3		38.1±8.4		37.8±7.8	
Marital Status						
Married	88	95.7	83	93.3	171	94.5
Widow	4	4.4	6	6.7	10	5.5
Education Level						
Not attending school/did not complete elementary school	34	37.0	29	32.6	63	34.8
Elementary school	41	44.6	38	42.7	79	43.7
Junior high school	9	9.8	14	15.7	23	12.7
Senior high school	8	8.7	7	7.9	15	8.3
Diploma	0	0.0	1	1.1	1	0.6
Mean±SD (yo)	5.9±2.9		6.1±3.0		6.0±3.0	
Occupation						
Housewife	78	84.8	74	83.2	152	84.0
Trader/entrepreneur	9	9.8	11	12.4	20	11.1
Laborer/farmer	3	3.3	2	2.3	5	2.8
Teacher/employee	2	2.2	2	2.3	4	2.2
Family Size						
Small (≤4 persons)	36	39.1	36	40.5	72	39.8
Medium (5-7 persons)	46	50.0	42	47.2	88	48.6
Large (>7 persons)	10	10.9	11	12.4	21	11.6
Mean±SD (persons)	5.4±1.9		5.2±1.7		5.3±1.8	

According to National Population and Family Planning Board/BKKBN (2010), the so-called small family is the one with ≤ 4 family members, while others are defined as medium-sized family (5-7 people) and large family (>7 people). In this study, family size was classified into three groups, just as the classification determined by BKKBN. In Table 3, it can be seen that most of the families, either in the control group or in the intervention group, fall into "medium-sized family" category with a total of 5-7 family members. The proportion of small family in the intervention group (40.5%) was almost similar to the control group (39.1%). In general, the mean number of family members was 5.3 people (fell into "medium-sized family" category).

4.2 Income and Expenditure

Income is one of the indicators that determines the social class of a family in the community. The higher the income, the higher the social class of the family. The results showed that the majority of monthly family income (<IDR 2.5 million) in both groups remained below the Minimum Wage of Bogor District (IDR 2,975,000). However, mean monthly family income in the intervention group was higher than the control group (Table 4).

Table 4. Distribution of subjects based on monthly family income (IDR)

Income	Control (n=92)		Intervention (n=89)		Total (n=181)	
	n	%	n	%	n	%
<2.5 million	62	67.4	59	66.3	121	66.9
2.5-5 million	27	29.4	18	20.2	45	24.9
>5 million	3	3.3	12	13.5	15	8.3
Mean±SD	2,229,088±1,644,697		2,906,318±3,408,947		2,562,090±2,676,592	

According to MoH (2014), if the percentage of expenditure used to fulfill non-food needs is lower than the food expenditure, then this condition reflects the characteristics of developing country. In this study, monthly per capita of non-food expenditure in both groups was higher than monthly per capita of food expenditure (Table 5). The expenditure for side dishes was the largest food expenditure in both groups.

The largest non-food expenditure between the control and the intervention groups was different. The expenditure for installments/credit/*arisan* was the largest expense (IDR 85,759) in the control group, while the largest expenditure in the intervention group was cigarette expenditure (IDR 64,226). However, the cigarette expenditure in the control group (IDR 64,723) was almost similar to the intervention group.

Table 5. Mean per capita expenditure (IDR/month)

No.	Types of expenditure	Control (n=92)		Intervention (n=89)		Total (n=181)	
		Mean	%	Mean	%	Mean	%
1	**Food**	**242,679**	**39.3**	**298,419**	**44.8**	**270,087**	**42.1**
	1. Staple food	60,188	9.7	63,736	9.6	61,933	9.6
	2. Side dishes	85,728	13.9	103,176	15.5	94,307	14.7
	3. Vegetable	25,361	4.1	37,123	5.6	31,145	4.9
	4. Fruit	11,304	1.8	25,913	3.9	18,487	2.9
	5. Snack	60,098	9.7	68,471	10.3	64,215	10.0
2	**Non-food**	**375,081**	**60.7**	**368,255**	**55.2**	**371,724**	**57.9**
	1. Health/treatment	2,376	0.4	3,109	0.5	2,737	0.4
	2. Cigarettes	64,723	10.5	64,226	9.6	64,479	10.0
	3. Hygiene	21,142	3.4	26,778	4.0	23,914	3.7
	4. Gas	10,199	1.7	14,684	2.2	12,404	1.9
	5. Electricity	16,596	2.7	16,230	2.4	16,416	2.6
	6. Water	2,138	0.3	734	0.1	1,448	0.2
	7. Transportation	50,710	8.2	46,084	6.9	48,435	7.5
	8. School books	1,567	0.3	1,145	0.2	1,360	0.2
	9. Books-stationery	2,026	0.3	2,491	0.4	2,254	0.4
	10. Uniform	2,803	0.5	4,301	0.6	3,539	0.6
	11. School activities	865	0.1	2,496	0.4	1,667	0.3
	12. Pocket money	68,767	11.1	76,517	11.5	72,578	11.3
	13. Other educational activities	5,280	0.9	3,085	0.5	4,200	0.7
	14. Clothing	20,996	3.4	21,309	3.2	21,150	3.3
	15. Phone credit	16,313	2.6	21,719	3.3	18,971	3.0
	16.Installment/credit/ *arisan*	85,759	13.9	61,988	9.3	74,070	11.5
	17. Others	2,821	0.5	1,361	0.2	2,103	0.3
	Total Expenditure	**617,760**	**100.0**	**666,674**	**100.0**	**641,812**	**100.0**

4.3 Characteristics of School Children

In this study, most of the school children in the control and intervention groups were girls. Mean age of the school children who became the study subjects was 11 years, and all of them were in the 5th grade (Table 6).

Table 6. Distribution of school children based on sex and age

Variables	Control (n=92)		Intervention (n=89)		Total (n=181)	
	n	%	n	%	n	%
Sex						
Boys	41	44.6	42	47.2	83	45.9
Girls	51	55.4	47	52.8	98	54.1
Age						
9-10 years	11	12.0	4	4.5	15	8.3
11-12 years	75	81.5	80	89.9	155	85.6
13-14 years	5	5.4	5	5.6	10	5.5
Mean±SD (yo)	11.29±0.78		11.43±0.68		11.36±0.74	

According to MoH (2014), School Participation Rate (SPR) can be generally categorized into three age groups; i.e. 7-12 years old that represents elementary school age, 13-15 years old representing the age of junior high school students, and 16-18 years old representing the age of senior high school/vocational high school students. The data in Table 6 shows that 5.4% of school children in the control group and 5.6% in the intervention group were in the age range of 13-14 years, the same level of junior high school age. It probably happened because the students were at the late school age when attending the elementary school or they had repeated a grade (grade retention).

Most of the school children, either in the control group or the intervention group, were the 3rd child with mean number of siblings 3.7 people in the control group and 3.8 people in the intervention group (Table 7). However, there were still school children with ≥ 7 siblings; i.e. 13.0% in the control group and 11.2% in the intervention group. It probably happened because the parents did not participate in Family Planning (FP) program. Whereas according to MoH (2014), family planning program is a strategy to prevent mothers from giving birth too often or to decrease maternal mortality due to childbirth at an extremely young age (under the age of 20), short interdelivery interval, and giving birth at an extremely old age (over the age of 35). FP is also one of the most effective ways to improve family resilience, health, as well as the health of the mothers, children and women.

Table 7. Distribution of school children based on birth order and number of siblings

Variables	Control (n=92)		Intervention (n=89)		Total (n=181)	
	n	%	n	%	n	%
Birth Order						
1st child	26	28.3	20	22.5	46	25.4
2nd child	26	28.3	23	25.8	49	27.1
3rd child and so on	40	43.5	46	51.7	86	47.5
Number of Siblings						
1-3	54	58.7	47	52.8	101	55.8
4-6	26	28.3	32	36.0	58	32.0
≥7	12	13.0	10	11.2	22	12.2

In this study, most of the school children in both groups were given pocket money of ≤IDR 5,000 by their parents (Table 8). Mean pocket money of the school children given by the parents in the control group (IDR 5,049) was slightly greater than the intervention group (IDR 4,820). The school children needs to be given good guidance from their parents, especially in terms of using pocket money to buy snacks at school.

Table 8. Distribution of school children based on the pocket money for snacks

Pocket money	Control (n=92)		Intervention (n=89)		Total (n=181)	
	n	%	n	%	n	%
≤ IDR 5,000	73	79.3	73	82.0	146	80.7
> IDR 5,000	19	20.7	16	18.0	35	19.3
Mean±SD (IDR)	5,049±1,970		4,820±2,015		4,936±1,990	

4.4 Characteristics of Teachers

Most of the teachers who were subjects in this study aged more than 40 years old, with mean age of 39.1 years in the control group and 40.2 years in the intervention group (Table 9). In this study, it could also be seen that most of the teachers were university graduates.

Table 9 shows that some teachers who became the subjects in this study also served as headmasters. Most of the teachers in the control group have been teaching for 10-20 years, while most of the teachers in the intervention group have been teaching for more than 20 years. However, the teachers' mean duration of teaching in both groups were similar; i.e. 16.8 years in the control group and 16.7 years in the intervention group. There were more teachers in the intervention group who had attended nutrition training compared to the ones in the control group. In the control group, only one teacher (5.6%) that had attended nutrition training.

Table 9. Distribution of teachers based on sex, education history, and nutrition training

Variables	Control (n=18)		Intervention (n=20)		Total	
	n	%	n	%	n	%
Age						
<30 years	6	33.3	7	35.0	13	34.2
30-40 years	4	22.2	2	10.0	6	15.8
>40 years	8	44.4	11	55.0	19	50.0
Mean±SD	39.1±13.2		40.2±12.5		39.7±12.7	
Education Level						
Senior high school/equivalent	3	16.7	2	10.0	5	13.2
2-year diploma	0	0.0	3	15.0	3	7.9
University	15	83.3	15	75.0	30	78.9
Position						
Headmaster	4	22.2	4	20.0	8	18.4
Teacher	14	77.8	16	80.0	30	81.6
Teaching Duration						
<10 years	5	27.8	7	35.0	12	31.6
10-20 years	7	38.9	5	25.0	12	31.6
>20 years	6	33.3	8	40.0	14	36.8
Mean±SD	16.8±11.9		16.7±12.2		16.7±11.9	
Participation in Nutrition Training						
Yes	1	5.6	10	50.0	11	28.9
No	17	94.4	10	50.0	27	71.1

5

CHARACTERISTICS OF SALT FOR CONSUMPTION

5.1 Characteristics of Iodized Salt from Household

Iodized salt used as "salt for consumption" is product of food that had sodium chloride (NaCl) as the key component and had been fortified with potassium iodate (KIO3) minimum 30 ppm (Indonesia National Standard/ SNI 2010). Based on Table 10, it is known that only 20.1% of the total households (27.1% of control households and 12.9% of intervention households) consumed salt with iodine content according to SNI (30-80 ppm), while most of the households (78.8% of households; i.e. 71.9% of the control households and 86.0% of the intervention households) consumed salt with iodine content of <30 ppm, and the rest (1.1% households; i.e. 1.0% of the control households and 1.1% of intervention households) consumed salt with iodine content of >80 ppm.

Table 10. Distribution of iodized salt from household based on iodine content

Category	Control (n=96)		Intervention (n=93)		Total (n=189)	
	n	%	n	%	n	%
<30 ppm	69	71.9	80	86.0	149	78.8
30-80 ppm	26	27.1	12	12.9	38	20.1
>80 ppm	1	1.0	1	1.1	2	1.1
Mean±SD (ppm)	23.61±17.26		20.40±16.57		22.03±17.00	

If compared with the Basic Health Research (Riskesdas) data in 2013 (MoH 2013[a]), the number of households consuming salt with sufficient iodine content in this study was still very low (20.1%) because the percentage at the national level reached 77.1%. Similarly, it is still considered very low when compared with the target of Universal Salt Iodization (USI) or "iodized salt for all" programs, which require that at least 90% of households consume salt with sufficient iodine content.

5.2 Characteristics of Iodized Salt from Salt Traders

Based on Table 11, it is known that 75% of salts sold by traders had an iodine content of <30 ppm. The rest of the salt (25%) sold by traders had sufficient iodine content (30-80 ppm). There is still a large number of salt that does not meet the requirement for iodine content, and it may become a problem for alleviating iodine deficiency disorders (IDDs). People will have difficulty accessing good-quality salts (sufficient iodine content).

Table 11. Iodine content of salt at the trader level

Salt's iodine content	n (brand of salt)	%
<30 ppm	15	75.0
30-80 ppm	5	25.0
>80 ppm	0	0.0
Total	20	100.0
Mean±SD (ppm)	23.13±18.19	

Characteristics' distribution of the salts sold in the last one year can be seen in Table 12. The characteristics include types of the salt sold, consideration in choosing the brand of the salt sold, frequency of salt purchased in a month, the amount of salt purchased at one time, the storage place for salt to be sold, and salt storage duration before sale.

Based on Table 12, all traders (100%) interviewed at the research sites claimed that the salt they sold contained iodine, and the type of salt most sold by salt traders in this study was fine salt (43.8%). There were also salt traders (37.5%) selling two types of salt (i.e. fine salt and bricket salt), and the rest of them (18.8%) only sold bricket salt. According to Ministry of Health (MoH), Republic of Indoesia (2005), 68.8% of salt in Indonesia are fine-type salts. In addition, fine salt has a better quality in terms of iodine content and texture than bricket salt and coarse salt.

Table 12. Distribution of traders based on characteristics of salt sold in the last one year

Variables	n	%
Selling iodized salt		
Yes	32	100.0
No	0	0.0
Types of salt sold		
Fine	14	43.8
Bricket	6	18.8
Both	12	37.5
Considerations in choosing the brand of salt sold		
Cheap price	2	6.3
Contains iodine	4	12.5
Available brand	12	37.5
Saltier taste	1	3.1
Mostly sold in the market	13	40.6
Frequency of salt purchased in a month (mean±SD)	1.63±0.79	
Once	17	53.1
Twice	11	34.4
Thrice	3	9.4
4 times	1	3.1
Amount of salt purchased at one time		
< 5 kg	15	46.9
5-10 kg	12	37.5
>10 kg	5	15.6
The storage place for salt to be sold		
Exposed to sunlight	21	65.6
Not exposed to sunlight	11	34.4
Salt storage duration before sale		
< 2 weeks	5	15.6
> 2 weeks	15	46.9
> 1 month	12	37.5

Traders have various considerations in choosing the salt brand that will be sold. They choose to sell a particular brand of salt because the brand was mostly sold in the market (40.6%), or the brand was available in their regions (37.5%). The availability of iodized salt varies in each region.

Table 12 also shows that most of the traders buy the salt for sale only once a month (53.1%), and there are some traders who bought salt up to 4 times a month (3.1%) with amount of salt purchased at one time ranging from <5 kg (46.9%), 5-10 kg (37.5%) and >10 kg (15.6%). Most of the traders stored the salt that they would sell in the sunlight-exposed places (65.6%) and the rest (34.4%) stored the salt in places not exposed to sunlight.

Frequency of purchase will affect the storage duration of iodized salt. The more rare they buy iodized salt, it will affect the storage duration of the salt. Saputri & Moesijanti (2006) stated that storage duration can affect iodine content in iodized salt. The iodine content in salt also depends on the storage place. The good storage place is the sealed and opaque container, so that the stability of iodine in salt is not disrupted.

Most of the traders (46.9%) stored the salt before sale for more than 2 weeks. The rest (37.5%) stored the salt for more than one month, and a small number of them stored the salt for less than 2 weeks (15.6%). In their study, Singh & Rita (2014) stated that iodized salt stored for 15 days would have a decrease in iodine content by 2.24%, the one stored for 30 days would have a decrease in iodine content by 8.9%.

Based on Table 13, 40.9% of traders could sell more than 25 packs of salt in a month, 43.2% of traders could only sell ≤ 10 packs of salt, and the rest of them (15.9%) could sell more than 10-25 packs. The average amount of salt that could be sold by traders were 38.9±46.1 packs/month.

Mean salt weight that could be sold by traders in one month was 12.1±17.0 kg. Nearly half of traders (47.7%) only managed to sell ≤10 kg salt in a month, the other half (18.2% of traders) sold more than 10 kg to 25 kg of salt, and the rest could sell up to more than 25 kg. The price per pack of the salt sold by traders was IDR 1,659±914.

Table 13. Distribution of traders based on the amount of salt sold per month

Variables	n	%
The amount of salt sold (mean±SD)	38.9±46.1 packs	
≤ 10 packs	19	43.2
>10-25 packs	7	15.9
>25 packs	18	40.9
Weight of the salt sold (mean±SD)	12.1±17.0 kg	
≤ 10 kg	21	47.7
>10-25 kg	8	18.2
>25 kg	5	11.4
Price/pack (mean±SD)	IDR 1,659±914	

5.3 Characteristics of Iodized Salt from Salt Producers

Based on the analysis of iodized salt conducted by Testing Laboratory of Agro Industry Center – Ministry of Industry, Bogor on the samples of the brands of salt derived from the factory (Table 14), it was found that 84.6% of salt did not meet SNI and only 15.4% that met the requirement of iodine content; i.e above 30 ppm (30-80 ppm). This finding shows that the quality of salts widely circulated at this time is still very far from the quality the salts should have. It happens because the production of salt is still traditional, the supervision system has not been effective and the sanctions has not firmly enacted because approximately 90% of the salt producers are small entrepreneurs/home industry (Sudarmadji 2010 in Haitami 2015). According to MoH RI in *Kapantow et al.* (2013), the companies that have not applied the SNI are generally small industries, in which the instruments for iodization used by the producers are still simple; thus, the iodine content in the salt is not homogeneous.

Table 14. Iodine content of the salt brands sampled from factory

Category	n	%
<30 ppm	11	84.6
30-80 ppm	2	15.4
>80 ppm	0	0
Total	13	100.0
Mean±SD	12.56±10.12 ppm	

6

FOOD CONSUMPTION

6.1 Consumption of Iodine Food Source in School Children

The most frequently consumed iodine food source among school children in this study was fried chicken egg (Table 15). It was consumed 3.1 times a week both in control and intervention groups. The other iodine food sources that were consumed more than 2 times a week were sweetened condensed milk, fish, and sweet bread.

Major source of iodine is seafood. The other source is vegetables grown on iodine containing soil. Bread can contain iodine because some bakery industry uses iodine salts as dough conditioners. Milk also may contain iodine due to most dairies feed cows iodine-containing medications and use iodine to disinfect milking equipment (Rolfes *et al.* 2009).

Seafood contain various amount of iodine, for example 60 g of prawns contains 6 mcg of iodine, 100 g of canned tuna contain 12 mcg of iodine, 100 g of salmon fillet contain 14 mcg of iodine, 120 g of cod fish contain 230 mcg of iodine, and 120 g of haddock fish contain 390 mcg of iodine (Bath & Rayman, 2016). As recommended intake of iodine for school children is a little, only 120 mcg (MoH 2013[b]), it can be easily met by consuming seafood, vegetables grown in iodine-rich soil and iodized salt. However, in this study, fish is only consumed 2 times a week and mostly are freshwater fish. The study location is far from coastal area and seafood price is relatively expensive so it is not affordable by the subjects whose socioeconomy background are from lower middle income family. Egg which is the most frequently consumed is more affordable than seafood and it contain 25 mcg of iodine per serving (50 g) (Bath & Rayman, 2016).

Table 15. Average consumption frequency of iodine food source (times/week)

No	Type of Food	Control (n=96)	Intervention (n=93)	Total (n=189)
1	Fried rice with egg	1.5±1.2	1.9±1.9	1.7±1.6
2	White bread	1.4±2.6	1.3±1.5	1.4±2.1
3	Sweet bread	2.3±2.4	1.8±1.6	2.1±2.0
4	French bean	0.7±1.0	1.1±1.3	0.9±1.2
5	Fish	1.8±1.4	2.6±3.1	2.2±2.4
6	Scallops	0.2±0.4	0.4±1.2	0.3±0.9
7	Crab	0.1±0.3	0.1±0.2	0.1±0.3
8	Sardines	0.9±1.4	1.2±1.2	1.1±1.3
9	Boiled chicken egg	1.7±1.9	1.8±1.4	1.7±1.7
10	Boiled duck egg	0.2±0.5	0.2±0.4	0.2±0.5
11	Fried chicken egg	3.1±3.0	3.1±2.5	3.1±2.8
12	Boiled egg yolk	0.0±0.1	0.0±0.0	0.0±0.1
13	Cow's milk	1.1±2.0	1.2±1.8	1.1±1.9
14	Powdered milk	0.5±1.2	0.5±1.2	0.5±1.2
15	Sweetened condensed milk	2.2±2.9	2.4±2.1	2.3±2.5
16	Yoghurt	0.8±1.6	1.4±2.8	1.1±2.3

Table 16 shows that iodine food source that was mostly consumed every week was fried rice with egg. In total, it was consumed 507.2 grams/week. The second mostly consumed iodine food source was fried chicken egg. It was consumed as much as 238.6 grams/week. The other food source that was consumed more than 100 grams per week were fish, sweet bread, sweetened condensed milk, cow's milk, white bread and boiled chicken egg. It can be seen that the highest consumption of iodine food source (in frequency and amount) among these subjects were from chicken egg which is relatively affordable. Chicken egg is a good source of iodine as the iodine content per serving is 20.8% of iodine RDA for children aged 10-12 years old (MoH 2013[b]; Bath & Rayman, 2016).

Table 16. Average consumption of iodine food source (grams/week)

No	Type of Food	Control (n=96)	Intervention (n=93)	Total (n=189)
1	Fried rice with egg	480.7±537.6	534.6±728.5	507.2±637.6
2	White bread	101.6±172.7	120.7±175.7	111.0±174.0
3	Sweet bread	164.9±213.0	159.0±229.8	162.0±220.8
4	French bean	27.0±49.5	64.3±118.8	45.3±92.2
5	Fish	162.2±265.6	206.1±327.7	183.8±297.8
6	Scallops	21.6±85.7	47.9±135.1	34.6±113.2
7	Crab	1.7±8.7	4.8±20.5	3.2±15.7
8	Sardines	24. 4±42.9	28.7±38.9	26.5±40.9
9	Boiled chicken egg	115.0±160.5	102.7±124.5	108.9±143.7
10	Boiled duck egg	10.3±42.2	4.6±27.9	7.5±35.9
11	Fried chicken egg	218.7±204.1	259.2±256.1	238.6±231.4
12	Boiled egg yolk	7.0±17.9	9.8±28.7	8.4±23.8
13	Cow's milk	126.5±288.1	106.1±244.8	116.5±267.2
14	Powdered milk	13.6±62.5	17.0±52.8	15.3±57.8
15	Sweetened condensed milk	126.7±182.1	140.6±160.7	133.6±171.6
16	Yoghurt	36.1±89.1	79.4±215.9	57.4±165.2

6.2 Energy and Nutrients Intake of School Children

Based on Table 17, the average energy, carbohydrate and protein intakes of the intervention group were significantly higher than the control group. On the other hand, the fat intake of both groups were quite similar. The average intakes of energy, carbohydrate and fat were adequate for both groups (almost or more than 90% of RDA). However, the average protein intake hadn't met the adequacy level for both groups (less than 90% of RDA).

Protein food source mostly consumed by the school children are chicken, fried tempeh, fried tofu, egg (sunny side up and omelet), and fish (fresh and salted), respectively. Rice also greatly contributed to protein intake since it is consumed three times a day and has protein content higher than other staple food.

Picauly & Toy (2013) stated that one of determinant factors of stunting is protein intake. They found that children with low intake of protein had higher risk to become stunting than those who had good protein intake. Iodine has a role in linear growth. Iodine is the component of thyroid hormone which is required to produce sufficient growth hormone (Widmaier *et al.*, 2008). Furthermore, thyroid hormone has a role in metabolism of macronutrients including protein. Adequate amounts of thyroid hormone are fundamental for the protein synthesis required for normal bodily growth (Sherwood 2010). Thus, deficiency of iodine with or without protein deficiency can contributed to decline in linear growth and resulted in stunting. A study in an endemic IDD area in North Sumatra, Indonesia showed that the growth of school children in an endemic IDD area tend to be poorer than children of the same age living in non-endemic IDD area (Aritonang & Evinaria, 2005).

Table 17 Average energy and macronutrients intake, RDA and % RDA of school children

Nutrients	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Energy (kcal)				
Intake (kcal)	1,504±513	1,713±596	1,607±564	0.012*
RDA (kcal)	1,775±420	1,807±306	1,791±368	
% RDA	87.6±31.3	96.6±35.2	92.0±33.5	0.071
Carbohydrate (g)				
Intake (g)	222.9±77.4	260.0±91.3	241.1±86.3	0.004*
RDA (g)	244.1±57.8	248.6±42.1	246.3±50.6	
% RDA	94.3±34.1	106.4±38.6	100.2±36.8	0.026*
Protein (g)				
Intake (g)	30.7 (11.3-70.0)	35.0 (8.1-91.9)	32.9 (8.1-91.9)	0.025*
RDA (g)	50.7±11.9	51.5±8.6	51.1±10.4	
% RDA	67.4±25.8	76.0±32.0	71.7±29.2	0.048*
Fat (g)				
Intake (g)	45.0 (17.4-214.8)	48.8 14.7-236.6)	47.1 (14.7-236.6)	0.781
RDA (g)	59.3±14.0	60.4±10.2	59.9±12.3	
% RDA	77.9 (31.7-421.2)	79.0 (27.4-385.3)	78.4 (27.4-421.2)	0.823

*significant at p<0.05

Table 18 shows that the average intake of phosphor and iodine in the intervention group was significantly higher than in the control group. The average intakes of calcium and iron were not significantly different between both groups. The average intakes of these four minerals were not adequate (less than 77% of RDA) in both groups.

Table 18 Average intake of minerals (calcium, phosphor, iron and iodine), RDA, and % RDA of school children

Mineral Intake	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Calcium (mg)				
Intake (mg)	148.9 (31.4-1219.1)	143.7 (15.4-1702.1)	145.5 (15.4-1702.1)	0.340
RDA (mg)	1,200±0	1,200±0	1,200±0	
% RDA	12.4 (2.6-101.6)	12.0 (1.3-141.8)	12.1 (1.3-141.8)	0.340
Phosphor (mg)				
Intake (mg)	273.9 (31.0-873.6)	362.6 (47.3-1206.1)	321.2 (31.0-1206.1)	0.001*
RDA (mg)	1,200±0	1,200±0	1,200±0	
% RDA	22.8 (2.6-72.8)	30.2 (3.9-100.5)	26.8 (2.6-100.5)	0.001*
Iron (mg)				
Intake (mg)	7.2 (1.3-26.1)	7.6 (1.4-35.8)	7.4 (1.3-35.8)	0.512
RDA (mg)	17.2±3.8	17.0±3.6	17.1±3.7	
% RDA	42.8 (10.3-200.6)	45.7 (7.2-275.2)	44.1 (7.2-275.2)	0.485
Iodine (mcg)				
Intake (mcg)	54.0 (5.2-275.1)	69.7 (17.0-245.0)	59.7 (5.2-275.1)	0.037*
RDA (mcg)	121.6±6.8	121.7±7.0	121.7±6.9	
% RDA	44.8 (4.4-198.9)	58.1 (14.2-204.2)	48.6 (4.4-204.2)	0.043*

*significant at p<0.05

Calsium food source mostly consumed by the school children are sweetened condensed milk, salted achovy, and jelly. Milk and anchovy are good source of calcium. However, they only consumed anchovy in small amount (in average 25 grams each time) and the milk they consumed wasn't fresh milk which contain higher calcium.

Phosphorus is commonly found in almost all food, therefore deficiency of this nutrient is quite uncommon. The best food souce of phosphorus are foods rich in protein, especially from animal (Rolfes *et al.*, 2009). However, since these school children also had low protein intake, phosphorus intake was also low.

Table 19 shows that the iodine density of the school children was not different between control and intervention group. The median iodine density of total school children at baseline was 43.0 µg per 1,000 kcal while it decreased at endline to 39.9 µg per 1,000 kcal. If compared to the Indonesian RDA (2013) of iodine (120 µg) and energy (2,100 kcal for boys and 2,000 kcal for girls) for children aged 10-12 years old, the iodine density should be 60 µg per 1,000 kcal. Therefore, the iodine density within these subjects was low and that contributed to the low intake of iodine among them. This might be caused by the food that frequently consumed was not iodine food source.

Table 19. Median (min-max) school children iodine density

	Control	Intervention	Total	mann whitney p-value
Baseline	42.6 (8.2-225.9)	45.7 (3.0-263.3)	43.0 (3.0-263.3)	0.396
Endline	39.5 (2.8-145.6)	40.1 (9.2-127.6)	39.9 (2.8-145.6)	0.642

In Table 20, it is shown that the average intakes of vitamin A, B1 and C were not significantly different between both groups. The average intakes of vitamin A was adequate in both groups but the average intake of vitamin B1 and C were not adequate.

Table 20 Average intake of vitamins (A, B1, and C), RDA, and % RDA of school children

Vitamin Intake	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Vitamin A (RE)				
Intake (RE)	683 ± 484	842 ± 633	761 ± 566	0.060
RDA (RE)	600±0	600±0	600±0	
% RDA	114±81	140±105	127±94	0.060
Vitamin B1 (mg)				
Intake (mg)	0.6 (0.1-2.8)	0.7 (0.0-3.8)	0.6 (0.0-3.8)	0.409
RDA (mg)	1.1±0.1	0.7 (0.0-3.8)	0.6 (0.0-3.8)	
% RDA	56.1 (5.8-279.6)	64.4 (1.9-378.8)	59.3 (1.9-378.8)	0.434
Vitamin C (mg)				
Intake (mg)	5.4 (0.0-112.5)	9.4 (0.0-229.4)	7.0 (0.0-229.4)	0.216
RDA (mg)	51±4	51±5	51±5	
% RDA	10.9 (0.0-225.1)	17.4 (0.0-458.7)	14.1 (0.0-458.7)	0.202

Based on Table 21, the energy and fat adequacy level between both groups was not significantly different. However, the carbohydrate and protein adequacy level were significantly different, i.e. the intervention group had higher carbohydrate and protein adequacy level than the control group.

Table 21 Proportion of school children based on energy and macronutrients adequacy level

Energy and Macronutrients Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Energy adequacy level							
Severe deficiency (<70%)	29	31.5	24	27.0	53	29.3	
Medium deficiency (70-79%)	12	13.0	12	13.5	24	13.3	
Mild deficiency (80-89%)	15	16.3	7	7.9	22	12.2	
Normal (90-119%)	25	27.2	23	25.8	48	26.5	
In Excess (≥120%)	11	12.0	23	25.8	34	18.8	
Mean±SD	87.6±31.3		96.6±35.2		92.0±33.5		0.071
Carbohydrate adequacy level							
Severe deficiency (<70%)	29	31.5	17	19.1	46	25.4	
Medium deficiency (70-79%)	4	4.3	9	10.1	13	7.2	
Mild deficiency (80-89%)	12	13.0	8	9.0	20	11.0	
Normal (90-119%)	28	30.4	28	31.5	56	30.9	
In Excess (≥120%)	19	20.7	27	30.3	46	25.4	
Mean±SD	94.3±34.1		106.4±38.6		100.2±36.8		0.026*
Protein adequacy level							
Severe deficiency (<70%)	56	60.9	45	50.6	101	55.8	
Medium deficiency (70-79%)	12	13.0	12	13.5	24	13.3	
Mild deficiency (80-89%)	9	9.8	8	9.0	17	9.4	
Normal (90-119%)	11	12.0	12	13.5	23	12.7	
In Excess (≥120%)	4	4.3	12	13.5	16	8.8	
Mean±SD	67.4±25.8		76.0±32.0		71.7±29.2		0.048*
Fat adequacy level							
Severe deficiency (<70%)	32	34.8	38	42.7	70	38.7	
Medium deficiency (70-79%)	17	18.5	9	10.1	26	14.4	
Mild deficiency (80-89%)	7	7.6	7	7.9	14	7.7	
Normal (90-119%)	18	19.6	17	19.1	35	19.3	
In Excess (≥120%)	18	19.6	18	20.2	36	19.9	
Median (min-max)	77.9 (31.7-421.2)		79.0 (27.4-385.3)		78.4 (27.4-421.2)		0.823

*significant at $p<0.05$

The protein adequacy level of school children in this study were poor. More than half of the children in both groups had severely deficient protein adequacy level.

In Table 22, it is shown that almost all subjects in control and intervention groups had deficit intake of calcium and phosphor. Most subjects also had deficit iron and iodine adequacy level.

Calcium deficiency will cause stunted growth in children. Moreover, a low calcium intake during childhood restricts the bones' ability to reach their optimal mass and density (Rolfes *et al.*, 2009). This might put them at risk of suffering from osteoporosis in later life.

Phosphorus is important for mineralization of bones and teeth and also necessary for growth. Phosphorus deficiency may cause muscular weakness and bone pain (Rolfes *et al.,* 2009).

Table 22 Proportion of school children based on mineral (calcium, phosphor, iron, and iodine) adequacy level

Mineral Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Calcium adequacy level							
Deficient (<77%)	90	97.8	88	98.9	178	98.3	
Adequate (≥=77%)	2	2.2	1	1.1	3	1.7	
Median (min-max)	12.4 (2.6-101.6)		12.0 (1.3-141.8)		12.1 (1.3-141.8)		0.340
Phosphor adequacy level							
Deficient (<77%)	92	100.0	85	95.5	177	97.8	
Adequate (≥77%)	0	0.0	4	4.5	4	2.2	
Median (min-max)	22.8 (2.6-72.8)		30.2 (3.9-100.5)		26.8 (2.6-100.5)		0.001*
Iron adequacy level							
Deficient (<77%)	80	87.0	72	80.9	152	84.0	
Adequate (≥77%)	12	13.0	17	19.1	29	16.0	
Median (min-max)	42.8 (10.3-200.6)		45.7 (7.2-275.2)		44.1 (7.2-275.2)		0.485
Iodine adequacy level							
Deficient (<77%)	77	83.7	64	71.9	62	34.3	
Adequate (≥77%)	15	16.3	25	28.1	119	65.7	
Median (min-max)	44.8 (4.4-198.9)		58.1 (14.2-204.2)		126.8±94.3		0.043*

*significant at p<0.05

Table 23 shows that the adequacy level of vitamin A and B1 in both groups were good but vitamin C was deficit. Two-third of school children had adequate vitamin A intake. Conversely, almost two-third had deficit vitamin B1 intake and almost all school children had deficient vitamin C intake. This may be due to lack of vegetables and fruits consumption among school children.

Table 23 Proportion of school children based on vitamin (A, B1, and C) adequacy level

Vitamin Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Vitamin A adequacy level							
Deficient (<77%)	32	34.8	30	33.7	62	34.3	
Adequate (≥77%)	60	65.2	59	66.3	119	65.7	
Mean±SD	113.7±80.6		140.2±105.4		126.8±94.3		0.060
Vitamin B1 adequacy level							
Deficient (<77%)	59	64.1	52	58.4	111	61.3	
Adequate (≥77%)	33	35.9	37	41.6	70	38.7	
Median (min-max)	56.1 (5.8-279.6)		64.4 (1.9-378.8)		59.3 (1.9-378.8)		0.434
Vitamin C adequacy level							
Deficient (<77%)	88	95.7	80	89.9	168	92.8	
Adequate (≥77%)	4	4.3	9	10.1	13	7.2	
Median (min-max)	10.9 (0.0-225.1)		17.4 (0.0-458.7)		14.1 (0.0-458.7)		0.202

6.3 Energy and Nutrients Intake of Mothers

The average energy, carbohydrate and protein intake of mothers in the intervention group was significantly higher than those in the control group (Table 24). Mother's fat intake was similar between both groups. However, the intake of energy and macronutrients were still below RDA, only fulfill about 60-70% of RDA for energy, carbohydrate, protein and fat intake.

Alhough, difference test was not conducted, the average energy and carbohydrate intake of mothers were lower compared to their children's intake in Table 17, while protein and fat intake were quite similar. As these subjects were from middle lower socioeconomy families, this might be caused by mothers tend to compromise their intake in order to feed more to their children. Besides, usually the priority of food is for the children and the father as the breadwinner. A study in Canada among 141 low-income lone mothers reported that dietary and the adequacy level of mothers' intakes were consistently poorer than their children's intake in general and throughout the course of a month (McIntyre *et al.*, 2003).

Protein and fat intake which were quite similar between mothers and children and also were lower than RDA might be related to the socioeconomy status of these subjects. Intake of low socioeconomy families tend to be dominated with carbohydrate sources. Protein intake is usually much lower than RDA in the low socioeconomy families because protein food sources are relatively less affordable to these families. Liberona *et al* (2010) conclude that children in higher socioeconomic levels had a higher intake of protein and fat, while a higher intake of carbohydrate was found among children in lower socioeconomic levels.

Table 24 Average energy and macronutrients intake, RDA, and % RDA of mothers

Energy and Macronutrients Intake	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Energy (kcal)				
Intake (kcal)	1374±458	1575±482	1473±479	0.005*
RDA (kcal)	2293±485	2257±415	2275±451	
% RDA	62.7±25.7	72.4±26.8	67.4±26.7	0.013*
Carbohydrate (g)				
Intake (g)	196.2±64.3	226.6±70.6	211.2±69.0	0.003*
RDA (g)	340.9±71.3	335.9±61.3	338.4±66.4	
% RDA	60.3±25.0	70.2±27.3	65.2±26.5	0.012*
Protein (g)				
Intake (g)	35.8±16.0	40.9±14.1	38.3±15.3	0.026*
RDA (g)	60.8±12.3	60.0±11.1	60.4±11.7	
% RDA	53.8 (6.2-183.5)	66.0 (21.6-148.3)	59.5 (6.2-183.5)	0.005*
Fat (g)				
Intake (g)	42.5 (4.3-383.8)	48.3 (11.6-186.8)	46.6 (4.3-383.8)	0.103
RDA (g)	65.5±15.2	64.3±12.9	64.9±14.1	
% RDA	66.6 (7.2-781.8)	77.6 (18.8-350.0)	72.6 (7.2-781.8)	0.091

*significant at p<0.05

In general, micronutrients intake of mothers are inadequate, except for vitamin A and vitamin B1 (Table 25 and 26). The average calcium, phosphor and iron intake of mothers in the intervention group were significantly higher than mothers in the control group.

The average intake of vitamin A and B1 between mothers in intervention and control groups were not significantly different. On the other hand, the average intake and %RDA of vitamin C were significantly higher among mothers in intervention group compared to those in control group. However, the average intake of vitamin C in both groups were very low, as it was only less than 77% of vitamin C RDA.

Table 25 Average intake of minerals (calcium, phosphor, and iron), RDA, and % RDA of mothers

Mineral Intake	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Calcium (mg)				
Intake (mg)	172.7 (24.9-987.0)	221.6 (39.5-1024.0)	185.8 (24.9-1024.0)	0.010*
RDA (mg)	1011±31	1010±30	1010±31	
% RDA	17.3 (2.5-98.7)	22.2 (4.0-102.4)	18.6 (2.5-102.4)	0.010*
Phosphor (mg)				
Intake (mg)	336±181	427±230	381±211	0.003*
RDA (mg)	700±0	700±0	700±0	
% RDA	48±26	61±33	54±30	0.003*
Iron (mg)				
Intake (mg)	9.5±4.1	11.5±5.2	10.5±4.7	0.005*
RDA (mg)	24.9±3.7	24.9±3.8	24.9±3.8	
% RDA	39.4±18.5	47.4±23.5	43.4±21.4	0.012*

*significant at p<0.05

Table 26 Average intake of vitamins (A, B1, and C), RDA, and % RDA of mothers

Vitamin Intake	Control (n=92)	Intervention (n=89)	Total (n=181)	p-value
Vitamin A (RE)				
Intake (RE)	753±476	901±646	826±569	0.081
RDA (RE)	500±0	500±0	500±0	
% RDA	151±95	180±129	165±114	0.081
Vitamin B1 (mg)				
Intake (mg)	1.0 (0.1-3.8)	1.0 (0.0-4.1)	1.0 (0.0-4.1)	0.919
RDA (mg)	1.1±0.0	1.1±0.0	1.1±0.0	
% RDA	94.0 (6.8-341.6)	90.5 (2.0-369.1)	90.7 (2.0-369.1)	0.916
Vitamin C (mg)				
Intake (mg)	11.6 (0.0-84.8)	23.4 (0.0-208.1)	17.0 (0.0-208.1)	0.000*
RDA (mg)	75±0	75±0	75±0	
% RDA	15.5 (0.0-113.0)	31.2 (0-277.5)	22.6 (0-277.5)	0.000*

*significant at p<0.05

Approximately, most mothers' energy, carbohydrate, protein and fat adequacy levels were categorized as severe deficiency. The energy and carbohydrate adequacy levels of mothers in the intervention group were significantly higher than those in the control group. Accordingly, the proportion of mothers with inadequate energy and carbohydrate intake is lower in the intervention group.

Table 27 Proportion of mothers based on energy and macronutrients adequacy level

Energy and Macronutrients Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Energy adequacy level							
Severe deficiency (<70%)	63	68.5	45	50.6	108	59.7	
Medium deficiency (70-79%)	12	13.0	17	19.1	29	16.0	
Mild deficiency (80-89%)	4	4.3	5	5.6	9	5.0	
Normal (90-119%)	10	10.9	17	19.1	27	14.9	
In Excess (≥120%)	3	3.3	5	5.6	8	4.4	
Mean±SD	62.7±25.7		72.4±26.8		67.4±26.7		0.013*
Carbohydrate adequacy level							
Severe deficiency (<70%)	64	69.6	53	59.6	117	64.6	
Medium deficiency (70-79%)	11	12.0	11	12.4	22	12.2	
Mild deficiency (80-89%)	9	9.8	5	5.6	14	7.7	
Normal (90-119%)	5	5.4	14	15.7	19	10.5	
In Excess (≥120%)	3	3.3	6	6.7	9	5.0	
Mean±SD	60.3±25.0		70.2±27.3		65.2±26.5		0.012*
Protein adequacy level							
Severe deficiency (<70%)	67	72.8	51	57.3	118	65.2	
Medium deficiency (70-79%)	8	8.7	9	10.1	17	9.4	
Mild deficiency (80-89%)	4	4.3	10	11.2	14	7.7	
Normal (90-119%)	7	7.6	14	15.7	21	11.6	
In Excess (≥120%)	6	6.5	5	5.6	11	6.1	
Median (min-max)	53.8 (6.2-183.5)		66.0 (21.6-148.3)		59.5 (6.2-183.5)		0.005*
Fat adequacy level							
Severe deficiency (<70%)	48	52.2	36	40.4	84	46.4	
Medium deficiency (70-79%)	11	12.0	10	11.2	21	11.6	
Mild deficiency (80-89%)	5	5.4	9	10.1	14	7.7	
Normal (90-119%)	9	9.8	15	16.9	24	13.3	
In Excess (≥120%)	19	20.7	19	21.3	38	21.0	
Median (min-max)	66.6 (7.2-781.8)		77.6 (18.8-350.0)		72.6 (7.2-781.8)		0.091

*significant at p<0.05

The protein adequacy level of mothers in intervention group was significantly higher than those in the control group (70.2% vs 60.3%). The fat adequacy level was similar and deficient in both groups.

The minerals (calcium, phosphor, and iron) adequacy level of mothers in the intervention group were significantly higher than those in the control group (Table 28). However, most mothers in both groups (75.3% - 98.9%) had inadequate intake of calcium, phosphor and iron.

Table 28 Proportion of mothers based on mineral (calcium, phosphor, and iron) adequacy level

Mineral Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Calcium adequacy level							
Deficient (<77%)	91	98.9	86	96.6	177	97.8	
Adequate (≥77%)	1	1.1	3	3.4	4	2.2	
Median (min-max)	17.3 (2.5-98.7)		22.2 (4.0-102.4)		18.6 (2.5-102.4)		0.010*
Phosphor adequacy level							
Deficient (<77%)	79	85.9	67	75.3	146	80.7	
Adequate (≥77%)	13	14.1	22	24.7	35	19.3	
Mean±SD	48.0±25.8		61.1±32.8		54.4±30.1		0.003*
Iron adequacy level							
Deficient (<77%)	88	95.7	81	91.0	169	93.4	
Adequate (≥77%)	4	4.3	8	9.0	12	6.6	
Mean±SD	39.4±18.5		47.4±23.5		43.4±21.4		0.012*

*significant at p<0.05

The adequacy level of vitamin A and B1 in both groups were quite similar (Table 29). Most mothers in both groups had adequate intake of vitamin A and B1. Alternatingly, the vitamin C adequacy level was significantly higher among mothers in the intervention group. Almost all mothers in the control group (97.8%) and about three-quarter of mothers in the intervention group (79.8%) had inadequate intake of vitamin C.

Table 29 Proportion of mothers based on vitamin (A, B1, and C) adequacy level

Vitamin Adequacy Level	Control (n=92)		Intervention (n=89)		Total (n=181)		p-value
	n	%	n	%	n	%	
Vitamin A adequacy level							
Deficient (<77%)	25	27.2	16	18.0	41	22.7	
Adequate (≥77%)	67	72.8	73	82.0	140	77.3	
Mean±SD	150.6±95.2		180.1±129.2		165.1±113.8		0.081
Vitamin B1 adequacy level							
Deficient (<77%)	40	43.5	37	41.6	77	42.5	
Adequate (≥77%)	52	56.5	52	58.4	104	57.5	
Median (min-max)	94.0 (6.8-341.6)		90.5 (2.0-369.1)		90.7 (2.0-369.1)		0.916
Vitamin C adequacy level							
Deficient (<77%)	90	97.8	71	79.8	161	89.0	
Adequate (≥77%)	2	2.2	18	20.2	20	11.0	
Median (min-max)	15.5 (0.0-113.0)		31.2 (0-277.5)		22.6 (0-277.5)		0.000*

*significant at p<0.05

7

NUTRITIONAL STATUS

7.1 Nutritional Status of School Children

Nutritional status is the physiological state of an individual that results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients (FAO/IFAD/WFP 2014). Anthropometric nutritional status in this study was assessed based on body mass index for age. Before the intervention (Table 30), nutritional status of most elementary school children in eight sub-districts of study sites fell under the normal category (83%), while small number of them fell into the thin/severely thin category (8%). On the other hand, the signs of children with overnutrition were also seen from some children who fell into overweight (6%) and obese (3%) categories. In this study area, the prevalence of thin and severely thin school children were lower than the national prevalence (11.2%). Nutritional status of overweight and obese children were still lower than the national prevalence (10.8%) and the prevalence in urban area (8%) (MoH 2013[a]).

Table 30 Distribution of school children by anthropometric nutritional status

Nutritional status (BMI for age)	Control (n=92)				Intervention (n=89)				Total (n=181)			
	baseline		endline		baseline		endline		baseline		endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Severely thin (<-3 SD)	0	0	1	1	0	0.00	0	0	0	0.00	1	1
Thin (-3 s/d <-2 SD)	11	12	7	8	4	4	4	4	15	8	11	6
Normal (-2 s/d +1 SD)	70	76	69	75	80	90	77	87	150	83	146	81
Overweight (>+1 s/d +2 SD)	6	7	9	10	4	4	7	8	10	6	16	9
Obese (>+2 SD)	5	5	6	7	1	1	1	1	6	3	7	4
Mean±SD[1]	-0.53±1.23		-0.31±1.27		-0.64±0.95		-0.29±0.95		-0.58±1.10		-0.30±1.12	
Delta[2]	0.22±0.49				0.35±0.35				0.29±0.43			

Description: [1] t-test before and after the program showed no significant difference (p>0.05) in the control group, whereas the ones in the intervention group showed significant difference (p<0.05)

[2] Mann-Whitney test, the difference in median BMI-for-age changes was significant

Note: there was an abnormal data of student's nutritional status in the baseline.

After the intervention, mean anthropometric nutritional status (z score) increased by 0.22 in the control group and 0.35 in the intervention group. The increase in nutritional status in the control group was not significantly different (p>0.05), while the students in the intervention group was significantly different before and after the intervention (p<0.05). Although this program focused on improving iodine status, but the balanced nutrition topic was also presented in the education program. Therefore, there might be changes in children's behaviors (i.e. improving food consumption) so that it had an impact on the anthropometric nutritional status.

The results of correlation test showed that students' BMI-for-age Z scores were positively related to maternal BMI, maternal education level, maternal nutrition knowledge, and household expenditures.

7.2 Anthropometric Status of Mothers

Maternal anthropometric nutritional status was assessed using BMI indicator. The ratio of body weight and height indicates weight in relation to height and is useful for measuring overweight and obesity in adults (Gibson 2005). Although this study sites were in rural areas, it was seen from the total distribution of nutritional status at baseline (Table 31) that the number of mothers with overweight status was quite high (16.6%), as were the obese mothers (38.1%). It turned out that the prevalence of obese mothers in this area was higher than the national average of 32.9% (MoH 2013[a]). Obese women had a higher risk of developing diabetes and coronary heart disease, cancer diseases such as endometrial cancer, cervical cancer, breast cancer, and ovarian cancer (Kulie *et al.* 2011).

Table 31 Distribution of the mothers based on anthropometric nutritional status

Maternal BMI	Control (n=92)				Intervention (n=89)				Total (n=181)			
	baseline		endline		baseline		endline		baseline		endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Thin (<18.50)	5	5.4	4	4.3	4	4.5	3	3.4	9	5.0	7	3.9
Normal (18.50-24.99)	37	40.2	40	43.5	36	40.4	38	42.7	73	40.3	78	43.1
Overweight (25.00-26.99)	13	14.1	9	9.8	17	19.1	15	16.9	30	16.6	24	13.3
Obese (≥27.00)	37	40.2	39	42.4	32	36.0	33	37.1	69	38.1	72	39.8
Mean±SD[1]	25.93±4.75		26.07±4.95		25.49±4.45		25.51±4.26		25.71±4.60		25.79±4.62	
Delta[2]	0.14±1.89				0.02±1.56				0.08±1.73			

Description: [1] t-test before and after the program in both groups showed no significant differences (p>0.05)

[2] t-test showed that the difference in mean BMI changes was not significant (p>0.05)

Nevertheless, on the other hand, mothers with thin nutritional status (5.0%) were still found and this prevalence was lower than the national prevalence (8.7%) (MoH 2013[a]). Differences in mean and proportion of nutritional status between the control and intervention groups were not significant (p>0.05). The main target of this program was the school children, thereby the impact actually was not expected to occur to their parents.

Results of correlation test showed that maternal BMI was related to the mother's education, total family income, maternal nutrition behaviors, and % RDA of energy, protein, fat and carbohydrates.

8

IMPACT OF INTERVENTION

8.1. Nutrition Knowledge, Attitude, and Practice of School Children

Nutrition knowledge becomes an important foundation for nutrition attitude changes. In this study, nutrition knowledge was measured by a number of true-false questions because elementary school-aged children would understand easier what was meant in the instruments of this study.

Table 32 shows the distribution of nutrition knowledge of the school children in the control and intervention group. In both groups, the majority of school children had poor nutrition knowledge (score <60), either at baseline or endline. It indicated that many school children did not understand the nutritional and food aspects in relation to health, as well as the things related to the benefits of iodine for health or intelligence.

After the intervention, there was no significant increase in nutrition knowledge score in the control group ($p>0.05$); i.e. the mean score at baseline was 43.04 and it slightly increased to 45.82 at the endline. It was different from the intervention group, in which the mean score of nutrition knowledge at baseline was 42.30 and then increased significantly ($p<0.01$) to 51.29 at the endline.

Independent t-test comparing the increase in nutrition knowledge score of the control group (2.77±14.05) versus the intervention group (8.99±13.02) showed a very significant difference ($p<0.01$). It meant that intervention activities conducted -- in the form of nutrition education -- had succeeded in increasing nutrition knowledge of the elementary students. According to Notoatmodjo (2003), knowledge about health is the result of investment in health education in the short term. Increased nutrition knowledge will be a good provision for the elementary students involved in this study to improve food consumption pattern, particularly the one related to food sources of iodine.

Table 32. Distribution of subjects based on nutrition knowledge of the school children

Nutrition knowledge (score)	**Control (n=92)**				**Intervention (n=89)**				**Total (n=181)**			
	Baseline		**Endline**		**Baseline**		**Endline**		**Baseline**		**Endline**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Poor (<60)	84	91.3	79	85.9	85	95.5	60	67.4	169	93.4	139	76.8
Moderate (60-79)	7	7.6	11	12.0	4	4.5	27	30.3	11	6.1	38	21.0
Good (≥80)	1	1.1	2	2.2	0	0.0	2	2.2	1	0.6	4	2.2
Mean±SD	43.04±12.38		45.82±13.08		42.30±10.93		51.29±14.49		42.68±11.66		48.51±14.02	
p	0.062				**0.000***				**0.000***			
Delta Score	2.77±14.05				8.99±13.02				5.83±13.87			
p	**0.002***											

*significant at p<0.05

Nutrition attitude is the tendency of a person (student) to have good nutrition practices according to the positive stimulus given. After the school children get nutrition knowledge through nutrition education activities, it is expected that they will also develop positive nutrition attitudes which eventually will be able to change their nutrition practices for the better.

Table 33 below shows the distribution of school children based on their nutrition attitudes. It appears that the nutrition attitudes in general (most of the elementary students) spreads among poor (score <60) and moderate (score between 60-79) categories. Very few elementary students in the control and intervention groups that had good nutrition attitudes.

Table 33. Distribution of subjects based on nutrition attitudes of the school children

Nutrition attitudes (score)	Control (n=92)				Intervention (n=89)				Total (n=181)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	42	45.7	53	57.6	41	46.1	34	38.2	83	45.9	87	48.1
Moderate (60-79)	44	47.8	34	37.0	41	46.1	40	44.9	85	47.0	74	40.9
Good (≥80)	6	6.5	5	5.4	7	7.9	15	16.9	13	7.2	20	11.0
Mean±SD	58.10±12.53		53.86±15.08		58.71±14.70		60.62±16.87		58.40±13.61		57.18±16.30	
p	**0.003***				0.250				0.271			
Delta Score	-4.24±13.42				1.91±15.57				-1.22±14.80			
p	**0.005***											

*significant at p<0.05

In the control group, the nutrition attitude actually worsened or the score dropped from 58.10 (baseline) to 53.86 (endline). This decrease was very significant (p<0.01) and it showed that nutrition attitude was unstable and volatile. In the intervention group, there was an increase in the score of nutrition attitude after nutrition education was completed (58.71 at baseline became 60.62 at endline) but the increase was not significant (p>0.05).

Independent t-test showed that the increase in scores in the intervention group (1.91±15.57) was significantly higher (p<0.05) than the control group (-4.24±13.42). This study proved that nutrition attitude could be improved by providing nutrition education intervention. The improvement in nutrition attitude is expected to improve students' nutrition practices towards a better direction.

Table 34 shows the distribution of nutrition practices of school children that was relatively similar to the nutrition attitudes; i.e. there were more students whose nutrition practices fell into poor (score <60) and moderate (score between 60-79) categories, and only few that fell under the "good nutrition practices" category. Baseline (57.88) and endline (56.96) scores in the control group showed a slight decrease, while there was an increase in nutrition practice scores in the intervention group (57.13 at baseline became 58.93 at endline).

Mann-Whitney test showed no significant difference (p>0.05) in the increase of nutrition practice scores in the control group (-0.92±16.03) and the intervention group (1.80±17.89). Changes in nutrition practices need longer duration than the changes in nutrition knowledge. Besides, there are other additional factors that can encourage changes in practices such as economic factors, food availability, etc. Good-quality foods or nutrients derived from animal food or seafood are generally expensive. Therefore, the improvement of family economy is necessary to change the practices related to good-quality foods.

In broad terms, it can be said that the action-research activities performed have been able to improve nutrition knowledge and attitudes of the school children, but not yet able to improve nutrition practices. It is expected that the improved economic life supported by improved policies in the distribution of iodized salt will encourage the changes in nutrition practices.

Table 34. Distribution of subjects based on nutrition practices of the school children

Nutrition practices (score)	Control (n=92)				Intervention (n=89)				Total (n=181)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	49	53.3	46	50.0	43	48.3	36	40.4	92	50.8	82	45.3
Moderate (60-79)	34	37.0	40	43.5	39	43.8	47	52.8	73	40.3	87	48.1
Good (≥80)	9	9.8	6	6.5	7	7.9	6	6.7	16	8.8	12	6.6
Mean±SD (Median)	57.88±14.09 (55.0)		56.96±14.58 (57.5)		57.13±14.50 (60.0)		58.93±14.05 (60.0)		57.51±14.26 (55.0)		57.93±14.32 (60.0)	
Wilcoxon p-value	0.498				0.339				0.842			
Delta Score	-0.92±16.03				1.80±17.89				0.41±16.98			
Mann-Whitney p-value	0.363											

8.2. Maternal Nutrition Knowledge, Attitude, and Practice

Table 35 shows the distribution of maternal nutrition knowledge scores. Similar to the knowledge of the elementary students, there were still many mothers with poor nutrition knowledge (82.6% in the control group and 83.2% in the intervention group) at the time of baseline data collected. It might be related to formal education of the mothers in rural areas that was generally also low (only elementary-school graduate); thus, the access to information on nutrition knowledge was limited. Suhardjo (1996) stated that poor nutrition knowledge led to decreased ability of a person to put the information into practice in everyday life, and was one of the causes of nutrition disorders. The results of study by Madanijah & Hirmawan (2007) indicated that maternal knowledge about Iodine Deficiency Disorders (IDDs) had a very significant association with the quality of iodine content in the salt used by the family. It showed that the quality of iodine in salt used by the family was also good if the mothers had good IDDs knowledge. De Vriendt *et al.* (2009) stated that education level, age, and types of women's occupation were important factors affecting nutrition knowledge.

After nutrition education activities were conducted, there was an improvement in nutrition knowledge among mothers in the intervention group. The nutrition knowledge score increased from 44.66 (baseline) to 52.81 (endline), and the increase of this score was very significant (p<0.01). Meanwhile, there was no significant increase in the control group (p>0.05).

Table 35. Distribution of mothers based on maternal nutrition knowledge

Nutrition knowledge (score)	Control (n=92)				Intervention (n=89)				Total (n=181)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	76	82.6	78	84.8	74	83.2	52	58.4	150	82.9	130	71.8
Moderate (60-79)	16	17.4	14	15.2	15	16.9	34	38.2	31	17.1	48	26.5
Good (≥80)	0	0.0	0	0.0	0	0.0	3	3.4	0	0.0	3	1.7
Mean±SD (Median)	43.75±14.31 (45.0)		43.59±13.43 (45.0)		44.66±12.54 (45.0)		52.81±14.77 (55.0)		44.20±13.44 (45.0)		48.12±14.81 (50.0)	
Wilcoxon p-value	0.994				**0.000***				**0.000***			
Delta Score	-0.16±12.81				8.15±13.02				3.92±13.53			
Mann-Whitney p-value	**0.000***											

*significant at p<0.05

Mann-Whitney test showed that changes in baseline-endline knowledge scores in the intervention group (8.15±13.02) were significantly much higher (p<0.01) than the control group (-0.16±12.81). Nutrition knowledge is included in cognitive domains, in which its improvement may occur when a person is able to remember the nutritional information given during nutrition education. Retention to remember this nutritional information may last for a long time after a person receives nutrition knowledge intervention. In this study, the interval between baseline and endline data collection was about five months. It means that the mothers involved in this intervention study are still able to remember well the nutritional information provided within the previous five-months range.

Table 36 shows the distribution of maternal nutrition attitudes that mostly fell into poor (score <60) and moderate (score between 60-79) categories. Only a few mothers (10.9% in the control group and 7.9% in the intervention group) had good nutrition attitudes. Good nutrition knowledge (cognitive) sometimes has not been able to encourage good nutrition attitudes because nutrition attitudes are manifestation of the tendency to act. The tendency will lead to positive things if the mothers have the resources to make it happen.

Baseline-endline data showed a decrease in maternal nutrition attitude scores in the control group (a score of 63.97 at baseline became 61.20 at endline), but there was an increase in the intervention group (a score of 64.49 at baseline became 69.33 at endline). Mann-Whitney test to analyze the occurrence of changes in baseline-endline scores showed that the change in maternal nutrition attitude scores in the intervention group (4.83±15.86) was higher ($p<0.01$) than the control group (-2.77±12.63). In conclusion, either in the elementary students or the mothers, nutrition education activities can significantly improve their nutrition attitudes.

Table 37 shows the distribution of maternal nutrition practices, found either in the control group or intervention group fell into poor (score <60) and moderate (score between 60-79) categories. Nutrition education activities in the intervention group succeeded in improving maternal nutrition practice scores significantly (baseline-endline). In the control group, there were no changes in baseline-endline scores ($p>0.05$).

Table 36. Distribution of mothers based on maternal nutrition attitude

Nutrition attitudes score	Control (n=92)				Intervention (n=89)				Total (n=181)			
	Baseline		Endline		Baseline		Baseline		Endline		Baseline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	23	25.0	34	37.0	18	20.2	12	13.5	41	22.7	46	25.4
Moderate (60-79)	59	64.1	49	53.3	64	71.9	50	56.2	123	68.0	99	54.7
Good (≥80)	10	10.9	9	9.8	7	7.9	27	30.3	17	9.4	36	19.9
Mean±SD (Median)	63.97±10.60 (65.0)		61.20±13.88 (60.0)		64.49±10.92 (65.0)		69.33±13.64 (70.0)		64.23±10.74 (65.0)		65.19±14.31 (65.0)	
Wilcoxon p-value	**0.046***				**0.002***				0.309			
Delta Score	-2.77±12.63				4.83±15.86				0.97±14.77			
Mann-Whitney p-value	**0.000***											

*significant at p<0.05

Table 37. Distribution of mothers based on maternal nutrition practices

Nutrition practices (score)	Control (n=92)				Intervention (n=89)				Total (n=181)			
	Baseline		Endline		Baseline		Baseline		Endline		Baseline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	52	56.5	59	64.1	38	42.7	30	33.7	90	49.7	89	49.2
Moderate (60-79)	32	34.8	24	26.1	47	52.8	43	48.3	79	43.7	67	37.0
Good (≥80)	8	8.7	9	9.8	4	4.5	16	18.0	12	6.6	25	13.8
Mean±SD (Median)	54.02±16.65 (52.5)		53.70±15.55 (50.0)		59.72±12.76 (60.0)		63.37±13.63 (65.0)		56.82±15.09 (60.0)		58.45±15.38 (60.0)	
Wilcoxon p-value	0.947				**0.029***				0.127			
Delta Score	-0.33±17.88				3.65±14.14				1.63±16.23			
Mann-Whitney p-value	0.207											

*significant at p<0.05

Mann-Whitney test showed that the changes in nutrition practice score in the control group (-0.33±17.88) were not significantly different (p>0.05) from the changes in nutrition practice score in the intervention group (3.65±14.14). It indicates that -- similar to nutrition practices of the elementary students that also have not changed after the intervention activities -- it still needs a longer duration accompanied by improvements in welfare that allows mothers to access good-quality foods, as well as better policies regarding iodized-salt distribution so that the families in rural areas are more aware and willing to choose iodized salt as good food for consumption.

8.3. Nutrition Knowledge, Attitude, and Practice of Teachers

In this study, nutrition knowledge intervention was given to three groups of subjects; i.e. elementary students, mothers, and teachers. This holistic intervention is expected to foster a more comprehensive awareness of nutrition on all targets. It is because the nutrition knowledge is one of the variables affecting a person's lifestyle besides other variables such as health knowledge, income, occupation, education, ethnicity, location or residence, religion and psychological characteristics. This lifestyle will then determine the individuals' practices in consuming food (Suharjo 1989).

Table 38 shows the distribution of teachers' nutrition knowledge scores. Most of the teachers, either in the control group or intervention group, fell in moderate (score between 60-79) and good (≥80) nutrition knowledge categories. It is understandable because teachers generally have higher education than the general population. Access to nutritional information and interest in reading may also be higher among teachers.

Baseline-endline data showed that the endline scores of nutrition knowledge (76.00) in the intervention group increased considerably higher than the baseline data (66.75). The increase in nutrition knowledge scores in the intervention group was very significant ($p<0.01$). Meanwhile, there was no increase in nutrition knowledge scores in the control group ($p>0.05$). Independent t-test showed that changes in nutrition knowledge scores in the intervention group (9.25±11.27) were significantly higher ($p<0.01$) than the ones in the control group (-1.39±8.19).

Table 38. Distribution of teachers based on nutrition knowledge

Nutrition knowledge (score)	Control (n=18)				Intervention (n=20)				Total (n=38)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	1	5.6	1	5.6	2	10.0	2	10.0	3	7.9	3	7.9
Moderate (60-79)	13	72.2	11	61.1	16	80.0	9	45.0	29	76.3	20	52.6
Good (≥80)	4	22.2	6	33.3	2	10.0	9	45.0	6	15.8	15	39.5
Mean±SD	72.78±9.11		71.39±12.81		66.75±8.47		76.00±13.04		69.61±9.18		73.82±12.38	
p	0.482				**0.002***				**0.026***			
Delta Score	-1.39±8.19				9.25±11.27				4.21±11.18			
p	**0.002***											

*significant at p<0.05

Table 39 shows the distribution of teachers' nutrition attitudes. Similar to teachers' nutrition knowledge, most of the teachers' nutrition attitudes fell under the moderate (score between 60-79) and good (score ≥80) categories. Nutrition attitude score in the intervention group increased significantly (p<0.05) at the endline (71.25) compared to the baseline score (66.00). The increased score also occurred in the control group but not significant (p>0.05). Furthermore, independent t-test showed that the changes in baseline-endline scores between the control group and the intervention group were relatively similar (p>0.05).

Table 39. Distribution of teachers based on nutrition attitudes

Nutrition attitudes (score)	Control (n=18)				Intervention (n=20)				Total (n=38)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	4	22.2	4	22.2	3	15.0	4	20.0	7	18.4	8	21.1
Moderate (60-79)	7	38.9	5	27.8	15	75.0	7	35.0	22	57.9	12	31.6
Good (≥80)	7	38.9	9	50.0	2	10.0	9	45.0	9	23.7	18	47.4
Mean±SD	68.61±13.15		71.39±12.81		66.00±10.59		71.25±16.37		67.24±11.78		71.32±14.60	
p	0.326				**0.039***				**0.028***			
Delta Score	2.78±11.66				5.25±10.57				4.08±11.02			
p	0.497											

*significant at p<0.05

The teachers' nutrition attitudes that have been relatively good, as well as their nutrition knowledge, are expected to be implemented in their families. In addition, the teachers as agents of change are expected to disseminate these nutrition knowledge and attitudes to their students. Teachers have more opportunities and better power to instill important aspects related to dietary pattern improvement (including choosing iodine food resource) to their students. In many ways, students are sometimes more obedient to their teachers than their families. Therefore, nutrition education intervention to the teachers can be an important entry point for nutrition improvement among students and their families.

Table 40 shows teachers' nutrition practices. There were no poor nutrition practices found in the control group, while poor nutrition practices were found in the intervention group at baseline (5.00%) and became 0.00% at the endline. By comparing the baseline and endline data, it was found that there was a significant increase ($p<0.01$) in the control group between the baseline (78.06) and endline (85.28) nutrition practice scores; and likewise in the intervention group ($p<0.05$), baseline score of 75.25 became 82.25 at the endline.

Independent t-test showed that there were no differences ($p>0.05$) between the changes in nutrition practice scores in the control group (7.22±7.90) and the intervention group (7.00±13.71). It meant that the changes in nutrition practice scores that led to a better thing were equally happening, either in the intervention group or in the control group. These changes (in both groups of teachers) could occur due to teachers' abilities to access nutritional information from various sources.

In rural areas, teachers generally have better economic position than the general population. It facilitates them to get good-quality foods (including food sources of iodine), which are more more expensive than other types of food. Thus, nutrition improvement can be achieved if synergistic efforts are continuously done through nutrition knowledge and economic improvements to the target groups (elementary students, mothers and teachers in this study).

Table 40. Distribution of teachers based on nutrition practices

Nutrition practices (score)	Control (n=18)				Intervention (n=20)				Total (n=38)			
	Baseline		Endline		Baseline		Endline		Baseline		Endline	
	n	%	n	%	n	%	n	%	n	%	n	%
Poor (<60)	0	0.0	0	0.0	1	5.0	0	0.0	1	2.6	0	0.0
Moderate (60-79)	9	50.0	1	5.6	10	50.0	6	30.0	19	50.0	7	18.4
Good (≥80)	9	50.0	17	94.4	9	45.0	14	70.0	18	47.4	31	81.6
Mean±SD	78.06±7.30		85.28±5.81		75.25±11.53		82.25±8.35		76.58±9.73		83.68±7.32	
p	**0.001***				**0.034***				**0.000***			
Delta Score	7.22±7.90				7.00±13.71				7.11±11.19			
p	0.222											

*significant at p<0.05

8.4. Iodine Status of School Children

According to WHO (2007), iodine deficiency occurs when iodine intake falls below the recommended levels. When iodine intake falls below the recommended levels, the thyroid may no longer be able to synthesize sufficient amounts of thyroid hormone. The resulting low level of thyroid hormones in the blood (hypothyroidism) is the principal factor responsible for damage to the developing brain and other harmful effects known collectively as "Iodine Deficiency Disorders (IDD)". Iodine deficiency, through its effects on the developing brain, has condemned millions of people to a life of few prospects and continued underdevelopment. On a worldwide basis, iodine deficiency is the single most important preventable cause of brain damage.

According to Andersson *et al.* (2012), the most recent data on Urinary Iodine Concentration (UIC) cover 96.1% of the world's population of school-age children (SAC), and since 2007, new national data are available for 58 countries. At the national level, there has been major progress: from 2003 to 2011, the number of iodine-deficient countries decreased from 54 to 32 and the number of countries with adequate iodine intake increased from 67 to 105. However, globally, 29.8% of SAC (241 million) are estimated to have insufficient iodine intakes. Southeast Asia has the largest number of SAC with low iodine intakes (76 million). Thus, although iodine nutrition has been improving since 2003, global progress may be slowing. Intervention programs need to be extended to reach the nearly one-third of the global population that still has inadequate iodine intakes.

In the total population of this study, the median value of UIC before the intervention was 180 μg/l. This median value fell into the normal category, although it was lower than the analysis result of the Indonesia Basic Health Research (IBHR) data in 2013 which showed that mean value among school children in rural areas was 198 μg/l (Kartono *et al.* 2016). At the baseline (Table 41), before the program was conducted, the median value of UIC in the control group was higher (199 μg/l) than the intervention group (166 μg/l). According to WHO (2007), median UIC value of 100-199 μg/l fell under the "sufficient" category; thus, children's iodine status in both groups before the intervention was sufficient (no iodine deficiency). However, before the program, the number of children below the standard (<100 μg/l) were 2.2% in the control group and 9.0% in the intervention group.

Table 41. Iodine status of school children based on on-spot urine collection

On-spot Urine Iodine Concentration (UIC)	Control (n=92)[1]				Intervention (n=89)[1]				Total (n=181)			
	baseline		endline		baseline		Endline		baseline		endline	
	n	%	n	%	n	%	n	%	n	%	n	%
mean±SD (median)[1]	189.6±53.7 (199)		189.0±74.1 (191)		169.3±54.9 (166)		176.8±55.6 (184)		179.6±55.1 (180)		183.0±65.8 (186)	
Subject's UIC < 100 μg/l < 100 μg/l	2	2.2	13	14.1	8	9.0	11	12.4	10	5.5	24	13.3
Delta UIC[2]	-0.6±79.9				7.6±66.9				3.43±73.7			

Description: [1] t-test before and after the program in both groups showed no significant differences (p>0.05)

[2] t-test showed that the difference in mean UIC changes was not significant (p>0.05)

After the intervention, in the form of 2-month public education, there were changes in median values of urinary iodine. In the control group, there was a slight decrease in median value of UIC to 191 μg/l although this number (-0.6 μg/l) was not significant (p>0.05). Meanwhile, in the intervention group the UIC increased to 184 μg/l after the intervention. Eventhough there was an increase of 7.6 μg/l, but it was not significant (p>0.05). Based on the t-test, the difference in UIC value changes between the two groups after the intervention was not significant (p>0.05). After the intervention, the number of children below the standard were 14.1% in the control group and 12.4% in the intervention group. It seems that the program undertaken in these activities has not fully affected the changes of iodine biomarkers in urine. It is possibly caused by the still widely circulating salt with SNI label on the market, but the iodine content is evidently below the standard.

Besides on-spot urine parameter, assessment of iodine status was also done by 24-hour urine collection. It was intended to see the possibility of difference in the outcomes between the two methods. With the 24-hour urine method, median value of UIC was seen lower than the on-spot urine. Median values in both groups were 160 µg/l in the control group and 154 µg/l in the intervention group (Table 42). Thus, the number of children with UIC below the standard (<100 µg/l) in the control and intervention groups before the program were 15.6% and 20.0%, respectively.

Table 42. Iodine status of school children based on 24-hour urine collection

24-hour Urine Iodine Concentration (UIC)	Control (n=45)				Intervention (n=45)				Total (n=90)			
	baseline		endline		baseline		Endline		baseline		endline	
	n	%	n	%	n	%	n	%	n	%	n	%
mean±SD (median) [1]	163.5±58.8 (160)		167.4±60.7 (166)		158.8±65.8 (154)		174.4±63.8 (174)		161.1±62.1 (160)		170.9±62.0 (169)	
Delta UIC[2]	3.9±54.9				15.7±63.0				9.8±59.1			
Subjects' UICs < 100 µg/l	7	15.6	6	13.3	9	20.0	7	15.6	16	17.8	13	14.4

Description: [1] t-test before and after the program in both groups showed no significant differences (p>0.05)

[2] t-test showed that the difference in mean UIC changes was not significant (p>0.05)

Table 43. Independent t-test between on spot and 24-hour Urine Iodine Concentration (UIC) of school children

Urine Iodine Concentration (UIC)	Baseline		Endline	
	On Spot	24-hour	On Spot	24-hour
Mean±SD (Median)	179.6±55.1 (180)	161.1±62.1 (160)	183.0±65.8 (186)	170.9±62.0 (169)
p-value of independent t-test	0.083		0.980	

After the intervention, there was an increase in UIC at 24-hour urine collection, either in the control group or the intervention group; i.e. 3.9 μg/l and 15.7 μg/l, respectively. There was no significant difference in the increase of UICs between the two groups (p>0.05). The percentage of children with UIC below 100 μg/l decreased to 13.3% in the control group and 15.6% in the intervention group. There was a tendency that UIC of the urine collected using 24-hour method had lower value than on-spot urine. Table 43 showed that according to independent t-test, there was no significant difference between the UIC of on-spot urine and 24-hour urine (p>0.05).

The correlation test also showed a correlation between iodine intake and on-spot UIC (r=0.174; p=0.016), but no correlation with 24-hour UIC (r=0.047; p=0.654). Those results were not in line with the results of study conducted by Rizqiawan (2015), which showed that there was no correlation between iodine intake and students' on-spot UICs. In addition, the validation of 24-hour and on-spot urine collections in this study did not show different conclusions, i.e.: a) UICs increased after the program in both groups; b) the improvement of UIC in the intervention group was higher than the control group although the difference was not significant.

9

NUTRITION PROMOTION TO STAKEHOLDERS

9.1. Nutrition to Optimize Children's Health and Intelligence

A seminar entitled "Nutrition to Optimize Children's Health and Intelligence" was conducted at Amaris Hotel - Bogor District on February 9, 2017. The seminar was intended to socialize and convince the importance of iodized salt for health and cognitive, and to succeed the Universal Salt Iodization Program in Indonesia.

The speakers were Dede Agung Priatna, MD (Head of Family Health and Nutrition Section, Health Office of Bogor District), Dr. Risatianti Kolopaking (psychologist at child clinic, Hermina Maternity and Children Hospital, Bekasi; Pertamedika Sentul City Hospital, Bogor; and lecturer at Syarif Hidayatullah State Islamic University, Jakarta), Karina Rahmadia Ekawidyani, MD, MSc, and Leily Amalia, STP, MSi (research team and lecturers at Department of Community Nutrition, Bogor Agricultural University). The participants were staffs of Regional Secretariat of Bogor District; Regional Development Planning Board of Bogor District; Health Office of Bogor District; Education Office of Bogor District; Office of Cooperatives, Small and Medium Enterprises, Industry and Trading of Bogor District; Puskesmas' Head and Nutritionist from 8 sub-districts of study sites; principals and teachers from 8 sub-districts of study sites.

The materials presented by Dede Agung Priatna was Profile of Nutrition and Health of Elementary School Children in Bogor District. The nutrition problems due to macronutrient deficiencies that occur among elementary school children in Indonesia are underweight (chronic energy malnutrition/CEM), stunting and obesity. The percentage of boys aged 6-12 years who are thin (CEM), stunted and obese were higher than girls of the same age range. Boys aged 6-12 years who are thin (CEM), stunted and obese are 13.2%, 36.5% and 10.7%, respectively. Meanwhile, the girls aged 6-12 years who are thin (CEM), stunted, and obese are 11.2%, 24.5% and 7.7%, respectively. In addition to macronutrient deficiencies, the school children also have nutrition problems due to micronutrient deficiencies; i.e. iron deficiency anemia (26.4% among children aged 5-14 years). The impact of iron deficiency anemia is decreased concentration and academic achievement.

One of the causes of nutrition problems is poor eating behaviors of the school children, such as breakfast skipping, irregular eating, likes to eat snacks, choosing a particular food based on preference and trends, and avoiding certain foods due to fear of being fat (the view of school children about body image). The prevalence of sweet, salty, and fatty foods consumed by children aged ≥ 10 years ranges between 45% and 51%. Two of 10 children aged ≥ 10 years eat noodle products ≥ 1 times a day.

The most common disease in the school children is acute respiratory infection (ARI); i.e. 25.42% in 2015. This health problem can be overcomed by 1) improving health education through extracurricular activities such as "Little Doctor" Program, Junior Red Cross (JRC), and Scout Program, as well as "My Health Report" Program; 2) improving health services by conducting periodical health screening, immunization month for school children, giving iron tablets to adolescent girls, and giving referral to Puskesmas/hospitals; and 3) conducting the development of healthy school environment such as providing clean water, healthy latrines, non-smoking school environment, healthy canteen/stalls, utilization of school yard, etc.

The second material about Balanced Nutrition Guidelines for Children and Adolescents was delivered by Karina Rahmadia Ekawidyani. Children and adolescents need to be accustomed to eating three times a day with their families, because eating together with family can prevent the children from consuming unhealthy and non-nutritious foods or make them reduce eating those foods. In Indonesia, almost half of the children have a habit of eating low-quality nutrition breakfast. Children and adolescents also need to be accustomed to eating fish and other protein sources. In Indonesia, its people only consume 32 kg/capita/year of fish, 1.75 kg/capita/year of beef, 8.9 kg/

capita/year of eggs, and 13.5 liters/capita/year of milk. The amount is still far behind the protein consumption of people from other countries such as Malaysia, Singapore, and India. Children and adolescents should also increase the consumption of vegetables and fruits. MoH of Republic of Indonesia recommends to consume at least 250 g of fruits and 150 g of vegetables in a day. In Indonesia, 63.3% of children aged more than 10 years consume less vegetables and 62.1% do not consume fruits.

In order to prevent or restrict the children from consuming unhealthy foods such as fast food, street food and sweet, salty and fatty snacks, the school children should be accustomed to bringing packed meals and plain water from home. It should be done because high sodium foods that will be responsible to high blood pressure, and high calorie foods will cause overweight or obesity. Central obesity becomes more common in Indonesia. It may cause heart attack, diabetes, hypertension, and cancer.

The third material on Nutrition and Intelligence was delivered by Leily Amalia. The children whose nutrient requirements are well-fulfilled will also have good intelligence, because nutrients have a very important role in intelligence; i.e. for growth and development of nerve cells, formation of glial cells, and chemical processes of the nerves (neurotransmitter synthesis and receptor synthesis). Nutrients that play a role in intelligence are energy, protein, iron, zinc, polyunsaturated fatty acids, vitamin A, copper (Cu) and iodine. The roles of iron in intelligence are for the formation of myelin that occurs during brain formation (fetal stage and infancy), producing neurotransmitter (fetal stage and infancy), and energy metabolism to make the nerve cells work (entire lifetime). If iron deficiency occurs, the brain cannot get the energy to carry out its function, causing the thinking process to be inhibited.

The roles of iodine in intelligence are to accelerate myelination that occurs during the brain formation, improve the cell differentiation and maturation processes, and the formation of synapses. All of these processes occur during fetal stage and infancy, thus the iodine deficiency in these periods may inhibit brain growth which is irreversible and make the child's IQ low.

In Indonesia, the causes of IDDs include: 1) low iodine intake. Iodine is commonly found in seafood that is expensive so that it is rarely consumed; 2) reduced iodine content in food (including salt) due to improper storage (iodine is volatile); and 3) excessive consumption of goitrogens. Goitrogens are substances that can inhibit the production or the use of thyroid hormones. The reduction of iodine content in iodized salt can be prevented by storing it in a dry place, in a dark glass container, and avoiding it from direct exposure to sunlight. Besides that, the characteristics of a good iodized salt also need to be known; i.e. the ones labeled as "containing iodine", had a clean-white color, dry and the packaging is tightly closed.

The last material presented at the half-day seminar was about Intelligence Stimulation for Elementary School Children, delivered by Risatianti Kolopaking. Educators, either the parents at home or teachers at school, should give stimulation of intelligence to children by stimulating and giving a guidance to improve the children's abilities in understanding, analyzing and solving problems. Elementary school children experience different stages of development. In the 1^{st}-2^{nd} grade (age 6-8 years), the children experience a transition period from children under five; thus, they only know about the concept at this period. In the 3^{rd}-4^{th} grade (age 9-10 years), they have experienced school maturity period; thus, they can sharpen the logic. In the 5^{th}-6^{th} grade (age 11-12 years), they undergo a transition period to adolescence; thus, they starts to learn in groups at this time.

There are three aspects of intelligence that need to be known: understanding (concentration and memory), analyzing (language and numeracy), and solving problems (motor and social-emotions). The category of intelligence is also divided into 3; i.e. with special needs (there is a delay in some aspects of intelligence), normal (intelligence appropriate for the age of development), and gifted (prominent in some aspects of intelligence). Intelligence quotient (IQ) is a unit used to measure intelligence. Intelligence is measured using psychological test instruments performed by trained psychologists.

There are 4 types of parenting (guiding the children) method; i.e. 1) democratic (the control lies in the parents according to the child's needs), 2) authoritarian (the control is in the parents), 3) permissive (the control is in the child), and 4) neglecting (no attachment between parents and children). When guiding the children to become smart, there must be a balance between the fulfillment of parents' demands and the understanding of children's needs. It can be done with positive discipline such as consistently managing, correcting and appreciating the child, and guiding the child in facing the difficulties/problems. Besides that, mutual communication is also required by listening carefully, understanding the childs' wishes, and sharing stories.

Stimulating the intelligence of children can be done by talking about everything with children, reading the book for them, teaching how to calculate in everyday activities, playing creative games with friends, exploring the surrounding environment/nature, and utilizing the digital technology. In order to be able to find out whether our children are healthy, intelligent and happy, the parents need to observe children's physical, mental and social development; assess child's weaknesses and strengths; organize the daily activities (eating, sleeping/resting, learning and playing); develop various aspects of intelligence in the digital age; do a collaboration between parents and teachers or between the activities at home and at school; and express our love to the child by saying "my love" or "my pride".

9.2. Problem and Solution of Iodized Salt Implementation in The Community

Iodine status improvement program recently conducted by Indonesia government focuses more on monitoring and evaluating the coverage of iodized salt consumption of the community (consumer side). Universal Salt Iodization (USI) activities conducted since 1990 have begun to slacken in the guidance of salt industry and supervision of iodized salt distribution (supply side). Based on 2013 IBHR data, 50.8% of the iodized salt marketed in the community are below the standard. It was reported that only 22.9% of households consume iodized salt (MoH 2013[a]).

As for the improvement of iodine status in Bogor District, it was reported from this study that most of the salt in the market was below SNI; i.e. 75%. The households consuming salt that meets the standard were only 2.1%. Not all households have sufficient knowledge, thus the economic limitations cause them to consume non-SNI salt which is cheaper. According to Presidential Decree No. 69 Year 1994, the tradable salt for human or livestock consumption, fish salting, or auxiliary materials for food industry is iodized salt that has met Indonesian Industrial Standard (SSI)/Indonesian National Standard (SNI). According to SNI No. 3556 Year 2010, iodized salt for consumption is a foodstuff product which the main component is sodium chloride (NaCl) with the addition of potassium iodate (KIO_3) of at least 30 mg/kg. However, recently the control of salt distribution in the market is still very weak or even absent. There is no penalty on the distribution of salt that does not meet SNI requirements in the market.

The salt distribution in the market area of Bogor mostly comes from other regions. From about 11 salt industries in Bogor area, only one that was registered in Industry and Trade Office. In the FGD we held in November 2016, it was concluded that the governments, either the district or provincial governments, acknowledged the weakening of government's concern to USI programs. As noted that in the mid-1990s, the government actively guided and supervised the salt producers.

The current development system allows a district/city to initiate a certain program. Local governments are given the necessary policy autonomy according to the local issues. Based on the above problems, just like the other areas (e.g. Pati District and East Lombok District), revitalization of USI program is required. The strategy required is an integrated approach from upstream (producer) to downstream (consumer). The steps we have done for it were:

I. Socialization of Study Results and Focus Group Discussion (FGD)

Socialization and FGD activities were conducted on November 15, 2016 in Fave Hotel, Bogor City. The aim was to disseminate the results of this study to the relevant stakeholders, who then agreed on the alternative solutions that must be undertaken by local government of Bogor District. Discussion participants were from legislative (Regional House of People's Representatives), executive (various related offices at the Bogor District of West Java Province), Food and Drug Administration, salt industry, national salt industry association, and non-governmental organizations.

The results of the socialization and FGD were all participants understood and agreed on the following matters:

a. The understanding on the negative impact of iodine deficiency disorder (IDD) on the decline in quality of human resources.

b. The understanding among stakeholders about the existing problems in the community related to low consumption of standardized iodized salt.

c. Realize the lack of supervision of salt for consumption on the market that mostly do not meet SNI requirements.

d. Realize that there has been a decline in the process of fostering the salt industry by government.

e. Understand the need to revitalize USI program.

f. Agree that the key success factors for achieving and sustaining optimal iodine nutrition are: 1) Government's commitment to USI, 2) Salt industry support, 3) Regular monitoring of iodine status, 4) Awareness of the consequences of iodine deficiency, 5) Recognition that USI program is compatible with the other health policies.

II. Advocacy Material Development

This activity was conducted through intensive discussion between research team and the Micronutrient Initiative Indonesia (MII) organization experienced in assisting USI program in other region in Indonesia. This discussion was intended to prepare advocacy materials to be presented to stakeholders in Bogor District. Among the key points of the discussion results was the proposal concerning the formation of IDD Response Team (IDDRT) in Bogor District. This team is expected to reincrease the attention of local government on USI programs. Formation of this team refers to Regulation of Ministry of Home Affairs No. 63 Year 2010. Meanwhile, the IDDRT's strategies in the implementation of the proposed activities are as follows:

1) Regulation of salt marketing in Bogor District, salt must be iodized according to SNI.
2) Guiding, monitoring and supervising the local salt industry/ producers.
3) Providing education to people concerning "Village Free of Stupid Salt Movement" or non-iodized salt or sub-standard iodized salt.

III. Advocacy with Health Office of Bogor District

The advocacy activity was conducted at the Health Office, i.e. the local government institution responsible for iodine status improvement in the community. The research team was received by the Head of Health Office, Head of Health Service Division, Head of Family Welfare and Nutrition Section, and staffs of the Health Office. The research team presented the proposal regarding the background, study findings and alternative solutions for iodine status improvement in Bogor. One of the suggestions was to coordinate the technical activities of USI program through IDDRT. The discussion result obtained was that the Health Office did not recommend to form a new team (IDDRT) because it was feared not to run well due to too many teams formed in Bogor District. Therefore, the Health Office recommended that the activities in IDDRT be incorporated to the existing teams such as Healthy District Forum. However, the research team considered that the institution such as this "Healthy District Forum" was lack of sufficient authority and resources to implement the three strategies of USI program we suggested.

IV. Advocacy with Regional Development Planning, Research and Expansion Agency (RDPREA) of Bogor District

The next advocacy implementation was to RDPREA, as an institution in district level in charge of coordinating between Local Government Working Units (LGWUs)/agencies. As the legal basis, it is mentioned in Regulation of Minister of Home Affairs No. 63 Year 2010 that the head of IDDRT is Regional Development Planning Agency (RDPA).

Advocacy to RDPREA represented by the Head of Social Welfare Division began with the presentation of study results and proposal regarding IDDRT formation. The result was that RDPREA would perform internal coordination to discuss this proposal, and they would plan to conduct cross-sector coordination meeting.

V. Advocacy to various related offices in Bogor District

This advocacy was facilitated by RDPREA by inviting relevant agencies in Bogor District. The participants invited and attended were the Health Office, the Industry and Trade Office, the Education Office, the Village and Community Empowerment Office, the District Police Unit, the Investment and One Stop Integrated Service Office, and the Tohaga Market Regional Company. In addition, it was also attended by Head of People's Welfare Division of the Regional Secretariat, RDPREA's Head of Government and Development Funding Division, RDPREA's Head of Facilities and Infrastructure Division, RDPREA's Head of Economic Division, and RDPREA's Head of Research and Development Division.

Half-day working meeting on the Prevention of IDDs was conducted at RDPA office. The agenda discussed the possibility of IDDRT formation based on the input from related institutions.

The results of the meeting consisted of:

1) Industry and Trade Office of Bogor District would coordinate with Industry and Trade Office of West Java Province to discuss regarding the authority related to the supervision of iodized salt. Most of the salt in Bogor District comes from outside district. Based on Law No. 23 Year 2014 on the Distribution of Regional Government Affairs, it is stated that obligatory matters related to basic services – including the strategic foods located across district/city – is the authority of provincial instead of district government. Therefore, in relation to the circulation of salt as a strategic food, it is necessary to do coordination between the governments in the province and district.
2) The data on the coverage of iodized salt in households collected by Health Office of Bogor District should be informed to the Head of RDPREA, Industry and Commerce Office, as well as RDPREA's Head of Economic Division. It is intended so that the data are not only static but also can be dynamic, which can be input for other agencies for their program implementation.
3) The commodity, i.e. salt for consumption, is included in basic-need and important commodity; thus, the supervision can be performed by Industry and Trade Office of Bogor District and West Java Province.
4) The responsible party for the plan of next IDDRT formation is from the RDPREA's Head of Economic Division. It is considered more appropriate than the RDPREA's Head of Social Welfare, because the problems are more commonly found in the supply side (salt production/distribution). For the next meeting, each agency will carry out internal coordination, including the certainty about the authority distribution in the supervision of salt circulation.

9.3 Sustainability of The Program

Intervention of the nutritional education for the students, mothers, and teachers have an important and potential effect in changing the knowledge, attitude and practice of nutrition especially related to iodine among students, mothers, and teachers in order to improve the iodine and nutritional status of students. Mothers hold a crucial role in improving their children's nutritional status. Teachers also hold a crucial role because students also listen to what their teacher said to them. In fact, the food patterns of the students depend on the capability of the mothers and also the teachers to transfer their nutritional knowledge into their attitude and good eating practice at home as well as at school.

The involvement of institutions responsible in production and distribution of iodized salt will further empower all stakeholders so that awareness on the quality of iodized salt that meets the requirement become important goal that need to be achieved. Therefore, at the end of the last advocation meeting, Regional Development Planning, Research and Expansion Agency (RDPREA) suggested there will be next meeting after they meet with the provincial government. The RDPREA asked the research team to participate in the monitoring of iodized salt in Bogor District, despite there will be an IDD team or not. The role of the research team is as consultant.

10

CONCLUSIONS AND RECOMMENDATIONS

10.1. Conclusions

1. Most of salts sold by traders (75.0%) had an iodine content <30 ppm, while the rest of salt sold by traders (25%) had sufficient iodine content (30-80 ppm). Most of households (78.8%) consumed salt with iodine content <30 ppm, 20.1% of households consumed salt with sufficient iodine content based on SNI (30-80 ppm), and a few households (1.1 %) consumed salt with iodine content more than SNI recommendation (>80 ppm).
2. The root problems of unstandardized iodized salt circulated in markets were lack of monitoring and supervision on the salt for consumption. Most of salt circulated in the market were produced by home industry. Although there is regulation that iodized salt must meet the SNI requirement and be registered in the National Agency of Drug and Food Control, there is no punishment for those who produce and sell unstandardized iodized salt.
3. Before nutrition education, the majority of students had poor nutrition knowledge and attitude and moderate nutrition practice. The majority of mothers had poor nutrition knowledge and practice and moderate nutrition attitude. The teachers' nutrition knowledge, attitudes, and practices had been relatively good.
4. The children's average intake of iodine was not adequate (less than 77% of RDA). The average intakes of energy, carbohydrate and fat were adequate (almost or more than 90% of RDA). However, the average

protein intake was below the adequacy level (less than 90% of RDA). The average intake of minerals (calcium, phosphorus, and iron), vitamin B1 and vitamin C among these children was also inadequate (less than 77% of RDA). On the other hand, the average intake of vitamin A was adequate.

5. Independent t-test comparing the increase in students' nutrition knowledge score of the control group versus the intervention group showed a very significant difference (p<0.01) and also for students' nutrition attitude (p<005). It meant that intervention activities conducted in the form of nutrition education had succeeded in increasing nutrition knowledge and attitude of the elementary students. However, independent t-test showed no significant difference (p>0.05) in the increase of students' nutrition practice scores in the control group and the intervention group.

   Independent t-test showed that changes in baseline-endline mothers' nutrition knowledge and attitude scores in the intervention group were significantly much higher (p<0.01) than the control group. However, independent t-test showed that the changes in nutrition practice score in the control group were not significantly different (p>0.05) from the changes in nutrition practice score in the intervention group.

   Independent t-test showed that changes in teachers' nutrition knowledge scores in the intervention group were significantly higher (p<0.01) than the ones in the control group but not significant in nutrition attitudes and practices (p>0.05).

   After the intervention, in the form of 2-month public education, there were changes in median values of urinary iodine of on spot urine collection. In the control group, there was a slight decrease in median value of UIC to 191 µg/l although this number (-0.6 µg/l) was not significant (p>0.05). Meanwhile, in the intervention group the UIC increased to 184 µg/l after the intervention. Eventhough there was an increase of 7.6 µg/l, but it was not significant (p>0.05).

   After the intervention, there was an increase in UIC at 24-hour urine collection, either in the control group or the intervention group; i.e. 3.9 µg/l and 15.7 µg/l, respectively. There was no significant difference in the increase in UICs between the two groups (p>0.05). And according to independent t-test, there was not significant difference between the UIC of on-spot urine and 24-hour urine (p>0.05).

10.2. Recommendations

In this study, we found that the root problem of the unstandardized iodized salt circulated in the market is lack of monitoring and supervision from the government. Therefore, Industrial and Trade Office should increase monitoring and supervision to the salt industry and salt trader. There also should be a severe sanction for those who still produce or sell unstandardized iodized salt. It is better if this office also work together with other related offices, such as Health Office, the District Police Unit, and Regional Development Planning, Research and Expansion Agency (RDPREA) and form an IDD team.

We also found that with nutrition education, the nutrition knowledge and attitude of children and mothers significantly increase but not the nutrition practice. Teachers have opportunity to deliver nutrition education through various courses (e.g. biology, science, and sport).

11

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Figure 2. Interviewing the mothers of school children

Figure 3. Anthropometry measurement

Figure 4. Nutrition education

Figure 5. Iodized salt factories visitation

Figure 6. Focus Group Discussion

Figure 7. Half day seminar

Figure 8. Advocation at Health Office of Bogor District

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