



Development of Recommended Dietary Allowance and Food-Based Dietary Guidelines for School-Aged Children in Cambodia



មូលហេតុការខ្មែរសម្រាប់ការលូតលាស់ល្អ



2017

Preface

This book has been written to introduce the newly developed Recommended Dietary Allowance (RDA) and Food-Based Dietary Guidelines (FBDG) for school-aged children in Cambodia.

Recommended Dietary Allowance (RDA) is a set of recommended amount of energy and nutrient intake per day. RDA for school-aged children in Cambodia (CAM-RDA) was first formulated based on the data analysis of a nationwide food consumption survey conducted in 136 schools in 23 provinces and Phnom Penh. This book elaborates how the recommended amount of energy and 19 types of nutrient for 6 to 17 years old were calculated. The establishment of RDA is the first step to develop FBDG, but it is meant to be used for hospital diet, school meal programs, food fortification and other nutrition-related activities as well.

Food-Based Dietary Guidelines (FBDG) for school-aged children in Cambodia consist of seven key messages and its educational materials. They have been developed to bring improvement to nutritional issues identified by the nationwide survey. It is very important that FBDG is disseminated to the public and integrated into the school-based health education to promote healthy eating habits.

We hope that RDA and FBDG will be used as a tool to foster healthy growth of school-aged children in Cambodia through integration into health education curriculum. It is also hoped that this book will be used as a reference for nutrition professionals in Cambodia to develop a set of RDA for other age groups in the future.

Phnom Penh, *November, 08* 2017



Prof. ENG HUOT
SECRETARY OF STATE

Acknowledgement

We acknowledge **Dr. Prak Pisethriangsey**, the former director of the Preventive Medicine Department at the Ministry of Health who first generated the enthusiasm among partners to create the first food-based dietary guidelines for Cambodia.

Our sincere gratitude goes to **Professor Nobuo Yoshiike** and **Professor Kaoru Kusama** from Aomori University of Health and Welfare in Japan, the advisors to the Foundation for International Development/Relief (FIDR), for their professional support and guidance during the process of development. We would also like to express our great appreciation to FIDR for their technical support and the financial assistance provided by Japanese donors through FIDR.

We would like to thank all of the respondents, principals and teachers of the 136 schools who participated in the survey. We would not have been able to conduct this analysis without their cooperation.

We would like to thank nutrition experts from government ministries and institutions, international organizations and NGOs for their valuable input and suggestions.

Most importantly, we would like to thank each member of the FBDG development team, as listed below, for their contribution and commitment to this project.

1. **Ms. Koeut Pichenda**, MD, MPH, PhD, Deputy Director of Preventive Medicine Department /PMD/MoH
2. **Dr. Chhun Loun**, Chief of Non-communicable Disease/PMD/MoH
3. **Dr. Hok Sirany**, Vice Chief of Non-communicable Disease/PMD/MoH
4. **Dr. Chea Mary**, Deputy Director of National Nutrition Program/MoH
5. **Dr. So Chhavyroth**, Deputy Director of School Health Department/MoEYS
6. **Dr. Say Ung**, Director Department, Health, Food Security and Nutrition of Council of Agriculture and Rural Development
7. **Dr. Leang Supheap**, Staff of National Institute of Public Health
8. **Mr. Hou Kroeun**, Deputy Country Director of Helen Keller International
9. **Dr. Khim Sam Ath**, Technical Officer for Non-Communicable Diseases and Health Promotion of World Health Organization
10. **Ms. Hanneke Vandyke**, Technical Officer of World Food Program
11. **Ms. Din Seanglay**, Nutrition Programme Assistant of World Food Program

Finally, we would like to extend our appreciation to the following supervisors for their continuous support and assistance: **H.E Sok Silo**, Deputy Secretary General, Council for Agriculture and Rural Development (CARD), **Dr. Kol Hero**, Director of Preventive Medicine Department (MoH), **Dr. Chhay Kimsotheavy**, Director of School Health Department (MoEYS), and **Dr. Prak Sophonneary**, Deputy Director of National Maternal and Child Health Center and Program Manager of the National Nutrition Program.

Executive Summary

Cambodia, like many other developing countries, is beginning to face the threat of emerging obesity and diet-related non-communicable diseases among school-aged children while the country is still struggling with malnutrition. Dietary habits are rapidly changing, especially in urban areas, with the increased access to undesirable nutrient-poor foods that are high in saturated fats, salt and sugar. These changes attribute to the phenomenon of obesity. On the other hand, stunting, underweight and wasting for age are still common in rural areas.

To address these problems, the Preventive Medicine Department at the Ministry of Health and the Foundation for International Development/Relief (FIDR) formed a joint initiative to develop Food-Based Dietary Guidelines (FBDG) for school-aged children to promote healthy eating behaviors. Like 17 other countries in Asia and the Pacific who have developed their FBDG, Cambodia should also follow the path to create Food-Based Dietary Guidelines in order to tackle nutritional problems, especially among school-aged children who are the future of the country.

The Food and Agriculture Organization of the United Nations (FAO) defines FBDG as providing advice to the general public on foods, food groups and dietary patterns to promote overall health and prevent chronic diseases. So far, Cambodia has not yet established a set of Recommended Dietary Allowances (RDA), therefore formulating RDA was the preliminary step to move on to develop FBDG.

In 2014, the relevant departments of the Royal Government of Cambodia, international organizations and non-governmental organizations met together to discuss the development of FBDG for Cambodian school-aged children. A nationwide survey on the nutritional status and dietary intakes of school-aged children was conducted between November 2014 and July 2015. More than 2,000 children aged 6 to 17 years old at 136 schools in 23 provinces and in Phnom Penh were surveyed using a dietary assessment method called “24-hour dietary recall”*. The overall aim of the survey was to investigate the nutritional status of Cambodian school-aged children by determining the specific nutrient gaps in their diets that can be linked to nutritional problems. The survey revealed that 33% of the students were stunted, 15% were wasted and 35% were underweight. The prevalence of malnutrition amongst school-aged children is estimated to remain high or is even getting worse compared to children under the age of 5 years. More than 50% of the girls in the age group 10-12 years old were stunted, which leads

*24-hour dietary recall will be described in chapter 2

to serious negative effects on their health especially during their reproductive age. Also, an important issue to consider is that children who are stunted are at risk of becoming overweight and obese later in life. Malnourished students were more numerous in rural than in urban areas. In rural schools, the prevalence of malnutrition was 36% for stunting, 16% for wasting and 38% for underweight, while the prevalence of malnutrition in urban schools was 20%, 10% and 22% for stunting, wasting and underweight respectively. Students in rural areas depend more on rice as a source of energy and protein than school-aged children in urban areas.

Anthropometric data was also collected during the survey to set a reference body weight for the development of Recommended Dietary Allowance for school-aged children in Cambodia (CAM-RDA). Energy and nutrient requirements for 19 types of macro- and micronutrients for boys and girls within 5 age groups were calculated mostly based on the reference body weight.

CAM-RDA is the foundation to formulate FBDG. In other words, technical recommendations are transformed into simple messages that are applicable to the target population. FBDG developed in a specific cultural context based on RDA can be useful for nutrition education programs and agriculture planning to bring about positive change in eating habits. The guidelines can also be used as the primary reference for making decisions about nutrition policies.

Food-Based Dietary Guidelines (FBDG) for school-aged children in Cambodia – Cambodian Food for Healthy Growth – has been developed with 7 key messages based on scientific evidence along with a food pyramid a visual display of FBDG. A brochure for primary schools and a booklet for secondary/high schools have been developed to provide further information on what and how much to eat from each food type. The feasibility of the messages and educational materials were tested, revised and finalized in collaboration with the FBDG development team.

Key messages:

1. Eat food from all food types with a well-balanced diet* everyday
2. Consume calcium rich-foods such as whole small fish, milk and milk products
3. Eat protein-rich foods such as fish, meat, eggs or beans at least 2 to 3 times a day
4. Eat plenty of fruits and vegetables regularly
5. Eat cereals and starchy foods such as rice, noodles, bread and its alternatives in an adequate amount

6. Reduce food high in salt, sugar and fat
7. Measure your body weight and height regularly and track your growth

* A well-balanced diet is to eat food from all food types in the proper amount and accompanied by physical activities.

Once the Cambodian FBDG is established, the next step is to disseminate the information to the target audience and to implement activities. It is recommended that FBDG is integrated into school-based health education curricula. Accompanying materials shall be used for nutrition education as part of the school health education. FBDG can be also used for interventions that promote healthy eating habits among the general public including parents and caretakers. FBDG can be introduced at various institutions, including health centers and hospitals where nutrition information shall be shared with health professionals and patients. The educational materials can be used to educate patients on healthy diets while RDA can also be used for managing and providing hospital meals.

The Food-Based Dietary Guidelines shall be monitored and evaluated on a regular basis to identify the relevance and applicability of the messages for the target population. People's lifestyles, eating patterns, and access to food are changing rapidly in the present times. Therefore, their dietary intakes shall be assessed by a wide range of stakeholders in order to ensure that relevant updates to the FBDG and its messages are made regularly.

List of Tables and Figures

Tables

Chapter 2

- Table 2-1: Respondent to questionnaire
- Table 2-2: Demographic characteristics of study participants by age group
- Table 2-3: Household demographic by region categories
- Table 2-4: Nutritional status of children by gender, age, and province
- Table 2-5: Frequency of food consumption by students
- Table 2-6: Common seasoning consumed

Chapter 3

- Table 3-1: CAM-RDA for school-aged children
- Table 3-2: CAM-RDA age group
- Table 3-3: Reference for BMR calculation
- Table 3-4: Physical activity level by age
- Table 3-5: Reference value for EER calculation
- Table 3-6: Reference value for EAR protein calculation
- Table 3-7: Reference value for RDA protein calculation
- Table 3-8: Reference value for calcium calculation
- Table 3-9: Reference value for iron calculation
- Table 3-10: Reference value for thiamin (VB1) calculation
- Table 3-11: Reference value for riboflavin (VB2) calculation
- Table 3-12: Reference value for niacin (VB3) calculation
- Table 3-13: Reference value for zinc calculation
- Table 3-14: Reference value for iodine calculation
- Table 3-15: Reference value for selenium calculation
- Table 3-16: Reference value for vitamin A calculation
- Table 3-17: Reference value for vitamin D calculation
- Table 3-18: Reference value for vitamin C calculation
- Table 3-19: Reference value for folate calculation
- Table 3-20: Reference value for copper calculation
- Table 3-21: Recommended fat percentage calculated from EER
- Table 3-22: Reference value for dietary fibre calculation
- Table 3-23: Reference value for sodium calculation
- Table 3-24: Reference value for potassium calculation
- Table 3-25: Reference value for phosphorus calculation

Chapter 4

Table 4-1: Average of height increase per 10 years (Boys)

Table 4-2: Average of height increase per 10 years (Girls)

Table 4-3: Average of weight increase per 10 years

Chapter 5

Table 5-1: Definition of 6 food types and standard of serving

Table 5-2: Energy-based ideal serving size for girls

Table 5-3: Energy-based ideal serving size for boys

Table 5-4: Ideal menu with serving size

Table 5-5: Ideal menu with nutrients data

Table 5-6: Summary of the activities during the 1st pilot study

Chapter 6

Table 6-1: Suggested monitoring and evaluation plan

Figures

Chapter 1

Figure 1-1: Roles of RDA and FBDG

Chapter 2

Figure 2-1: GIS map of the survey location

Figure 2-2: Nutritional status of children by age group

Figure 2-3: Typical meal pattern

Figure 2-4: Macronutrient distribution (urban vs rural students)

Figure 2-5: Macronutrient distribution (boys vs girls)

Figure 2-6: Comparison of calcium intake

Figure 2-7: Comparison of iron intake

Figure 2-8: Comparison of sodium intake

Chapter 3

Figure 3-1: Line graph of CAM-RDA reference body weight for boys

Figure 3-2: Line graph of CAM-RDA reference body weight for girls

Chapter 4

Figure 4-1: Distribution of energy intake and EER

Figure 4-2: Changes in protein supply in Cambodia, neighboring countries, China, Korea, and Japan (1990-2005)

Figure 4-3: Ratio of food groups for protein source

Figure 4-3a: Cereals

Figure 4-3b: Legumes

Figure 4-4: Changes in calcium intake and calcium food group (legumes, fish, meat, eggs, milk and milk products) intakes in Japan

Figure 4-5: Changes in milk supply in Cambodia, neighboring countries, China, Korea, and Japan (1990-2005)

Figure 4-6: Ratio of food groups for calcium source by age group

Figure 4-6a: Condiments

Figure 4-6b: Vegetables

List of Abbreviations

BMR	Basal Metabolic Rate
CAM-RDA	Cambodian Recommended Dietary Allowance
CDHS	Cambodia Demographic Health Survey
DG	Dietary Goal
EAR	Estimated Average Requirement
EER	Estimated Energy Requirement
FAO	Food and Agriculture Organization of the United Nations
FBDG	Food-Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
FIDR	Foundation for International Development/Relief
GIS	Geographic Information Systems
IEC materials	Information Education and Communication materials
MoH	Ministry of Health
MoEYS	Ministry of Education Youth and Sports
NCDs	Non-communicable Diseases
NPH	National Pediatric Hospital
PAL	Physical Activity Level
PMD	Preventive Medicine Department
RDA	Recommended Dietary Allowance
SEA-RDA	Southeast Asia Recommended Dietary Allowance
WHO	World Health Organization

Table of Contents

Preface	i
Acknowledgement.....	ii
Executive Summary	iii
List of tables and figures	iv
List of Abbreviations.....	ix
Chapter 1 Introduction	
1.1 Background	1
1.2 Definition and purpose of RDA and FBDG.....	2
1.3 Timeline of the process.....	5
Chapter 2 Nutritional Status and Dietary Intakes of School-aged Children in Cambodia (2014-2015)	
2.1 Survey subject	6
2.1.1 Survey subject and Sample size	6
2.1.2 Random selection	7
2.1.3 Respondents and Response Rate.....	7
2.2 Data collection	8
2.2.1 Anthropometric measurements	9
2.2.2 Household questionnaire	9
2.2.3 24-hour dietary recall method.....	9
2.2.4 Statistical analysis	9
2.3 Results.....	10
2.3.1 Demographic characteristics.....	10
2.3.2 Characteristics of households.....	11
2.4 Nutritional Status of students	12
2.4.1 Prevalence of Stunting.....	13
2.4.2 Prevalence of Wasting and Thinness	13
2.4.3 Prevalence of Underweight	14
2.4.4 Prevalence of Overweight.....	14
2.5 Food Consumption and Nutrient Intakes	16
2.5.1 Food consumption by students	16
2.5.2 Nutrient Intakes by Students	18
2.6 Survey Findings	21
Chapter 3 Cambodian Recommended Dietary Allowance (CAM-RDA)	
3.1 Cambodian Recommended Dietary Allowance (CAM-RDA).....	23

3.2 Formula to calculate CAM-RDA	25
3.2.1 Energy	26
3.2.2 Protein	28
3.2.3 Calcium	29
3.2.4 Iron	30
3.2.5 Thiamin (Vitamin B1), Riboflavin (Vitamin B2) and Niacin (Vitamin B3) .	32
3.2.6 Zinc, Iodine, Selenium, Vitamin A, Vitamin D, Vitamin C, and Folate	33
3.2.7 Copper	37
3.2.8 Fat	38
3.2.9 Dietary fiber	38
3.2.10 Sodium	39
3.2.11 Potassium	40
3.2.12 Phosphorus	41
 Chapter 4 Comparison of the survey results and CAM-RDA and recommendations for improvement	
4.1 Comparison of dietary intakes and CAM-RDA	42
4.2 Recommendations on increasing intakes of some important nutrients	44
4.2.1 Ideal intake goals for protein and calcium	44
4.2.2 Ideal goals for height and weight	48
 Chapter 5 The Cambodian Food-Based Dietary Guidelines- Cambodian Food for Healthy Growth	
5.1 Seven messages	50
5.2 Educational materials for dissemination	51
5.2.1 Poster	52
5.2.2 Brochure	53
5.2.3 Booklet	55
5.3 The Pilot Study	61
5.3.1 The First Pilot Study	61
5.3.2 The Second Pilot Study	63
 Chapter 6 For the next step	
6.1 A handbook for parents and caretakers	64
6.2 Training programs and workshops for school teachers	64
6.3 Mass media usage	64
6.4 Campaigns and promotion activities	64
6.5 Application in healthcare institutions	65
6.6 Monitoring and evaluation	65

References	66
Appendix 1: Member list of Food-Based Dietary Guidelines Development Team	70
Appendix 2-1: The List of 136 Schools	72
Appendix 2-2: Questionnaire-School Children Anthropometry	77
Appendix 2-3: Questionnaire Household	78
Appendix 2-4: Questionnaire for 24 hour recall.....	83
Appendix 3-1: Dietary intakes and CAM-RDA for Boys	85
Appendix 3-2: Dietary intakes and CAM-RDA for Girls	85
Appendix 3-3: Energy intakes and CAM-RDA	86
Appendix 3-4: Protein intakes and CAM-RDA	86
Appendix 3-5: Calcium intakes and CAM-RDA	87
Appendix 3-6: Iron intakes and CAM-RDA.....	87
Appendix 3-7: Zinc intakes and CAM-RDA.....	88
Appendix 3-8: Vitamin A intakes and CAM-RDA	88
Appendix 3-9: Vitamin C intakes and CAM-RDA.....	89
Appendix 3-10: Thiamin (Vitamin B1) intakes and CAM-RDA	89
Appendix 3-11: Riboflavin (Vitamin B2) intakes and CAM-RDA	90
Appendix 3-12: Niacin (Vitamin B3) intakes and CAM-RDA	90
Appendix 3-13: Copper intakes and CAM-RDA	91
Appendix 3-14: Fat intakes and CAM-RDA	91
Appendix 3-15: Dietary Fibre intakes and CAM-RDA	92
Appendix 3-16: Sodium intakes and CAM-RDA	92
Appendix 3-17: Salt (Sodium Chloride) intakes and CAM-RDA	93
Appendix 3-18: Potassium intakes and CAM-RDA.....	93
Appendix 3-19: Phosphorus intakes and CAM-RDA	94

1.1 Background

Cambodia has been struggling with the poor nutritional status of children. According to the Cambodia Demographic Health Survey (CDHS) 2014, 32 percent of children under the age of 5 are stunted, 10 percent are wasted, and 24 percent are underweight.¹⁾

Focusing at the goal of the National Nutrition Strategy 2009-2015²⁾, the Cambodian Government and development agencies have been increasing its efforts to reduce maternal and child morbidity and mortality by improving the nutritional status of women and children. Most of the efforts in nutrition made by the Government and development agencies have been targeting children under the age of 5. However, there seems to be less nutritional interventions for school-aged (6 to 17 years old) children than needed. There is also only limited data available of those age groups.

The nutritional status during the primary school period has a significant impact on pubertal development. Raising awareness among caretakers and educating young children to consume an adequate and balanced diet during that important phase is crucial for their proper growth. As the progression of puberty is affected by malnutrition, young children can remain more likely malnourished and lack proper cognitive development in their adolescent life, which will have an effect during their reproductive years.

While Cambodia is still struggling with undernutrition, issues of obesity and non-communicable diseases (NCDs), which are partly attributable to improper nutritional intake, are gradually appearing. Other neighboring countries are already facing emerging obesity and NCDs, even among children. Cambodia has achieved rapid economic growth but is also facing changes in people's dietary patterns with many options of nutrient-poor, unbalanced, processed food and sugary beverages. This affects directly today's eating habits of school-aged children, and they are more exposed to the threat of obesity and NCDs.

Nutritional interventions to promote healthy eating habits of school-aged children are therefore very important and an urgent task on which the Government and development agencies should work together to protect children from diet-related health problems. These interventions are vital to stop the cycle of passing the negative impact of malnutrition on to the next generation. In that sense, nutritional interventions for school-aged children not only support children's well-being but are also a meaningful investment to increase the productivity and resilience of the population.

The World Declaration and Plan of Action for Nutrition (1992) calls on that governments, together with other groups, should, on the basis of energy and nutrient recommendations, provide advice to the public by disseminating dietary guidelines relevant for different age groups and lifestyles and appropriate for the country's population.³⁾ However, as written in a report of the Regional Consultation on Food-Based Dietary Guidelines for countries in the Asia Region 2010 *"Cambodia does not have a food consumption survey. They also do not have the technical expertise to develop FBDGs"*⁴⁾, nutrient standards and food-based dietary guidelines based on scientific evidence have not yet been established in Cambodia.

To respond to such needs, the Preventive Medicine Department of the Ministry of Health and the Foundation for International Development/Relief (FIDR) came together to form an initiative to develop the first Cambodian Recommended Dietary Allowance (CAM-RDA) and to facilitate the development of Food-Based Dietary Guidelines (FBDG) for school-aged children to promote healthy eating behaviors. Like 17 other countries in Asia and the Pacific who have developed their FBDGs, it is time for Cambodia to have its own RDA and FBDG to tackle nutritional issues especially among school-aged children who are the future of the country.

In 2014, the relevant departments of the Royal Government of Cambodia, international organizations and non-governmental organizations met together to discuss the development of FBDG for Cambodian school-aged children (see Appendix 1). A nationwide survey was conducted to analyze the situation and the development process was carried out in accordance with the protocols instructed in the joint report "Preparation and Use of Food-Based Dietary Guidelines" by FAO and WHO.⁵⁾ Although it was a big challenge for all of the development team members as it was the first attempt in Cambodia to create a set of RDA and FBDG, the RDA and FBDG for school-aged children have been finally developed. The purpose of this book is to publish the outcomes and to record the three-year development process.

1.2 Definition and purpose of RDA and FBDG

What is RDA?

Recommended Dietary Allowance (RDA) is the amount of nutrient and energy intake per day considered necessary for maintenance of good health, calculated for males and females of various age.⁶⁾ Sufficient scientific evidence is required to establish RDA. In other countries, RDA is used to develop hospital diet or school meal menus and it is supposed to be periodically reviewed and revised. Since 2007, the National Pediatric Hospital (NPH) in Phnom Penh has provided inpatients with a hospital diet based on nutritional calculations. The NPH referred to the RDA of Southeast Asia to

develop menus as there were no established RDA or nutritional requirements specifically for Cambodians.

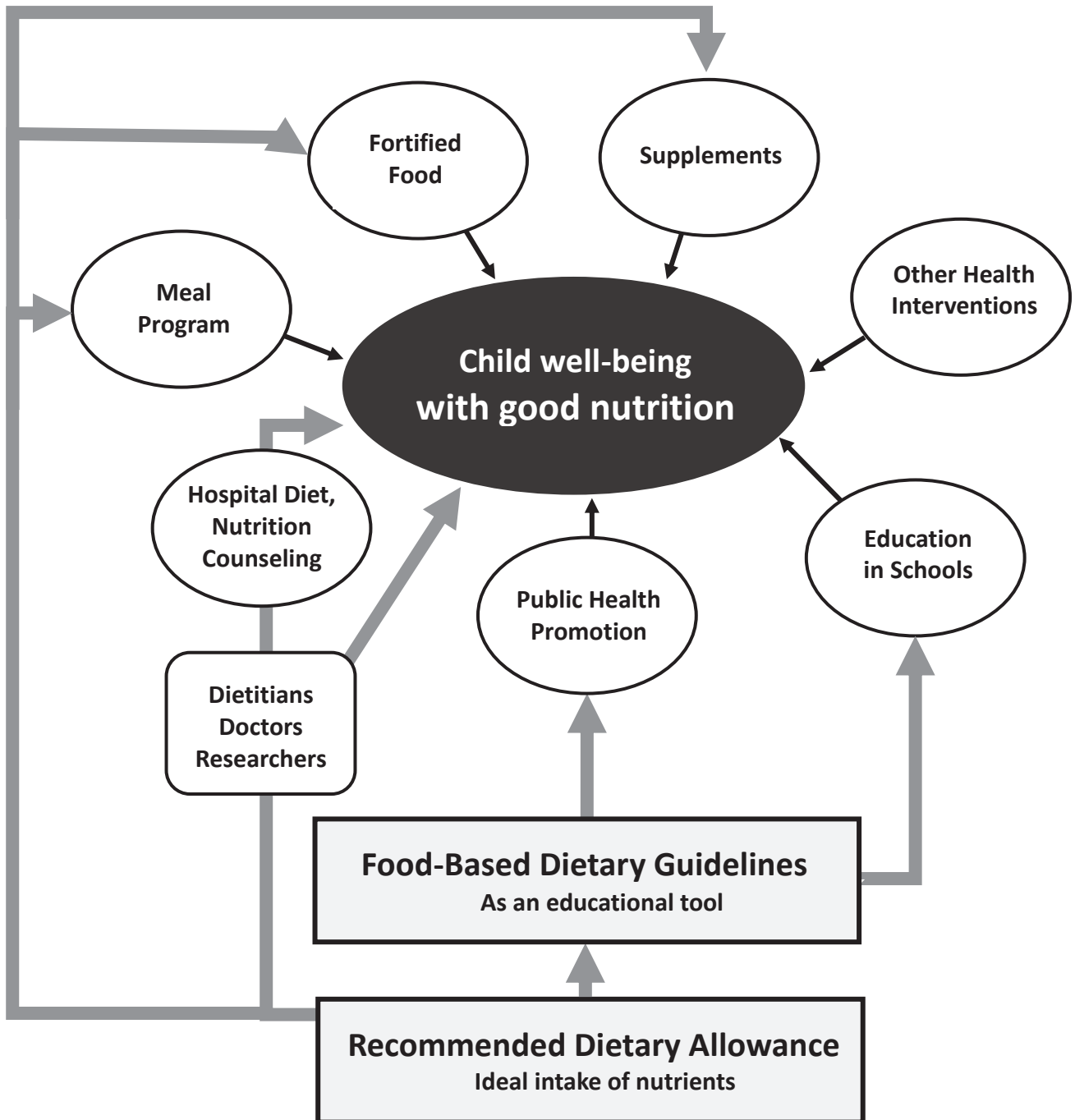
What is FBDG?

Once RDA is established, it should be disseminated to the entire target population. As WHO states, RDA is the foundation for a country to develop Food-Based Dietary Guidelines (FBDG).⁷⁾ In other words, FBDG are a means of communicating the message to guide the target population to the recommended nutritional level. FBDG present information that the public can easily understand with a focus on ordinary foods, portion sizes and behaviors.⁸⁾ It can be used as a key tool for nutritional education and behavior change by health providers, teachers and others working directly with the public (Figure 1-1).

Why food-based?

Nutrients should primarily be taken from daily diet, for children as well as other age groups (This does not apply to those under clinical treatments). Supplements and fortified food can only support specific nutrients and they do not ensure the wide range of nutrients necessary for child growth. It is recommended that meals for school-aged children be based on the guidelines demonstrated in this book. Implementers of school meal should also refer to FAO recommendation related to sustainability of such meals. Sustainable diets are protective and respectful of biodiversity and the ecosystem, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy.⁹⁾

Figure 1-1: Roles of RDA and FBDG



1.3 Timeline of the process

■ **FBDG Development Team**

A FBDG Development Team comprising representatives of the government, international organizations and NGOs met together.

■ **Nation-wide survey**

Survey of “Nutrition Status and Dietary Intakes of School-aged Children in Cambodia” was carried out in 2 rounds. 136 schools in 23 provinces and in Phnom Penh were surveyed.

■ **Summary report of the survey results to the National Ethical Committee**

■ **Drafting educational materials**

Food guide pyramid poster and other IEC materials for primary, secondary, and high school students.

■ **Pilot study / FFQ validation**

The guidelines and IEC materials were tested in 12 schools in 6 provinces. FFQ Validation study was conducted 2 times in 4 schools in Phnom Penh.

■ **2nd Pilot study**

The revised guidelines and IEC materials were tested in Phnom Penh and Kampong Chhnang.

2014

■ **Preparation of the situation analysis**

The research protocol was reviewed several times to get the approval from the National Ethic Committee for Health Research.

2015

■ **Data entry and analysis**

In total, 2048 samples were collected. The amount of nutritional intake and eating patterns of children are analyzed.

■ **Calculating CAM-RDA**

Cambodian Recommended Dietary Allowance (CAM-RDA) was calculated based on the findings of the survey. Southeast RDA was used as reference.

2016

■ **Drafting FBDG slogans**

Food-Based Dietary Guidelines (FBDG) was drafted based on the findings of the survey.

■ **Developing FFQ**

Food Frequency Questionnaire (FFQ) was developed drafted based on the findings of the survey.

2017

■ **Revising guidelines and IEC materials**

Feedback from other nutrition experts were considered. The working group reviewed and discussed for improvement.

Chapter 2

Nutritional Status and Dietary Intakes of School-aged Children in Cambodia (2014-2015)

The survey was started in November 2014 and completed on July 2015. The period of the survey was divided into two rounds with an interval to avoid the holiday season.

1) Round 1 was conducted from November 2014 to January 2015: 49 Schools in 6 provinces and Phnom Penh.

2) Round 2 was conducted from May to July 2015: 87 Schools in 17 provinces.

The objectives of the survey were to:

- (i) examine the nutritional status of Cambodian school aged children (6-17 years old); and
- (ii) determine the amount of nutritional intake and eating patterns of such children.

The overall aim of the survey was to investigate the nutritional status of Cambodian school-aged children by determining the specific nutrients gaps in their diets that can be linked to nutrition related problems. Based on the results of this survey, the Food Based Dietary Guidelines (FBDG) have been developed and will be promoted in Cambodia for school-aged children.

2.1 Survey subject

2.1.1 Survey subject and Sample size

The subject of the survey is school aged children: between 6 to 17 years old. ENA for SMART 2011¹⁰⁾ was used to calculate its sample size as in the formula down below.

$$n = \left[z^2 \times \frac{p \times (1-p)}{d^2} \right] \times DEFF$$

Sample size was determined based on the following formula: where 'n' is the required sample size, 'z' is linked to 95% confidence interval (1.96 was used), 'p' is the estimated prevalence of the key variable of interest (25% was adopted considering over and undernutrition), 'd' is the relative desired precision (counted as $\pm 3\%$ which should be sufficient in the most cases in general). To meaningfully interpret Global Acute Malnutrition estimate in the survey, Design Effect 'DEFF' was set as 2. The calculated sample required for the study was 1,743 and taking into account a non-response rate of 20%, the required final sample size was increased to 2,091.

2.1.2 Random selection

The subjects were randomly selected through multi-stage sampling.

1) Primary Sampling Unit (PSU)*: The target schools were randomly selected from all public schools in Cambodia using the Probability Proportionate to Size (PPS) method. The school lists (Appendix 2-1) from the 24 provinces/municipality are obtained from the Education Management Information System (EMIS) office, Department of Planning, Ministry of Education, Youth and Sport (MoEYS). One hundred fifty-four (154) schools (including reserve samples of 19) schools in 21 cities-provinces (except Pailin) were selected for the survey.

2) Secondary Sampling Unit (SSU)*: Students between 6-17 years old, within PSUs were randomly selected using the systematic sampling technique. As a result, 20 students from each elementary school and 12 students from each secondary and high school were respectively selected for the survey.

*PSU and SSU are selected by using ENA for SMART 2011.

2.1.3 Respondents and Response Rate

Among students selected by SSU, students over 12 years (n=925) were eligible to answer questionnaires directly to enumerators. For students aged between 6 to 11 years (n=1,095), their caretakers were called to answer the questionnaires for them. Those students who did not meet the criteria of the survey were excluded; the criteria were:

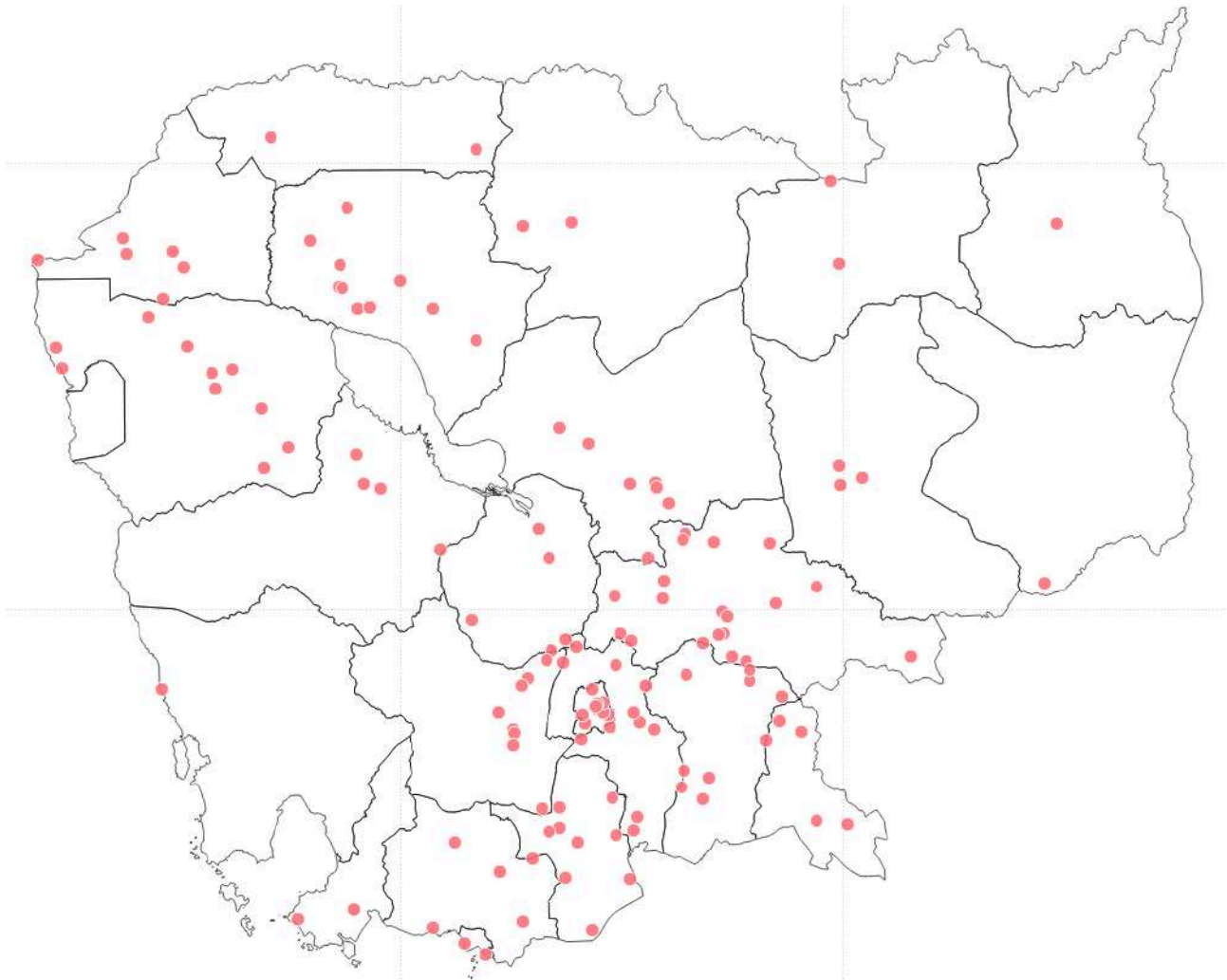
- 1) Student without physical disability affecting his/her weight or height;
- 2) Student with normal enrollment age for his/her grade.

Altogether students in 136 schools were surveyed: 134 selected schools and 2 reserve sample schools. Response rate was 96.6%. In total, 2,020 samples were collected.

Table 2-1: Respondents to questionnaire (n=2,020)

Respondent	n	Percent
Student self	925	45.8
Mother	622	30.8
Father	185	9.2
Aunt	25	1.2
Grandmother	169	8.4
Other relative	94	4.7

Figure 2-1: GIS map of the survey location



2.2 Data collection

Cross sectional data were collected to assess health status, socio-economic background, food consumption and eating pattern via three methods:

- 1) anthropometric measurements,
- 2) household questionnaire,
- 3) 24-hour dietary recall method.

Questionnaires were initially designed in English and translated into Khmer by the survey team and nutrition specialists. The translated questionnaires were tested to assure the appropriateness of the questions ahead of the survey.

A pretest of the entire data collection process was conducted in two schools (not selected nor reserved) with 20 students: one school in Phnom Penh and one in Kampong Chhnang province from October 13 to 16, 2014. The pretest served to ensure that the questionnaire was fully understood by the enumerators. It also served to test the enumerator behavior while in conducting interviews. The Nutrition Specialist evaluated the results and a final consultation was held with the enumerators. Difficulties with

the questionnaire that were encountered by the enumerators were discussed and phrasing and/or translation was adjusted accordingly.

2.2.1 Anthropometric measurements

Central weighing and measuring stations were installed in each school selected for the survey. Weight and height of children were measured according to an anthropometric protocol based on the WHO Child Growth Standard Training course¹¹⁾ on child growth assessment.

Children's weights were taken while wearing light clothing and no shoes. Heights and weights were assessed to the nearest 0.5 cm and 0.1 kg respectively. All measures were taken twice and the mean value was used for analysis. (Appendix 2-2)

Weight was measured using standardized digital flat scales (TANITA HD-662, Capacity: 150 kg). Height was measured with a stadiometer (SECA 213, measuring range: 20-205 cm). A pair of enumerators, each consisting of a measurer and an assistant, took all measurements. The data was collected in the record form. (Appendix 2-3)

2.2.2 Household questionnaire

After providing written consent, caretakers for students aged between 6 and 11 years and students over 12 years old were interviewed in person by enumerators. Depending on the given infrastructure, caretakers were either invited in advance to come to school for interview, or enumerators went to caretakers' homes. (Appendix 2-4)

If the interviews were conducted centrally in a public place, privacy was assured by keeping an adequate distance between the interviewed respondents such that only enumerators were able to hear the answers.

2.2.3 24-hour dietary recall method

A 24-hour dietary recall method was used to collect meal intake. A quick dietary record form was used to record food and drinks respondents consumed over the course of one day, where possible. Based on this quick dietary record form, enumerators asked and probed the amount consumed by the respondent using FIDR Picture Book¹²⁾. This book shows nine food-groups with pictures of actual portion sizes of 130 sample foods to estimate intake amount.

2.2.4 Statistical analysis

1) Household data was entered using EPI Data version 3.0 and then exported to the SPSS data editor (IBM SPSS Statistics version 20) and checked for inconsistencies. Flagged values were checked against the paper questionnaires.

If necessary, study participants were approached to verify the result.

2) Anthropometric data was entered in WHO Anthro Plus¹³⁾ and analyzed.

3) Nutrient analysis was performed using FIDR Nutrition Calculation Database 2013.

4) Statistical analysis was performed using IBM SPSS statistics version 20.

2.3 Results

2.3.1 Demographic characteristics

During the study period 2,020 children in 136 schools in 23 provinces and Phnom Penh of Cambodia were surveyed. The age range of students was 6 years old as minimum to 17 years old as maximum. The mean age of students was 12.1 years old with the median age being 12 years old. In five age groups as defined in ASEAN Food Composition Tables 2000¹⁴⁾ for school-aged children, the age group 13-15 years old was the largest group (33.2%), and 47.5% of boys and 52.5% of girls were involved in this study. All provinces were divided into four regions as follows:

Plain: Phnom Penh, Kandal, Kampong Cham, Tbmong Khmum, Svay Rieng, Prey Veng, Takeo

Tonle Sap: Kampong Thom, Siem Reap, Battambang, Pursat, Kampong Chhnang, Banteay Meanchey, Oddar Meanchey, Pailin

Coastal: Sihanoukville, Kampot, Kep, Koh Kong

Plateau and Mountain: Kampong Speu, Stung Treng, Ratanak Kiri, Mondul Kiri, Kratie, Preah Vihear

As shown in Table 2-2, 19.9% of students live in urban areas while 80.1% live in rural areas. The largest number of students live in plain areas (45.5%), which includes Phnom Penh, Kandal, Kampong Cham, Svay Rieng, Prey Veng, and Takeo. Second to the plains, 34.1% live in Tonle Sap area.

Table 2-2: Demographic characteristics of study participants by age groups

	All (%)	Group 1 (6 years)	Group 2 (7-9 years)	Group 3 (10-12 years)	Group 4 (13-15 years)	Group 5 (16-17 years)	P-value*
n	2,020	72	422	532	670	324	-
Participants per cluster	14.9	0.5	3.1	3.9	4.9	2.4	-
Age	12.1 (±3.15)	6.0	8.0 (±0.78)	11.1 (±0.83)	14.0 (±0.82)	16.4 (±0.50)	-
Sex							
Male	959 (47.5%)	32 (44.4%)	200 (47.4%)	251 (47.2%)	310 (46.3%)	166 (51.2%)	0.644
Female	1,061 (52.5%)	40 (55.6%)	222 (52.6%)	281 (52.8%)	360 (53.7%)	158 (48.8%)	
Region							
Plain	919 (45.5%)	27 (37.5%)	184 (43.6%)	236 (44.4%)	301 (44.9%)	171 (52.8%)	<0.001
Tonle Sap Lake	689 (34.1%)	41 (56.9%)	161 (38.2%)	186 (35.0%)	204 (30.4%)	97 (29.9%)	
Coastal	154 (7.6%)	2 (2.8%)	27 (6.4%)	40 (7.5%)	64 (9.6%)	21 (6.5%)	
Plateau and Moutaneous	258 (12.8%)	2 (2.8%)	50 (11.8%)	70 (13.1%)	101 (15.1%)	35 (10.8%)	
Rural/Urban							
Rural	1,618 (80.1%)	61 (84.7%)	328 (77.7%)	430 (80.8%)	551 (82.2%)	248 (76.5%)	<0.001
Urban	402 (19.9%)	11 (15.3%)	94 (22.3%)	102 (19.2%)	119 (17.8%)	76 (23.5%)	

*P-value of <0.001 indicates statistically significant level

2.3.2 Characteristics of households

Summary of household demographic by region categories is shown in table 2-3. While a half of students answered, the rest asked their caretakers to answer the questionnaire. Median age of caretakers was 31, in which difference by regions was observed ($p < 0.001$). Most of the caretakers' relationship to children was mother (74.9%) followed by grandmother (12.8%). About one fifth of respondents owned the poor ID card (21.4%). With regards to the type of poor ID card, proportions of level 1 and 2 were nearly the same (Table 2-3). It was also found that overall, 16.9% of people experienced food deficit, which is not different regionally. (Not shown in table) However, the proportion of respondents experienced food deficit was significantly higher in rural areas compared to urban areas (Rural; 18.2%, Urban; 11.9%, respectively; $p = 0.003$).

Table 2-3: Household demographic by region categories

Variables	All (%)	Region category				P-value*
		Plain	Tonle Sap Lake	Coastal	Plateau and Mountainous	
Number of respondents	2,020	919	689	154	258	
Q1 Gender of respondent						
Male	668 (33.1%)	310 (33.7%)	217 (31.5%)	62 (40.3%)	79 (30.6%)	0.154
Female	1,352 (66.9%)	609 (66.3%)	472 (68.5%)	92 (59.7%)	179 (69.4%)	
Q2 Caretaker's age						
Median (IQR)	31 (15-42)	33 (16-43)	30 (15-43)	17 (15-36)	25 (15-38)	<0.001
Q3 Relationship to children						
Mother	622 (30.8%)	295 (32.1%)	208 (30.2%)	41 (26.7%)	78 (30.2%)	
Father	185 (9.2%)	88 (9.6%)	58 (8.4%)	11 (7.1%)	28 (10.9%)	
Aunt	25 (1.2%)	10 (1.1%)	9 (1.3%)	2 (1.3%)	4 (1.6%)	
Grandmother	169 (8.4%)	63 (6.9%)	83 (12.1%)	8 (5.2%)	15 (5.8%)	
Relatives	94 (4.6%)	40 (4.3%)	43 (6.2%)	5 (3.2%)	6 (2.3%)	
Self	925 (45.8%)	423 (46.0%)	288 (41.8%)	87 (56.5%)	127 (49.2%)	
Q4 Marital status						
Single	968 (47.9%)	437 (47.6%)	306 (44.4%)	87 (56.5%)	138 (53.5%)	
Divorced/Separated	36 (1.8%)	28 (3.0%)	6 (0.9%)	0 (0)	2 (0.8%)	
Widowed	102 (5.0%)	42 (4.6%)	48 (7.0%)	3 (1.9%)	9 (3.5%)	
Married	913 (45.2%)	412 (44.8%)	328 (47.6%)	64 (41.6%)	109 (42.2%)	
Other	1 (0.1%)	0 (0)	1 (0.1%)	0 (0)	0 (0)	
Q5 Direct caretaker of child						
Mother	1,513 (74.9%)	705 (76.7%)	467 (67.8%)	121 (78.6%)	220 (85.3%)	
Father	70 (3.5%)	34 (3.7%)	21 (3.0%)	3 (1.9%)	12 (4.7%)	
Aunt	42 (2.1%)	17 (1.9%)	15 (2.2%)	5 (3.2%)	5 (1.9%)	
Grandmother	259 (12.8%)	117 (12.7%)	110 (16.0%)	16 (10.4%)	16 (6.2%)	
Relatives	92 (4.6%)	35 (3.8%)	44 (6.4%)	8 (5.2%)	5 (1.9%)	
Self	44 (2.2%)	11 (1.2%)	32 (4.6%)	1 (0.7%)	0 (0)	
Q9 ID poor card						
No	1,530 (75.8%)	716 (77.9%)	502 (72.9%)	118 (76.6%)	194 (75.2%)	0.278
Yes	433 (21.4%)	178 (19.4%)	168 (24.4%)	33 (21.4%)	54 (20.9%)	
Don't know	57 (2.8%)	25 (2.7%)	19 (2.7%)	3 (2.0%)	10 (3.9%)	
Q10 Type of ID poor card	(n = 433)	(n = 178)	(n = 168)	(n = 33)	(n = 54)	
Level 1	153 (35.3%)	60 (33.7%)	60 (35.7%)	14 (42.4%)	19 (35.2%)	0.367
Level 2	186 (43%)	83 (46.6%)	73 (43.5%)	8 (24.3%)	22 (40.7%)	
Don't know	94 (21.7%)	35 (19.7%)	35 (20.8%)	11 (33.3%)	13 (24.1%)	

*P-value of <0.001 indicates statistically significant level

2.4 Nutritional Status of students

The nutritional status of study participants by age, gender, and province is shown in Table 2-4. It shows that the mean (Z-score) of all indicators (height-for-age, weight-for-height, and weight-for-age) resulted negative values, which means the participants' nutritional status is below the average of the WHO standard¹⁵).

2.4.1 Prevalence of Stunting

Students whose height-for-age is below minus two standard deviation ($<-2SD$) compared to WHO child growth standard are considered “stunted”, and are short for their age. Stunting is the outcome of failure to receive adequate nutrition over an extended time¹⁶). Recurrent or chronic illness also may contribute to the effect. Thirty-three percent (33.2%) of students were short for their age. The rate of stunting, which includes severe stunting ($<-3SD$), for boys (36.8%) was higher than that of girls (30.0%). By age group in total, age group 10-12 years showed the highest rate of stunting (43.0%) (Table 2-4). By comparison with sex, age group 13-15 for boys showed the highest, while age group 10-12 years showed the highest for girls (Figure 2-1). The prevalence of stunting was higher among rural students (36.4%) than among urban students (20.4%). The highest rate of stunting (53.3%) was found in Kep province (Table 2-4).

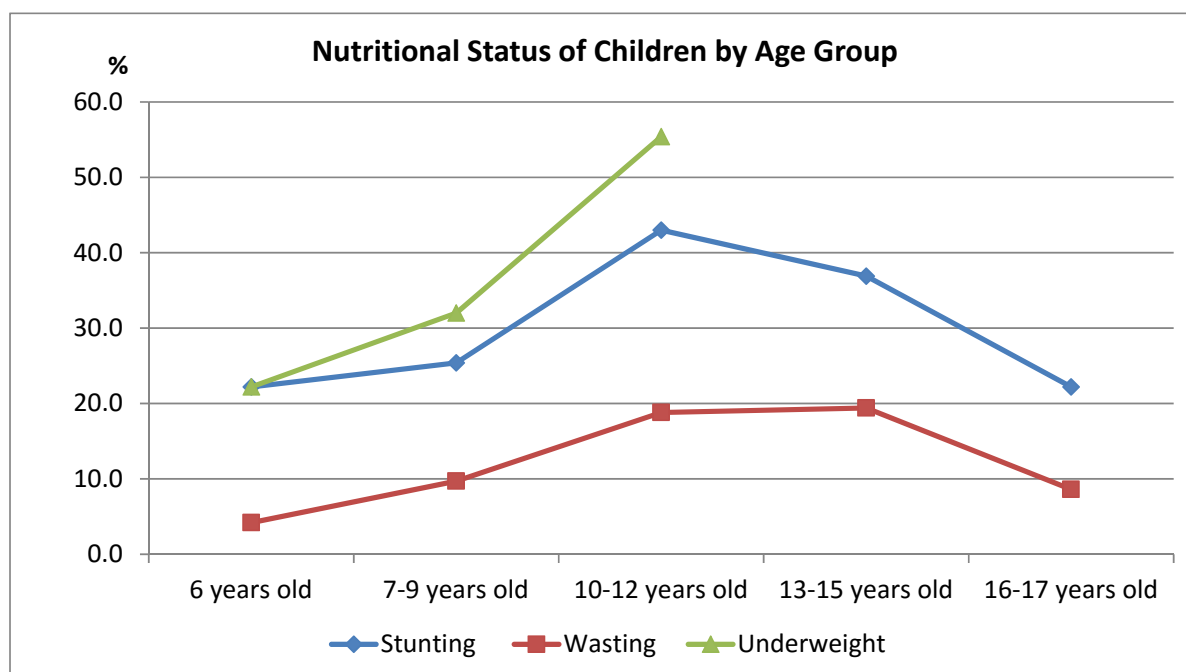
2.4.2 Prevalence of Wasting and Thinness

Students whose weight-for-height is lower than negative 2 standard deviation ($<-2SD$) compared to WHO child growth standard are considered wasted or thin. Wasting represents the failure to receive adequate nutrition in the period immediately before the survey, and typically is the result of recent illness, especially diarrhea, or the effect of a rapid deterioration in food supplies¹⁷).

The survey found that fifteen percent (15.0%) of students were wasted at the time of the survey. The rate of stunting for boys (16.7%) was higher than girls (13.4%). By age group, age group 13-15 years showed the highest rate of wasting (19.4%) (Figure 2-1). The prevalence of wasting in rural area was 16.1% while 10.4% was in urban area. The highest rate of wasting (23.3%) was found in Kep (Table 2-4).

The prevalence of thinness or severe thinness (BMI-for-age) was 15.0% in total, and the highest was among 13-15 years old boys (25.0%) and 10-12 years old girls (21.0%).

Figure 2-2: Nutritional status of children by age group



*Underweight (Weight for Age) does not include students over 11 years old.

2.4.3 Prevalence of Underweight

Students whose weight-for-age is lower than 2 standard deviation (<-2SD) compared to WHO child growth standard are considered as underweight. The measurement is reflecting the effects of both acute and chronic under nutrition. However, the score of weight-for-age in WHO Anthro Plus is only available up to 10 years old thus students older than 10 years old were not analyzed in this study.

Around thirty-five percent (35.1%) of children was underweight. The prevalence of underweight among boys and girls was almost the same, 35.3% for boys and 35.1% for girls (Table 2-4).

The prevalence of underweight was higher among rural (22.1%) than urban students (38.1%). The highest rate of underweight (75.0%) is found in Stung Treng province (Table 2-4).

2.4.4 Prevalence of Overweight

Students whose weight-for-height is greater than 2 standard deviations compared to WHO growth standard are considered overweight. Overweight and obese children are more likely to stay obese into adulthood and more likely to develop NCDs at a younger age¹⁸).

The data showed that 3.2% of students in total were overweight. The prevalence of overweight is higher among urban (2.1%) than rural students (0.1%) and highest among children aged 6 (2.8%). Although, in the majority of provinces students are not overweight, Phnom Penh and Siem Reap stand out with 3.7% and 1.2% prevalence of overweight among students, respectively.

Table 2-4: Nutritional status of children by gender, age, and province

Background Characteristic	Height-for-age			Weight-for-height				Weight-for-age*				Number of Children (N)
	Percent-age below	Percent-age below	Mean	Percent-age below	Percent-age below	Percent-age above	Mean	Percent-age below	Percent-age below	Percent-age above	Mean	
	-3 SD	-2 SD**	Z-score (SD)	-3 SD	-2 SD**	+2 SD	Z-score (SD)	-3 SD	-2 SD**	+2 SD	Z-score (SD)	
Age group (years)												
6	4.2	22.2	-1.24	1.4	4.2	2.8	-0.75	4.2	22.2	1.4	-1.31	72
7 – 9	5.2	25.4	-1.36	0.7	9.7	0.7	-0.92	7.8	32.0	0.7	-1.50	422
10 – 12	11.2	43.0	-1.76	2.6	18.8	0.6	-1.12	13.4	55.4	-	-2.02	532
13 – 15	12.8	36.9	-1.72	3.3	19.4	0.1	-1.03	-	-	-	-	670
16 – 17	4.0	22.2	-1.34	0.9	8.6	0.3	-0.83	-	-	-	-	324
Sex												
Boy	11.4	36.8	-1.67	2.8	16.7	0.6	-1.11	8.6	35.3	0.8	-1.53	959
Girl	7.4	22.6	-1.50	1.5	13.4	0.4	-0.88	8.2	35.1	0.6	-1.61	1,061
Residence												
Urban	4.7	20.4	-1.20	1.0	10.4	2	-0.76	2.7	22.1	1.8	-1.05	402
Rural	10.4	36.4	-1.67	2.4	16.1	0.1	-1.05	9.7	38.1	0.4	-1.70	1,618
Province												
BanteayMeanchey	4.3	27.7	-1.40	1.1	5.3	0	-0.76	9.6	24.5	0	-1.43	94
Battambang	9.3	35.3	-1.54	0	10.7	0.7	-0.88	9.1	29.1	0	-1.56	150
Kampong Cham	13.1	37.2	-1.70	4.0	21.2	0	-1.17	13.9	44.4	0	-1.82	274
KG Chhnang	10.0	42.9	-1.87	0	8.6	0	-1.00	6.9	41.4	0	-1.72	70
Kampong Speu	7.0	33.9	-1.71	0.9	16.5	0	-1.08	11.1	40.7	0	-1.67	115
Kampong Thom	12.1	45.8	-1.74	1.9	15.0	0	-1.07	12.1	33.3	0	-1.49	107
Kampot	11.0	26.8	-1.44	2.4	18.3	0	-1.17	16.7	44.4	5.6	-1.82	82
Kandal	6.3	25.7	-1.44	4	20.0	0.6	-1.03	10.6	40.4	2.1	-1.30	175
Koh Kong	0	8.3	-0.39	0	8.3	0	-0.68	0	0	0	0	12
Kratie	9.6	36.5	-1.80	0	19.2	0	-1.18	18.2	40.9	0	-1.89	52
Mondulkiri	0	20.0	-1.35	0	10.0	0	-1.03	0	0	0	0	10
Phnom Penh	2.2	17.0	-1.12	1.5	7.4	3.7	-0.67	2.1	21.3	2.1	-1.01	135
PreahVihear	6.7	33.3	-1.74	0	10.0	0	-0.88	0	27.3	0	-1.43	30
Prey Veng	8.2	37.3	-1.65	1.5	17.8	0.7	-1.06	12.2	46.3	2.4	-1.81	134
Pursat	11.0	38.4	-1.69	1.4	15.1	0	-1.04	5.0	35.0	0	-1.71	73
Ratanakiri	0	22.2	-1.25	0	10.5	0	-1.05	0	22.2	0	-1.57	19
Siem Reap	7.3	29.9	-1.52	2.4	15.2	1.2	-0.83	4.9	19.7	0	-1.46	164
Sihanouk Ville	10.0	33.3	-1.46	0	3.3	0	-0.65	0	27.3	0	-1.35	30
Stung Treng	18.8	43.8	-1.96	0	15.6	0	-1.00	0	75.0	0	-2.18	32
SvayRieng	16.9	43.7	-1.82	2.8	11.3	0	-0.87	12.5	31.3	0	-1.75	71
Takeo	7.7	27.7	-1.55	4.6	15.4	0	-1.05	7.5	45.0	0	-1.83	130
OtdarMeanchey	22.6	41.9	-1.63	3.2	12.9	0	-0.87	10.0	0	0	-0.95	31
Kep	20.0	53.3	-1.94	3.3	23.3	0	-1.39	0	40.0	0	-2.01	30
Total	9.3	33.2	-1.58	2.1	15.0	0.5	-0.99	8.4	35.1	0.7	-1.57	2,020

* Weight for age category does not include students over 11 year old.

** Includes students <-3SD (below minus three standard deviations) from the WHO Child Growth Standards population median.

2.5 Food Consumption and Nutrient Intakes

2.5.1 Food consumption by students

Frequency of consumption of selected food groups by students is summarized in Table 2-5.

Fruits: The result showed that 86.7% of students ate fruit at least one day a week. Among those, the most common answer (23.7%) was 2 days per week (Table 2-5).

Vegetables: Almost all students (95.9 %) ate vegetable at least one day a week. Among those, the most common answer (31.1%) was 7 days per week (Table 2-5).

Meat: Animal meat was found to be consumed by 91.3% of students at least one day per week. Among those, the most common answer (22.3%) was 3 days per week (Table 2-5).

Fish/poultry or seafood: Fish/poultry or seafood was found to be consumed by almost all students (99.3%) at least one day per week. As fish is widely available in Cambodia, 30.0% of students consumed 7 days per week (Table 2-5).

Milk/Soy milk: In Cambodia, it is not common to consume fresh milk as it is produced in very few amount domestically and not everyone has access to it due to its availability and price. However, around a half (45.9%) of students did drink milk or soymilk at least one day a week. The most common answer (11.6%) was 2 days in a week (Table 2-5). Further, 6.5% of students answered that they consumed unsweetened whole milk while 7.9% of students consumed sweetened whole milk. (Data not shown here)

Junk food consumption: The majority of students (86.6%) consumed junk food at least one day a week. The most common answer (21.9%) was 7 days per week (Table 2-5).

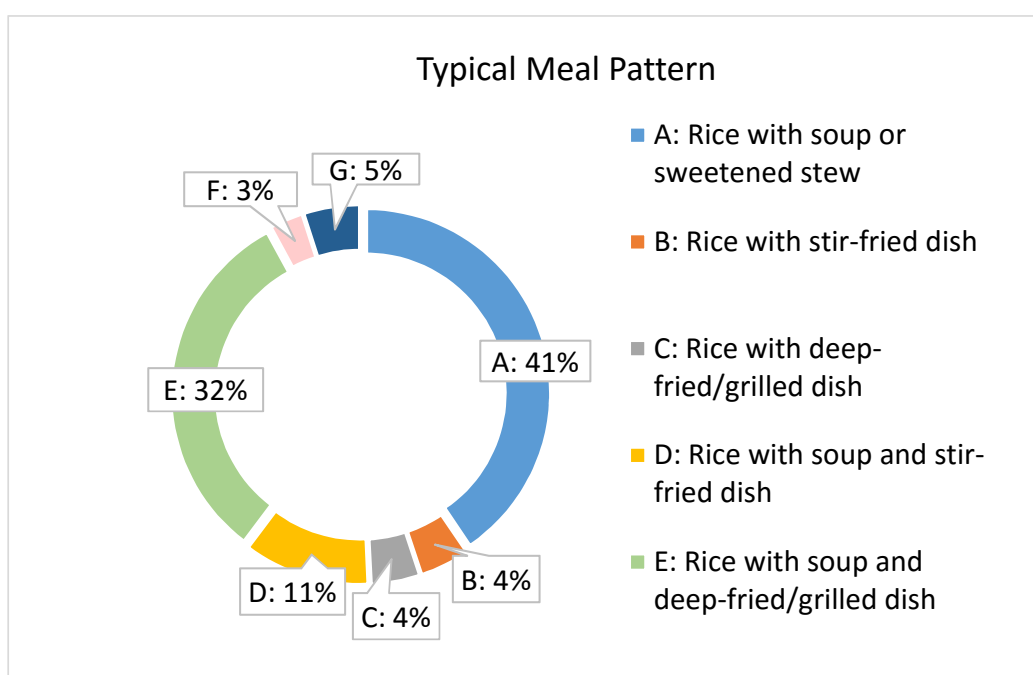
Soft drink consumption: The majority of students (84.3%) consumed soft drink which contain a lot of sugar at least one day per week. The most common answer (18.4%) was 2 days per week (Table 2-5).

Table 2-5: Frequency of food consumption by students (n=2,020)

Per week	Fruit	Vegetable	Meat	Fish/poultry	Milk	Junk food	Soft drink
None	13.3%	4.1%	8.7%	0.7%	54.1%	13.4%	15.7%
1 day	16.8%	2.4%	10.9%	2.2%	11.1%	7.0%	12.5%
2 days	23.7%	7.7%	19.8%	10.1%	11.6%	14.8%	18.4%
3 days	22.5%	17.0%	22.3%	14.7%	9.2%	16.2%	16.8%
4 days	8.3%	15.0%	12.8%	16.7%	3.6%	8.0%	8.8%
5 days	7.6%	16.7%	12.3%	17.1%	3.5%	10.0%	9.4%
6 days	1.5%	6.0%	3.4%	8.4%	1.5%	8.7%	6.4%
7 days	6.3%	31.1%	9.8%	30.0%	5.4%	21.9%	11.8%

Typical meal composition: The type of meal pattern was questioned to identify the typical meal composition. The most common type of meal seemed to be composed of rice with soup or sweetened stew (41%) followed by rice with soup and deep-fried/grilled dish (32%) (Figure 2-3).

Figure 2-3: Typical meal pattern



Common seasoning: The common seasonings consumed were salt (99.5%), oil/fat (98.6%) and MSG/ Rosdee/Knorr (99.4%) (Table 2-6).

Table 2-6: Common seasoning consumed

Variables	All (%)	Multiple answers	
		Rural	Urban
Number of respondents	2,020	1,618	402
Common seasoning consumed			
Palm sugar	713 (35.3%)	547 (33.8%)	166 (41.3%)
White sugar	1,869 (92.5%)	1,480 (91.5%)	389 (96.8%)
Fish sauce	1,822 (90.2%)	1,450 (89.6%)	372 (92.5%)
Soy sauce	798 (39.5%)	562 (34.7%)	236 (58.7%)
Oyster sauce	577 (28.6%)	375 (21.2%)	202 (50.3%)
Salt	2,009 (99.5%)	1,612 (99.6%)	397 (98.8%)
MSG/Rosdee/Knorr	2,007 (99.4%)	1,611 (99.6%)	396 (98.5%)
Chilli sauce	363 (18.0%)	257 (15.9%)	106 (26.4%)
Vinegar	216 (10.7%)	165 (10.2%)	51 (12.7%)
Oil/Fat	1,991 (98.6%)	1,592 (98.4%)	399 (99.3%)
Others	919 (45.5%)	815 (50.4%)	104 (25.9%)

2.5.2 Nutrient Intakes by Students

Energy: In comparison between urban and rural area, the average amount of students' total energy intake per day was higher in urban area (1,636 kcal) than that of rural area (1,591kcal) (Figure 2-4). As the amount of energy intake between urban and rural areas differs, the composition of energy intake was also different. As Figure 2-4 shows, the students in rural area were more dependent on carbohydrate as the source of energy than those in urban. On the other hand, the students in urban area consumed more fat than in rural area.

Protein: In comparison between urban and rural area, the result showed that the students in urban area consumed more protein (48.3g) in average than students in rural area (43.9g). Further, boys consumed 47.7g of protein in average and 42.2g for girls, but in terms of energy contribution, both were not so much different from each other (Figure 2-4, 2-5).

Fat: Like protein, more fat was consumed by urban students (17.7% from total energy) than students in rural (14.4% from total energy) in average. In comparison between genders, fat intake was 14.4% for boys and 15.6% for girls in average, and girls' fat consumption was contributing more to their total energy intake than that of boys (Figure 2-4, 2-5).

Carbohydrate: All students consumed well amount of carbohydrate. When its intakes were compared in the macronutrient distribution chart, only a slight difference was observed between boys and girls (Figure 2-5). However, it seemed that students in rural area were relying more on carbohydrate, rice in this case, as the main source of their energy (Figure 2-4).

Figure 2-4: Macronutrient distribution (urban vs rural students)

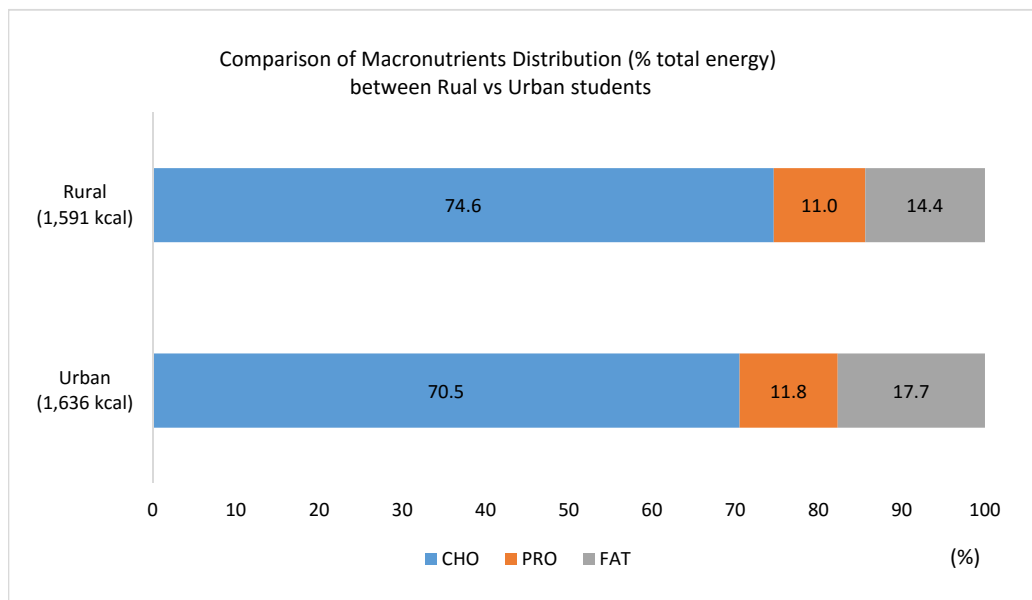
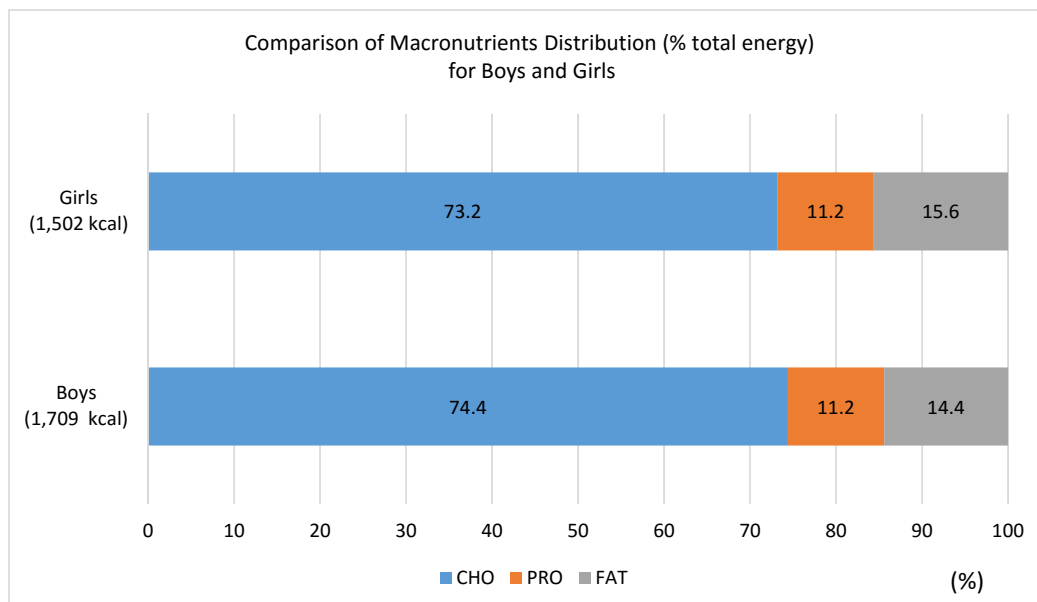


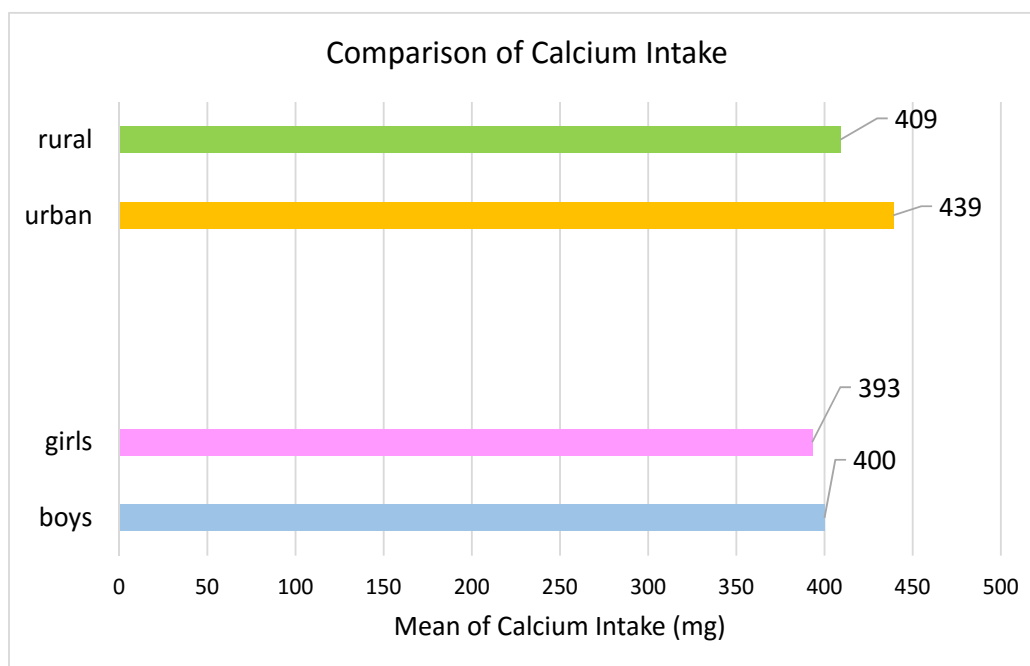
Figure 2-5: Macronutrient distribution (boys vs girls)



Calcium: In comparison between the area and gender, Figure 2-6 shows that average amounts of total calcium intake were similar. It was observed that fish-related foods largely contributed to calcium intake for both students in urban and rural areas. The students in urban area were more likely to consume calcium from milk and dairy

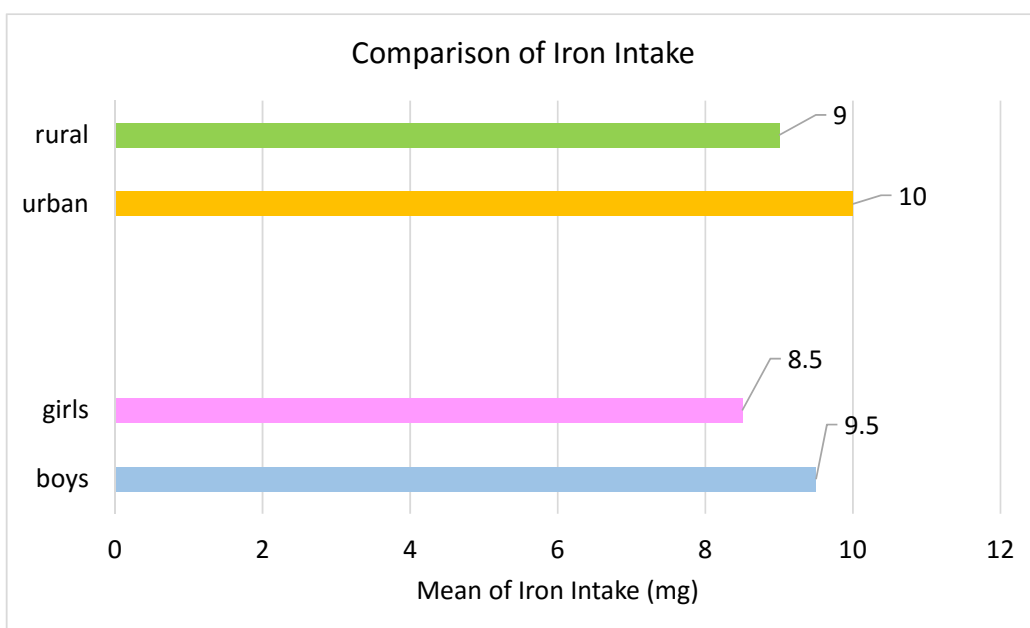
products, while the students in rural took more calcium from the food group of condiments and spices, which refers to fish paste in this case.

Figure 2-6: Comparison of calcium intake



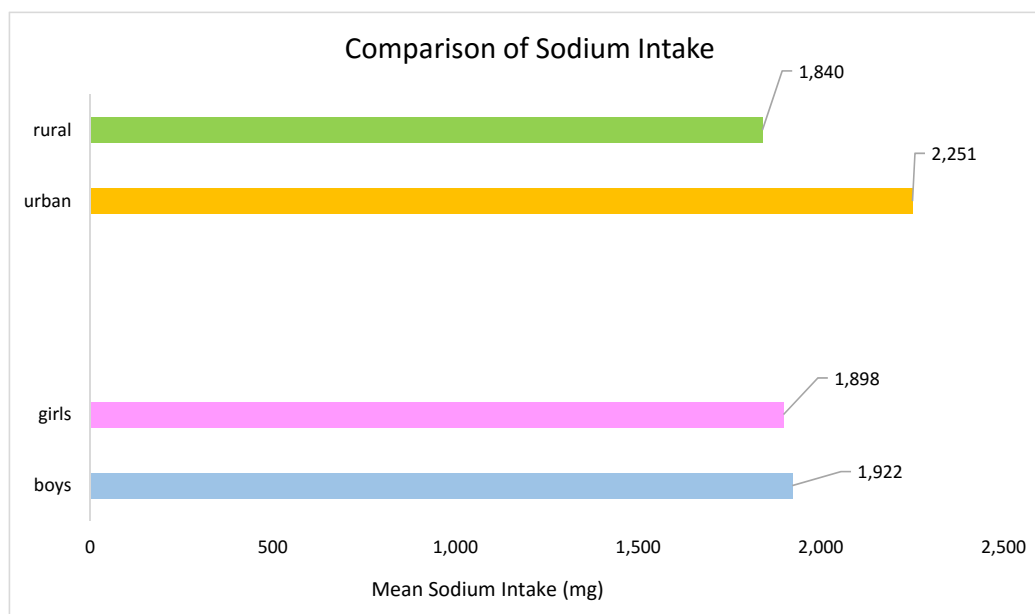
Iron: In comparison between urban and rural area, the average amount of total Iron intake was different as urban students consumed more than rural students. When compared between gender, boys consumed more iron than girls (Figure 2-7).

Figure 2-7: Comparison of iron intake



Sodium: As for sodium intake, there were not much difference between genders. In comparison between urban and rural area, however, it showed a clear difference in the average amount of sodium intake, and urban students consumed more sodium (2,251mg) than rural students (1,840mg) (Figure 2-8).

Figure 2-8: Comparison of sodium intake



2.6 Survey Findings

The survey found that 33.2% of the students were stunted, 15.0% was wasted and 35.1% was underweight. The prevalence of malnutrition among school-aged children (6-17 years old) is estimated to remain still high or is even worsen compared to children under 5 years old. The 2014 *Cambodia Demographic and Health Survey*¹⁹⁾ provides data for the prevalence of malnutrition among children under 5 years old: 32.4% of these children were stunted, 9.6% was wasted and 23.9% was underweight.

In the students of age group 10-12 years old, stunted (43.0%) was found the most. Wasted (19.4%) appeared the most in the age group of 13-15 years old and underweight (54.4%) was noticed the most in the age group of 10 years old. In gender comparison, the girls of the age group 10-12 years old should be highlighted. More than 50.0% of the girls in the group were stunted, which leads to serious negative effects on their health especially during reproductive age. Girls with stunting are reported to experience slow secondly growth (puberty) and tend to give birth to an underweight baby. Also, an important issue to consider is that children who are stunted are at risk of becoming overweight and obese later in life. Looking at adult overweight and increasing non-communicable diseases in Cambodia²⁰⁾, the high prevalence of stunting among children is worrisome.

The students were found more malnourished in rural area compared to urban area. In rural schools, a prevalence of malnutrition was 36.4% for stunting, 16.1% for wasting and 38.1% for underweight. While the prevalence of malnutrition in urban school was 20.4%, 10.4% and 22.1% for stunting, wasting and underweight respectively.

Poverty and food shortage surely wield influence on malnutrition status of students. The mean scores for stunting (height for age: HAZ) among students from those households that possessed ID poor cards was worse (-1.85) than students from normal households (-1.50). In addition, the mean of HAZ for the students from households that experienced food shortage more than one month in the previous year was worse (-1.92) than students from households not experienced (-1.51).

In the survey, some key findings on dietary intake of students should be emphasized. In comparison between urban and rural area, the students in rural area are more dependent on rice as a source of energy than those in urban. On the other hand, the students in urban area consume more foods which contain fat and protein and various kinds of foods than in rural area.

The prevalence can be reduced by improving nutrient intakes of school-aged children through increase of awareness regarding their quality of diet. Children and caretakers of these children should be educated about the importance of balanced diet. Consumption of protein and calcium rich food products such as milk, legumes, animal meat and whole small fish etc., should be promoted and increased. Further recommendations and suggestions are made in later chapter.

Chapter 3

Cambodian Recommended Dietary Allowance (CAM-RDA)

Recommended Dietary Allowance (RDA) refers to the level of intake of energy and dietary components which, on the basis of current scientific knowledge, are considered adequate for the maintenance of health and well-being of nearly all healthy persons in the population. RDA provides the levels of nutrient intake that almost all individuals (97% to 98%) should consume to avoid the risk of deficiency and can reduce the risk for development of non-communicable diseases (NCDs) in a target population²¹.

3.1 Cambodian Recommended Dietary Allowance (CAM-RDA)

Cambodian Recommended Dietary Allowance (CAM-RDA) for school-aged children was developed for the first time in Cambodia through data collection from a nation-wide survey among school-aged children in 2014 and 2015. Energy and nutrient requirements for 19 types of macro- and micronutrients for boys and girls within 5 age groups were calculated based on the reference body weight of Cambodian school-aged children.

The RDA energy and nutrient requirements are used to formulate food-based dietary guidelines (FBDG) that are applicable to the target populations. FBDG developed in a specific cultural context based on RDA can be useful for nutrition education programs and agriculture planning to bring about positive change in eating habits. It can also be used as the primary reference for making decisions about nutrition policies. Moreover, RDA is used as a basis for food labeling of nutrition facts to indicate nutritional values of a food or food product. It is hoped that this newly developed CAM-RDA is not only the foundation for formulating the FBDG, but that it is also to serve as a starting point for the government when developing nutrition policy, planning, and education programs.

Table 3-1: CAM-RDA for school-aged children

CAM-RDAs

Gender	Age Group* (Years)	Reference Body Weight kg	Energy			Protein		Calcium mg	Iron a: menstruation mg
			Low	Middle	High	Estimated Average Requirement (EAR) **	Recommended Dietary Allowance (RDA)		
			kcal			g			
Boys	(4-) 6	19	1,300	1,500	1,700	25	30	550	6.5
	7 - 9	24	1,500	1,700	1,900	30	40	600	7.5
	10 - 12	30	1,800	2,100	2,300	40	50	750	7.0
	13 - 15	42	2,200	2,500	2,700	45	60	850	12.0
	16 - 17 (18)	53	2,500	2,800	3,100	45	60	750	9.0
Girls	(4-) 6	18	1,300	1,500	1,600	25	30	500	6.0
	7 - 9	24	1,500	1,700	1,900	30	40	650	8.0
	10 - 12	31	1,700	2,000	2,200	40	50	850	9.0 / 13.5 ^a
	13 - 15	43	2,000	2,200	2,500	40	50	750	9.5 / 13.5 ^a
	16 - 17 (18)	48	2,100	2,300	2,600	40	50	650	6.0 / 10.0 ^a

Gender	Age Group (Years)	Zinc mg	Iodine µg	Selenium mg	VitaminA µg	VitaminD µg	VitaminC mg	Thiamin (VB1) mg	Riboflavin (VB2) mg
Boys	(4-) 6	5.5	90	20	450	5	30	0.6	0.6
	7 - 9	5.5	110	20	450	5	30	0.8	0.8
	10 - 12	6.0	110	30	550	5	60	1.2	1.3
	13 - 15	8.0	140	30	550	5	60	1.1	1.2
	16 - 17 (18)	8.5	140	30	600	5	60	1.1	1.2
Girls	(4-) 6	5.5	80	20	400	5	30	0.6	0.6
	7 - 9	5.5	110	20	450	5	30	0.8	0.8
	10 - 12	5.5	110	25	550	5	60	1.1	1.0
	13 - 15	7.0	140	25	550	5	60	1.1	1.0
	16 - 17 (18)	7.0	150	25	600	5	60	1.1	1.0

Gender	Age Group (Years)	Niacin (VB3) mg	Folate µg	Fat*** (median) %	Dietary Fibre g	Sodium (Salt****) mg (g)	Potassium mg	Phosphorus mg	Copper mg
Boys	(4-) 6	8	200	20-30(25)	8	1,600 (4)	1,300	500	0.5
	7 - 9	11	300	20-30(25)	10	1,600 (4)	1,400	600	0.5
	10 - 12	15	400	20-30(25)	12	1,600 (4)	1,700	850	0.6
	13 - 15	15	400	20-30(25)	15	2,000 (5)	2,000	950	0.8
	16 - 17 (18)	15	400	20-30(25)	18	2,000 (5)	2,300	950	1.0
Girls	(4-) 6	8	200	20-30(25)	8	1,600 (4)	1,400	450	0.5
	7 - 9	11	300	20-30(25)	10	1,600 (4)	1,700	550	0.5
	10 - 12	15	400	20-30(25)	12	1,600 (4)	2,000	850	0.6
	13 - 15	15	400	20-30(25)	15	2,000 (5)	2,200	900	0.7
	16 - 17 (18)	15	400	20-30(25)	16	2,000 (5)	2,300	900	0.7

* 4, 5 years old and 18 years old were excluded from the data collection.

** EAR (Estimated Average Requirement) is the intake level for a nutrient at which the needs of 50 percent of the population will be met²²⁾.

*** Fat percentage from total energy

****Sodium chloride

Note that the figures are rounded for the final CAM-RDA. The actual quantitative amounts are showed in the colored column in the following pages.

3.2 Formula to calculate CAM-RDA

Table 3-1: CAM-RDA for school-aged children

Gender	Age group (years)
Boys	(4-) 6
	7 - 9
	10 - 12
	13 - 15
	16 - 17 (18)
Girls	(4-) 6
	7 - 9
	10 - 12
	13 - 15
	16 - 17 (18)

All energy and nutrient requirements were calculated based on each age group. Students' ages were divided into five groups in accordance with the SEA (Southeast Asian)-RDA table. However, while the school age in Cambodia is 6 to 17 years, other ages like 4 or 18 years remained in the table in parentheses as a reference. The classification of CAM-RDA age groups was set as shown in (Table 3-2).

Reference body weights used for Cambodian school-aged children were set at the mid-point between the median of the survey data and the SEA-RDA.

Figure 3-1: Line graph of CAM-RDA reference body weight of boys

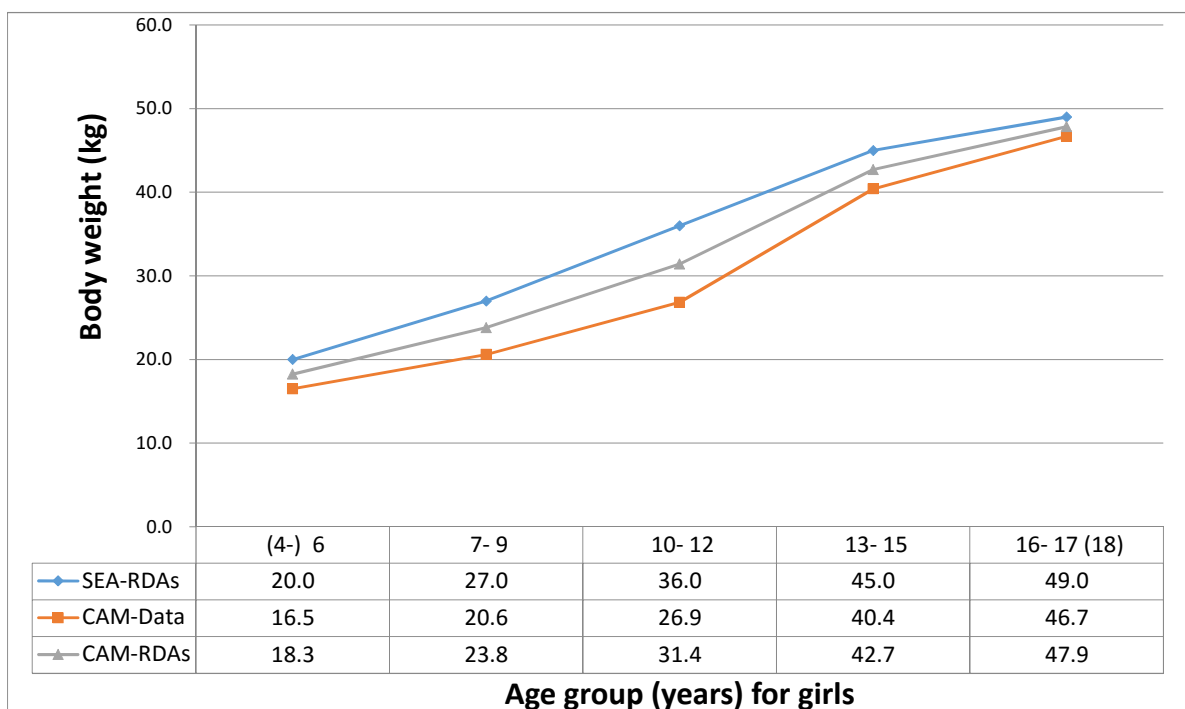
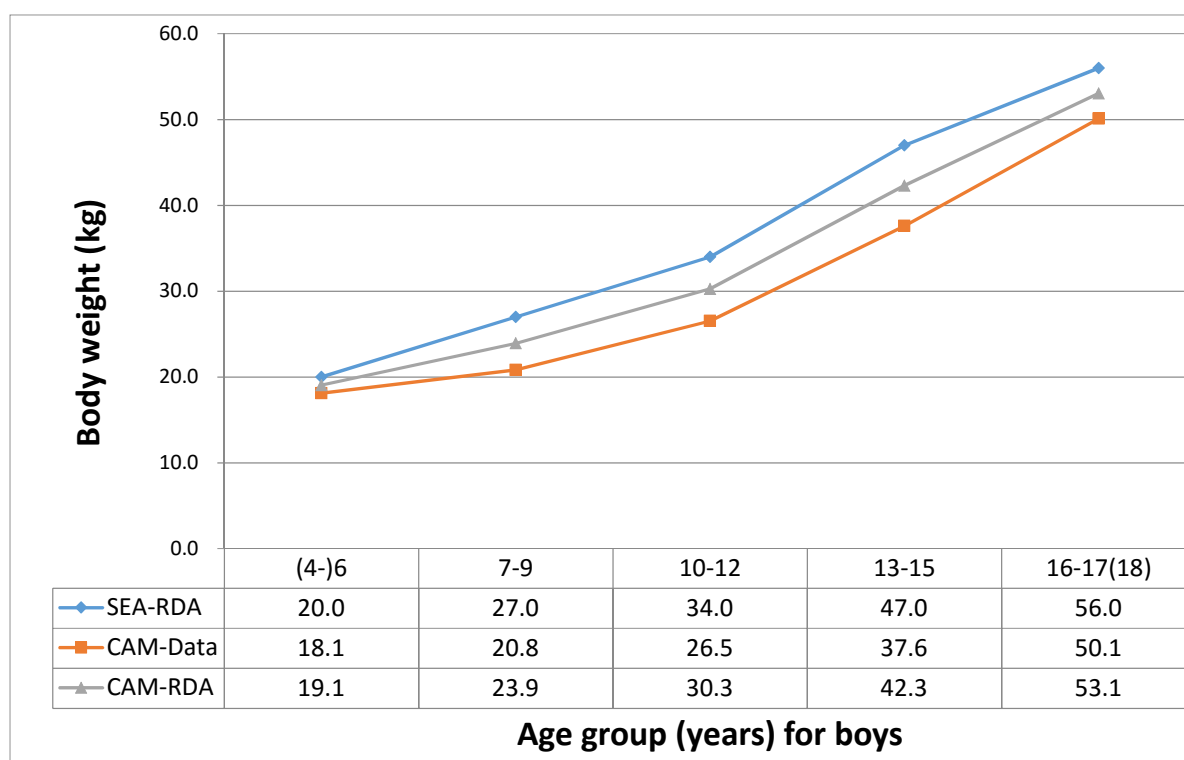


Figure 3-2: Line graph of CAM-RDA reference body weight of girls



3.2.1 Energy

The estimated energy requirement (EER) is “the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity, consistent with long term good health”²³⁾.

EER for each age group and sex was calculated based on the BMR predictive equations²⁴⁾ along with level of physical activity. The data of the real target group of Cambodian children from the survey were also used for the calculation.

$$\text{EER} = \text{BMR} \times \text{PAL} + \text{Energy deposition}$$

In which:

Note: Energy deposition = Weight gain per year x 1000/365 x Energy density

Basal Metabolic Rate (BMR) is defined as the lowest rate of energy exchange in the body that is related to the organization of bodily functions and the production of body heat. Technically, it is defined as the rate of energy expenditure of a fasted and fully-rested individual in a thermoneutral environment. It can also simply be defined as the minimal rate of energy expenditure compatible with life. The following equations

were used to estimate BMR by using reference body weight in Kg²⁵).

Table 3-3: Reference for BMR predictive equations

Age (Years)	Boys (Kcal/day)	Girls (Kcal/day)
3-10	22.7 x W + 495	22.5 x W + 499
10-18	17.5 x W + 651	12.2 x W + 746

W = Reference body weight

PAL (Physical Activity Level)

Japanese table of PAL were used to calculate estimated energy requirement²⁶)

Table 3-4: Physical activity level by age (for both boys and girls)

Age (Years)	PAL		
	Low	Middle	High
6	1.35	1.55	1.75
7	1.35	1.55	1.75
8	1.40	1.60	1.80
9	1.40	1.60	1.80
10	1.45	1.65	1.85
11	1.45	1.65	1.85
12	1.50	1.70	1.90
13	1.50	1.70	1.90
14	1.50	1.70	1.90
15	1.55	1.75	1.95
16	1.55	1.75	1.95
17	1.55	1.75	1.95

Table 3-5: Reference value for EER calculation

Age Group (Years)	Weight (kg)	Height (cm)	BMR	PAL			For growth			Value of Calculated Estimated Energy Requirement (EER)			
				Low	Middle	High	Weight gain (kg/year)	Energy density (kcal/g of body)	Energy deposition (kcal/day)	Low kcal/day	Middle kcal/day	High kcal/day	
				b	c	d	e	f	g	h=(f x 1000/365) x g	d x e+h	d x e+h	d x e+h
Boys													
(4-6)	19.1	112.5	927.4	1.35	1.55	1.75	4.86	2.10	27.98		1,280	1,466	1,651
7-9	23.9	120.2	1,037.8	1.38	1.58	1.78	6.35	2.37	41.17		1,477	1,684	1,892
10-12	30.3	132.4	1,180.6	1.47	1.67	1.87	12.04	2.50	82.45		1,814	2,050	2,286
13-15	42.3	149.6	1,391.3	1.52	1.72	1.92	10.75	1.63	48.11		2,158	2,436	2,715
16-17(18)	53.1	163.7	1,579.4	1.55	1.75	1.95	0.00 *	1.90	0.00 *		2,448	2,764	3,080
Girls													
(4-6)	18.3	108.7	909.6	1.35	1.55	1.75	5.55	2.80	42.58		1,271	1,452	1,634
7-9	23.8	119.5	1,034.5	1.38	1.58	1.78	7.63	3.07	64.06		1,495	1,702	1,909
10-12	31.4	134.4	1,129.4	1.47	1.67	1.87	11.28	2.73	84.43		1,741	1,967	2,193
13-15	42.7	149.8	1,266.9	1.52	1.72	1.92	5.15	3.57	50.32		1,972	2,225	2,479
16-17(18)	47.9	155.0	1,329.8	1.55	1.75	1.95	0.00 *	4.70	0.00 *		2,061	2,327	2,593

* 0.00 is set for the calculation as there is no data from the survey

3.2.2 Protein

The estimated average requirement (EAR) is key to calculating RDA. For protein, EAR was calculated using the formula below:

$$\text{EAR} = (\text{Protein deposition} / \text{Conversion for utilization for growth} \times 100 + \text{Maintenance requirement} / \text{Efficiency of conversion from dietary protein} \times 100) \times \text{RBW}$$

In which:

Protein deposition = weight gain x 1000/365 x body protein mass/100/RBW

Conversion for utilization for growth = 40%

Maintenance requirement = 0.67

Efficiency of conversion from dietary protein = 70 - 85%

RBW = CAM reference BW (Cambodia reference body weight)

Table 3-6: Reference value for EAR Protein calculation

Age Group (Years)	Reference Body Weight (kg)	Weight gain (kg/year)	Body protein mass (%)	Protein deposition (growth requirement) (g/kg/day)	Conversion for utilization for growth (%)	Maintenance requirement (g/kg/day)	Efficiency (digestion) of conversion from dietary protein (%)	Value of Calculated Estimated Average Requirement (EAR) (g/day)
	a	b	c	d	e	f	g	
	from our data	from our data		$b \times 1000/365 \times c/100/a$				$(d/e \times 100 + f/g \times 100) \times a$
Boys								
(4-6)	19.1	4.86	15.5	0.11	40.0	0.67	70.0	23.4
7-9	23.9	6.35	14.8	0.11	40.0	0.67	70.0	29.3
10-12	30.3	12.04	13.9	0.15	40.0	0.67	76.7	37.9
13-15	42.3	10.75	14.3	0.10	40.0	0.67	81.7	45.2
16-17(18)	53.1	0.00	15.0	0.00	40.0	0.67	85.0	41.8
Girls								
(4-6)	18.3	5.55	14.1	0.12	40.0	0.67	70.0	22.8
7-9	23.8	7.63	13.8	0.12	40.0	0.67	70.0	30.0
10-12	31.4	11.28	14.7	0.14	40.0	0.67	76.7	38.8
13-15	42.7	5.15	13.8	0.05	40.0	0.67	81.7	39.9
16-17(18)	47.9	0.00	11.9	0.00	40.0	0.67	85.0	37.7

The above calculated EAR is used to determine the RDA for protein by using the following equation. Twelve point five percent was assumed to be the inter-individual variation of the requirement²⁷.

$$\text{RDA (g)} = \text{EAR} \times \text{Coefficient of variation}$$

Coefficient of variation = 1.25

Table3-7: Reference value for RDA Protein calculation

Age Group (Years)	Estimated Average Requirement (g/day)	Coefficient of Variation	Value of Calculated RDA Calcium
Boys			
(4-)6	23.40	1.25	29.2
7-9	29.34	1.25	36.7
10-12	37.91	1.25	47.4
13-15	45.21	1.25	56.5
16-17(18)	41.82	1.25	52.3
Girls			
(4-)6	22.83	1.25	28.5
7-9	30.00	1.25	37.5
10-12	38.79	1.25	48.5
13-15	39.91	1.25	49.9
16-17(18)	37.72	1.25	47.1

3.2.3 Calcium

Only 1% of calcium is found in blood, extracellular fluid, muscle and other tissue, where it plays an important role in mediating vascular contraction and vasodilatation, muscle contraction, nerve transmission and glandular secretion. The other 99% is found in bone and teeth²⁸. To meet the recommended value of calcium, the estimated average requirement is multiplied by the coefficient of variation.

$$\text{EAR} = (\text{Bone mineral accretion} + \text{Urinary Excretion} + \text{Loss through skin}) / \text{Apparent calcium absorption}$$

The above calculated EAR is used to determine the RDA for calcium by using the following equation. 10% was assumed to be the inter-individual variation of the requirement²⁹.

$$\text{RDA} = \text{EAR} \times \text{Coefficient of variation}$$

$$\text{Coefficient of variation} = 1.2$$

Table 3-8: Reference value for Calcium calculation

Age Group (Years)	Reference Body Weight (Kg)	Bone mineral accretion (mg/day)	Urinary excretion (mg/day)	Losses through the skin (mg/day)	Apparent calcium absorption (%)	Coefficient of variation	EAR (mg/day)	Calculated value of RDA calcium (mg/day)
	a	b	c	d	e	f	$g = (b+c+d)/e$	$g \times f$
Boys								
(4-6)	19.1	99	55	9	0.4	1.2	465	558
7-9	23.9	102	65	11	0.4	1.2	507	608
10-12	30.3	170	77	13	0.4	1.2	625	750
13-15	42.3	212	100	17	0.5	1.2	728	874
16-17(18)	53.1	151	118	20	0.5	1.2	641	770
Girls								
(4-6)	18.3	86	53	9	0.4	1.2	422	507
7-9	23.8	119	65	11	0.4	1.2	555	665
10-12	31.4	173	80	13	0.4	1.2	695	833
13-15	42.7	148	100	17	0.4	1.2	612	735
16-17(18)	47.9	89	109	18	0.4	1.2	541	649

3.2.4 Iron

Most girls reach puberty at an earlier age than boys and they generally start their first menstrual cycle around the age of 10. The RDA was calculated in two recommendations. One is for non-period days and another is for period days (Table 3-9).

Table 3-9: Reference value for Iron calculation

Age Group	Intermediate value of age	Reference Body Weight	Weight gain	Basal Iron Losses *	Volume of blood	hemoglobin level	Increment of hemoglobin level	Volume of hemoglobin	Iron deposition in hemoglobin**	Increment of Tissue Iron (non iron storage)	Increment of iron storage	Total Iron storage	Menstrual blood losses	Period cycle of Menstrual	Menstrual iron Losses	Iron Absorption %	Coefficient of variation ****	EAR	EAR for menstruation	Value of Calculated RDA	Value of Calculated RDA for menstruation	
	a	b	c	d	e	f	g	h	i	j	k	m	n	o	p	q	s	t	u	v	x t	x t
Formula & resource			CAM RDAs	CAM RDAs	$X-X_0 \cdot W/W_0^{0.75}$	Ref: 30)	Ref: 31)	Ref: 31)	t x g	0.7mg/kg/365	Ref: 32)	J+K+m	Ref: 33/34)	Ref: 33/34)	o/p x 0.135 x 3.39			(e+h+k+m)/s	g/s of over 10yrs: (e+h+k+m+q)/s	u x t	v x t	
Boys																						
(4)6	6	18.1	4.9	0.37	1.62	128.8		208.7	0.29	0.01	0.01	0.30				0.15	1.40	4.51		6.31		
7-9	8	23.8	6.4	0.44	1.91	130.7		250.3	0.35	0.01	0.00	0.36				0.15	1.40	5.35		7.49		
10-12	11	30.3	12.0	0.52	1.75	135.6	1.40	235.6	0.20	0.02	0.21	0.21				0.15	1.40	4.98		6.98		
13-15	14	42.3	10.8	0.67		142.1	2.07		0.66	0.02	0.67	0.67				0.15	1.33	8.99		11.99		
16-17(18)	16.5	53.1	0.0	0.79		150.4	3.40		0.31	0.00		0.32				0.15	1.20	7.36		8.83		
Girls																						
(4-)6	6	18.3	5.6	0.36	1.66	128.7		213.6	0.27	0.01	0.01	0.28				0.15	1.40	4.28		6.00		
7-9	8	23.8	7.6	0.43	1.93	130.2		251.9	0.38	0.01	0.00	0.38				0.15	1.40	5.54		7.75		
10-12	11	31.4	11.3	0.53	1.83	134.0	1.10	243.1	0.40	0.02	0.41	0.41	31.1	31.0	0.46	0.15	1.40	6.40	9.46	8.95	13.24	
13-15	14	42.7	5.2	0.67		135.8	0.83		0.38	0.01	0.39	0.39	31.1	31.0	0.46	0.15	1.33	7.10	10.16	9.47	13.55	
16-17(18)	16.5	47.9	0.0	0.73		135.6	0.28		0.03	0.00	0.03	0.03	31.1	31.0	0.46	0.15	1.20	5.10	8.16	6.12	9.80	

* Extrapolation: $W_0=68.6\text{kg}$, $X_0=0.96\text{mg/day}$

** 6-9 yrs: (volume of hemoglobin of higher age group -volume of hemoglobin the target age group) x 3.39mg/(median age of the higher age group median of the target age group)/365days; 10-17yrs: $c \times (h+d) \times g \times 0.075L \times 3.39/365$

*** 6-14yrs= 20%; >15yrs= 10%

3.2.5 Thiamin (Vitamin B1), Riboflavin (Vitamin B2) and Niacin (Vitamin B3)

Following upon the estimated energy requirement (EER) calculated for Cambodian children, the amount of required Vitamin B1, B2, and B3 were calculated based on the EER of CAM-RDA.

$$X = X_0 \times \text{EER of CAM-RDA} / \text{EER}_0$$

X = new RDA for the target population

X_0 = value existing in the reference (SEA-RDA)

EER_0 = EER existing in the reference (SEA-RDA)

Thiamine (Vitamin B1) was calculated as below (Table 3-10):

Table 3-10: Reference value for Thiamin (VB1) calculation

Age Group (Years)	SEA-EER (kcal/day)	CAM-EER Energy Middle (kcal/day)	SEA-Vit B1 (mg/day)	Value of Calculated CAM-RDA Vit B1 (mg/day)
Boys				
(4-6)	1,470	1,500	0.6	0.6
7-9	1,825	1,700	0.9	0.8
10-12	2,110	2,100	1.2	1.2
13-15	2,650	2,500	1.2	1.1
16-17(18)	2,980	2,800	1.2	1.1
Girls				
(4-6)	1,470	1,500	0.6	0.6
7-9	1,825	1,700	0.9	0.8
10-12	2,010	2,000	1.1	1.1
13-15	2,205	2,200	1.1	1.1
16-17(18)	2,240	2,300	1.1	1.1

Riboflavin (Vitamin B2) was calculated as below (Table 3-11):

Table 3-11: Reference value for Riboflavin (VB2) calculation

Age Group (Years)	SEA-EER (kcal/day)	CAM-EER Energy Middle (kcal/day)	SEA-Vit B2 (mg/day)	Value of Calculated CAM-RDA Vit B2 (mg/day)
Boys				
(4-6)	1,470	1,500	0.6	0.6
7-9	1,825	1,700	0.9	0.8
10-12	2,110	2,100	1.3	1.3
13-15	2,650	2,500	1.3	1.2
16-17(18)	2,980	2,800	1.3	1.2
Girls				
(4-6)	1,470	1,500	0.6	0.6
7-9	1,825	1,700	0.9	0.8
10-12	2,010	2,000	1.0	1.0
13-15	2,205	2,200	1.0	1.0
16-17(18)	2,240	2,300	1.0	1.0

Niacin (Vitamin B3) was calculated as below (Table 3-12):

Table 3-12: Reference value for Niacin (VB3) calculation

Age Group (Years)	SEA-EER (kcal/day)	CAM-EER Energy Middle (kcal/day)	SEA-Vit B3 (mg/day)	Value of Calculated CAM- RDA Vit B3 (mg/day)
Boys				
(4-)6	1,470	1,500	8	8.2
7-9	1,825	1,700	12	11.2
10-12	2,110	2,100	16	15.9
13-15	2,650	2,500	16	15.1
16-17(18)	2,980	2,800	16	15.0
Girls				
(4-)6	1,470	1,500	8	8.2
7-9	1,825	1,700	12	11.2
10-12	2,010	2,000	16	15.9
13-15	2,205	2,200	16	16.0
16-17(18)	2,240	2,300	16	16.4

3.2.6 Zinc, Iodine, Selenium, Vitamin A, Vitamin D, Vitamin C, and Folate

Another basic rule to extrapolate RDA values is based on the reference body weight of the target group and the reference value of the existing reference, where an exponent of 0.75 is adopted to estimate the ratio of body surface area proportional to the requirement of the selected nutrients. Nutrient and body weight references from SEA were used to calculate Zinc, Iodine, Selenium, Vitamin A, Vitamin D, Vitamin C and Folate.

$$X = X_0 \times (W/W_0)^{0.75}$$

X = new RDA for the target population

X₀ = values in the existing reference (SEA-RDA)

W = CAM reference BW

W₀ = "reference BW" used in the existing reference (SEA-RDA)

Zinc was calculated as below (Table 3-13):

Table 3-13: Reference value for zinc calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Zn (mg/day)	Value of Calculated CAM- RDA Zn (mg/day)
Boys				
(4-)6	20	19.1	5.7	5.5
7-9	27	23.9	6.0	5.5
10-12	34	30.3	6.8	6.2
13-15	47	42.3	8.9	8.2
16-17(18)	56	53.1	8.6	8.3
Girls				
(4-)6	20	18.3	5.7	5.3
7-9	27	23.8	6.0	5.5
10-12	36	31.4	6.1	5.5
13-15	45	42.7	7.2	6.9
16-17(18)	49	47.9	6.8	6.7

Iodine was calculated as below (Table 3-14):

Table 3-14: Reference value for iodine calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Iodine ($\mu\text{g/day}$)	Value of Calculated CAM-RDA Iodine ($\mu\text{g/day}$)
Boys				
(4-)6	20	19.1	90	87
7-9	27	23.9	120	110
10-12	34	30.3	120	110
13-15	47	42.3	150	139
16-17(18)	56	53.1	150	144
Girls				
(4-)6	20	18.3	90	84
7-9	27	23.8	120	109
10-12	36	31.4	120	108
13-15	45	42.7	150	144
16-17(18)	49	47.9	150	147

Selenium was calculated as below (Table 3-15):

Table 3-15: Reference value for selenium calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Selenium (mg/day)	Value of Calculated CAM-RDA Selenium (mg/day)
Boys				
(4-)6	20	19.1	22	21
7-9	27	23.9	21	19
10-12	34	30.3	32	29
13-15	47	42.3	32	30
16-17(18)	56	53.1	32	31
Girls				
(4-)6	20	18.3	22	21
7-9	27	23.8	21	19
10-12	36	31.4	26	23
13-15	45	42.7	26	25
16-17(18)	49	47.9	26	26

Vitamin A was calculated as below (Table 3-16):

Table 3-16: Reference value for Vitamin A calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Vit A ($\mu\text{g/day}$)	Value of Calculated CAM-RDA Vit A ($\mu\text{g/day}$)
Boys				
(4-)6	20	19.1	450	434
7-9	27	23.9	500	456
10-12	34	30.3	600	550
13-15	47	42.3	600	554
16-17(18)	56	53.1	600	576
Girls				
(4-)6	20	18.3	450	420
7-9	27	23.8	500	455
10-12	36	31.4	600	542
13-15	45	42.7	600	577
16-17(18)	49	47.9	600	589

Vitamin D was calculated as below (Table 3-17):

Table 3-17: Reference value for Vitamin D calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Vit D ($\mu\text{g/day}$)	Value of Calculated CAM-RDA Vit D ($\mu\text{g/day}$)
Boys				
(4-)6	20	19.1	5	5
7-9	27	23.9	5	5
10-12	34	30.3	5	5
13-15	47	42.3	5	5
16-17(18)	56	53.1	5	5
Girls				
(4-)6	20	18.3	5	5
7-9	27	23.8	5	5
10-12	36	31.4	5	5
13-15	45	42.7	5	5
16-17(18)	49	47.9	5	5

Vitamin C was calculated as below (Table 3-18):

Table 3-18: Reference value for Vitamin C calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Vit C (mg/day)	Value of Calculated CAM-RDA Vit C (mg/day)
Boys				
(4-)6	20	19.1	30	29
7-9	27	23.9	35	32
10-12	34	30.3	65	60
13-15	47	42.3	65	60
16-17(18)	56	53.1	65	62
Girls				
(4-)6	20	18.3	30	28
7-9	27	23.8	35	32
10-12	36	31.4	65	59
13-15	45	42.7	65	62
16-17(18)	49	47.9	65	64

Folate was calculated as below (Table 3-19):

Table 3-19: Reference value for Folate calculation

Age Group (Years)	SEA-BW (kg)	CAM-RDA BW (kg)	SEA-Folate ($\mu\text{g}/\text{day}$)	Value of Calculated CAM-RDA Folate ($\mu\text{g}/\text{day}$)
Boys				
(4-)6	20	19.1	200	193
7-9	27	23.9	300	274
10-12	34	30.3	400	367
13-15	47	42.3	400	370
16-17(18)	56	53.1	400	384
Girls				
(4-)6	20	18.3	200	187
7-9	27	23.8	300	273
10-12	36	31.4	400	361
13-15	45	42.7	400	385
16-17(18)	49	47.9	400	393

3.2.7 Copper

Copper was calculated using the same formula as the other micronutrients, but with a different reference (Table 3-20). The Japanese reference was used for X_0 and W_0 . Fifteen percent was assumed to be the inter-individual variation of the requirement³⁵.

$$\text{RDA (g)} = \text{EAR} \times \text{Coefficient of variation}$$

Coefficient of variation= 1.3

Table 3-20: Reference value for copper calculation

Age Group (Years)	DRIs JPN EAR (mg/day)	CAM-RDA (kg)	DRIs JPN (kg)	EAR (mg/day)	Coefficient of variation	Value of Calculated CAM-RDA Copper (mg/day)
Formula	X_0	W	W_0	$X_0 \times (W/W_0)^{0.75}$		$\text{EAR} \times \text{Coefficient of variation}$
Boys						
(4-)6	0.4	19.1	22.2	0.36	1.3	0.46
7-9	0.4	23.9	26.1	0.37	1.3	0.49
10-12	0.6	30.3	40.1	0.46	1.3	0.60
13-15	0.7	42.3	52.6	0.62	1.3	0.81
16-17(18)	0.8	53.1	59.7	0.73	1.3	0.95
Girls						
(4-)6	0.4	18.3	21.9	0.35	1.3	0.45
7-9	0.4	23.8	25.6	0.38	1.3	0.49
10-12	0.5	31.4	40.0	0.44	1.3	0.58
13-15	0.6	42.7	49.0	0.54	1.3	0.70
16-17(18)	0.6	47.9	51.9	0.56	1.3	0.73

3.2.8 Fat

The Japanese reference was used to determine the percentage of the recommended fat intake. The percentages vary from 20-30% based on the level of activity. To calculate the amount of fat intake, we used the estimated energy requirement of each age group and selected the activity level (Table 3-21).

A median of 25% is recommended to avoid both chronic energy deficiency and obesity.

Table 3-21: Recommended Fat percentage calculated from EER

Age Group (Years)	Fat (median)
	% Energy
Boys	
(4-)6	20-30(25)
7-9	20-30(25)
10-12	20-30(25)
13-15	20-30(25)
16-17(18)	20-30(25)
Girls	
(4-)6	20-30(25)
7-9	20-30(25)
10-12	20-30(25)
13-15	20-30(25)
16-17(18)	20-30(25)

3.2.9 Dietary Fibre

Dietary Fibre was calculated by using the data from the survey combined with Japanese reference values. The new Dietary Goal (DG_x) was derived from the equation below:

$$DG_x = 18.9 \times (\text{RBW of our data}/57.8)^{0.75}$$

The above figure 18.9g is the intermediate value of a and b, which is set as a tentative goal to be achieved by considering very low actual intake levels in the target population.

a: Median of DF intake in Japanese adult (over 18 years) (13.7g/day)³⁶⁾.

b: Observed risk decrease in heart attack mortality (24g/day)³⁷⁾.

57.8 = the average body weight of Japanese adult

DG_x = Tentative goal aimed to prevent life-style related disease e.g. coronary heart disease, stroke and cancer³⁸⁾.

Table 3-22: Reference value for Dietary Fibre calculation

Age Group (Years)	CAM-RDA BW (Kg)	DGx (g)
Formula	a	$18.9 \times (a/57.8)^{0.75}$
Boys		
(4-)6	19.1	8.2
7-9	23.9	9.7
10-12	30.3	11.6
13-15	42.3	15.0
16-17(18)	53.1	17.7
Girls		
(4-)6	18.3	8.0
7-9	23.8	9.7
10-12	31.4	12.0
13-15	42.7	15.1
16-17(18)	47.9	16.4

3.2.10 Sodium

A reduction in sodium intake to <2 g/day sodium (5 g/day salt) is recommended by WHO to reduce the risk of high blood pressure, cardiovascular disease, stroke and coronary heart disease in adults. Not only for adults, but WHO also recommends a reduction in sodium intake to control blood pressure in children. The recommended maximum level of intake of 2 g/day sodium in adults should be adjusted for children based on the energy requirements of children³⁹).

$$DGx = [5.0 \times (EERx / EER_0) + Ix] / 2$$

DGx = tentative dietary goal for preventing life-style related diseases

5.0 = Suggested maximum level of intake for sodium chloride (salt) in gram by WHO for adult

EERx = EER for CAM-RDA

EER₀ = EER for 18-29 years old for SEA-RDA

Ix = Median of sodium chloride (salt) intake in CAM data

In this formula, the intermediate values between the true recommended level (=5g) adjusted for EER and the actual intake levels are calculated as a tentative and achievable goal in the real settings of the target population.

Table 3-23: Reference value for sodium calculation

Sodium Chloride (salt)					Sodium
Age Group (Years)	EER _c (kcal)	EER ₀ (kcal)	Ix(cam) (g/day)	DG _x (g/day)	DG _{x'} (mg/day)
Formula & resource	a	b	c	$(5x(a/b)+c)/2$	
Boys					
(4-)6	1,500	2,635	3.3	3.1	1,575
7-9	1,700	2,635	3.3	3.3	1,575
10-12	2,100	2,635	3.9	3.9	1,575
13-15	2,500	2,635	4.3	4.5	1,969
16-17(18)	2,800	2,635	4.7	5.0	1,969
Girls					
(4-)6	1,500	2,115	3.3	3.4	1,575
7-9	1,700	2,115	3.3	3.7	1,575
10-12	2,000	2,115	3.9	4.3	1,575
13-15	2,200	2,115	4.3	4.8	1,969
16-17(18)	2,300	2,115	4.7	5.1	1,969

3.2.11 Potassium

An increase in potassium intake from dietary sources is suggested by WHO in order to reduce blood pressure, the risk of cardiovascular disease, stroke and coronary heart disease in adults. WHO also suggests an increase in potassium intake from dietary sources to control blood pressure in children. The recommended potassium intake of at least 90 mmol/day (3,510mg/day) should be adjusted downward for children, based on the energy requirements of children relative to those of adults⁴⁰).

$$DG_x = [3,510 \times (EER_x/EER_0) + Ix] / 2$$

In which:

DG_x = tentative dietary goal for preventing life-style related diseases

3,510 = recommended potassium intake in mg by WHO for adults

EER_x = EER for CAM-RDA

EER₀ = EER for 18-29 years old for SEA-RDA

Ix = median of potassium intake in CAM data

Table 3-24: Reference value for potassium calculation

Age Group (Years)	EER _X (kcal/day)	EER ₀ (kcal/day)	I _X (mg/day)	DG _X (mg/day)
Formula & resource	a	b	c	(3,510 x (a/b)+c)/2
Boys				
(4-)6	1,500	2,635	582	1,290
7-9	1,700	2,635	546	1,405
10-12	2,100	2,635	663	1,730
13-15	2,500	2,635	818	2,074
16-17(18)	2,800	2,635	906	2,318
Girls				
(4-)6	1,500	2,115	443	1,466
7-9	1,700	2,115	498	1,660
10-12	2,000	2,115	655	1,987
13-15	2,200	2,115	741	2,196
16-17(18)	2,300	2,115	716	2,266

3.2.12 Phosphorus

The adult requirements for phosphorus are based on studies of serum inorganic phosphorus concentration. The EAR, and hence the RDA, for healthy adolescents aged 9 through 18 years is based on a factorial approach and is higher than the adult value. This is because this age range is one of intensive growth, with growth rate, absorption efficiency, and normal values of inorganic phosphorus in the extracellular fluid changing during this time⁴¹).

$$\text{CAM-RDA Phosphorus} = (\text{DRI US \& Canada} + I_x) / 2$$

In which:

DRI US & Canada= the DRI value of -US and the RDA value of Canada

I_x = Median of Phosphorus intake in CAM data

Table 3-25: Reference value for phosphorus calculation

Age Group (Years)	DRIs US&Canada (mg/day)	I _X (CAM-Data) (mg/day)	CAM-Phosphorus (mg/day)
Formula	a	b	(a+b)/2
Boys			
(4-)6	500	517	509
7-9	750	458	604
10-12	1,250	489	870
13-15	1,250	614	932
16-17(18)	1,250	683	967
Girls			
(4-)6	500	369	435
7-9	750	397	573
10-12	1,250	489	869
13-15	1,250	524	887
16-17(18)	1,250	528	889

Chapter 4

Comparison of the survey results and CAM-RDA and Recommendations for improvement

This chapter intends to discern the gap between the actual nutritional status and dietary intakes revealed by the nationwide survey and the nutritional objectives (RDA) as well as to introduce recommendations aiming to improve the nutritional status of school-aged children. The recommendations are derived from the gap analysis with relevant data from other Asian countries. It is hoped that this will serve as useful information for policy-makers when developing a nutrition policy for children and adolescents.

4.1 Comparison of dietary intakes and CAM-RDA

From the survey results introduced in Chapter 2, the mean of students' intake of energy and fifteen nutrients such as protein, calcium, iron, thiamin (VB1), riboflavin (VB2), niacin (VB3), zinc, vitamin A, vitamin C, copper, fat, dietary fiber, sodium/salt (sodium chloride), potassium, phosphorus along with CAM-RDA are shown by gender and age group (Appendix 3-1 to 3-19).

In summary, the majority of students surveyed were found not meeting the CAM-RDA for most nutrients. The total average of energy intake is $1,600 \pm 595$ kcal (mean \pm SD). When energy intake is compared with EER of CAM-RDA, all groups except 6 year-old boys are not within the appropriate range of EER (Figure 4-1). There is a slight difference between girls (54%) and boys (61%) who are getting enough protein. 6 year-old boys (91%) were getting sufficient protein (Appendix 3-4).

The total intake of calcium was 396 ± 246 mg (mean \pm SD). It is the most needed among 10-12 year-old boys (only 6% meet the EAR of CAM-RDA), followed by 13-15 year-old boys and 10-12 year-old girls (in both age groups only 10% meet the EAR of CAM-RDA). Overall, only 14% of students met the EAR of CAM-RDA for calcium (Appendix 3-5). Iron intake was the lowest among 10-12 year-old girls (31% meet EAR of CAM-RDA) and the highest among 16-17 year-old boys (82% meet EAR of CAM-RDA) (Appendix 3-6). None of the students surveyed met the RDA for zinc (Appendix 3-7).

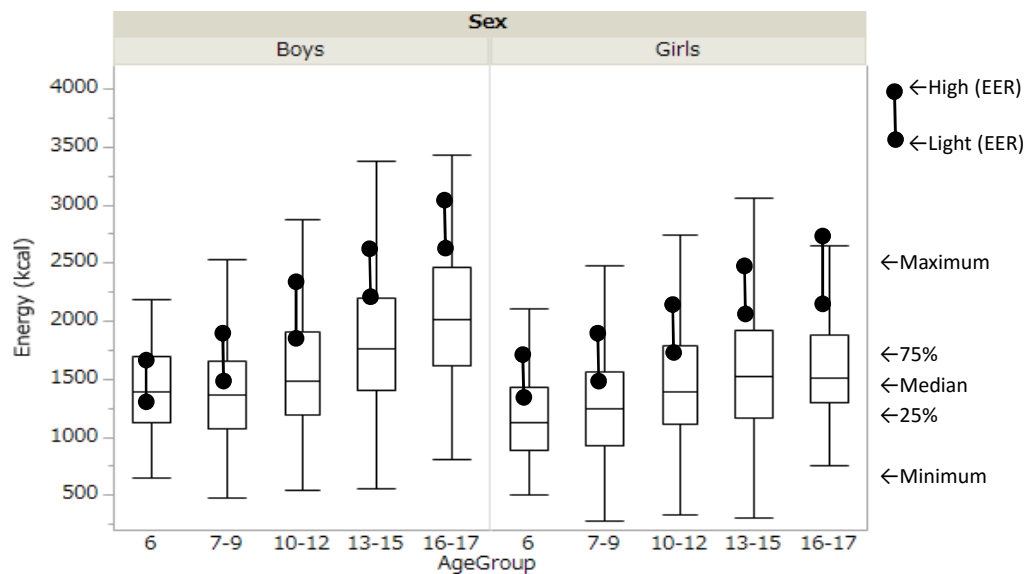
A majority of children did not meet the CAM-RDA for vitamins A, C, B1 and B2. For vitamin A, only 21% of boys and 18% of girls met the recommended dietary intake and it was lowest among 6 year-old boys (only 6% meet CAM-RDA). For vitamin C, only 41% of boys and 44% of girls met the RDA. Only 14% of boys and 13% of girls consumed the recommended amount of thiamin or vitamin B1. Similarly, 18% of boys and 20% of girls met the RDA for riboflavin or vitamin B2, the lowest consumption was seen among 10-12 year old boys (8%). For niacin or vitamin B3, the lowest percentage of students who consumed adequate amounts is among 10-12 year old boys (7%) and

girls (7%) (Appendix 3-8 to 3-12).

The percentage of students who met the dietary goal (DG) for fat is low overall (19%) but is higher among girls (22%) than boys (16%) (Appendix 3-13). While the percentage of students who consumed within the dietary goal for sodium (49%) and sodium chloride (49%) seems relatively high, a closer look reveals that the other 50% consumed either more than enough or not enough sodium (Appendix 3-15, 3-16). For potassium, only 2% of students met the DG of CAM-RDA. 17% met the DG for phosphorus, while 9% met the DG for copper, with only slight differences between girls and boys (Appendix 3-18, 3-19). Considering the importance of the sodium-potassium ratio to prevent hypertension, the current data is worrisome. Far too few children consumed an adequate amount of potassium, but too much sodium.

It would be ideal to grasp habitual intakes measured by survey of multiple days to compare them with values of CAM-RDA for more strict assessment. The demonstrated results from a single-day survey could be different from the habitual intakes, therefore, it should be carefully interpreted.

Figure 4-1: Distribution of energy intake and EER



4.2 Recommendations on increasing intakes of some important nutrients

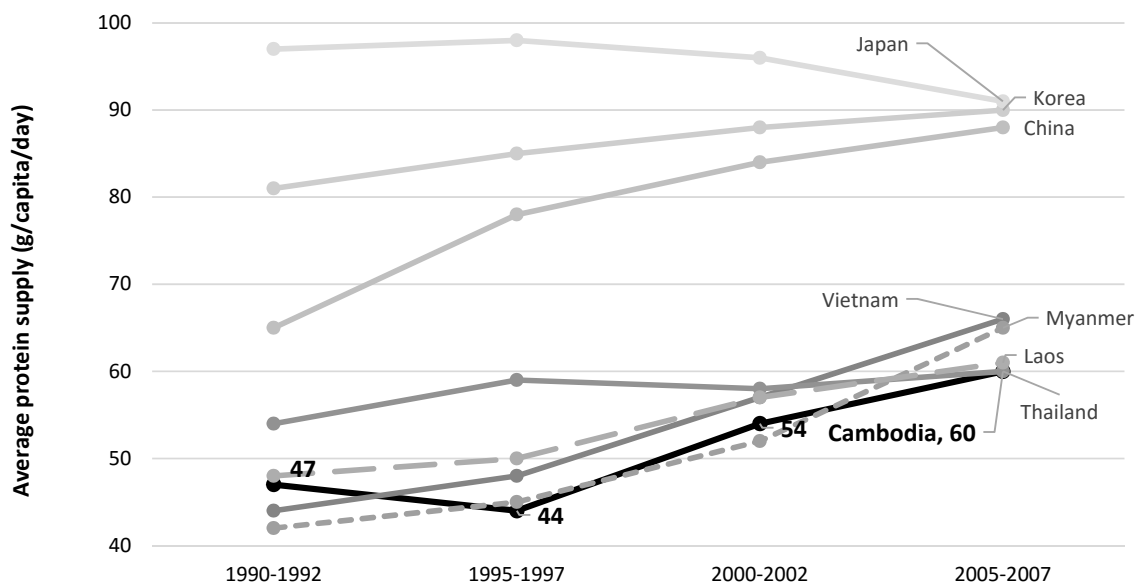
4.2.1 Ideal intake goals for protein and calcium

Adolescents require more nutrients compared to the needs of younger children as they enter puberty and experience many physical changes including growth spurts, sexual maturity, bone mineralization, and body composition changes. The survey results indicated that both boys and girls for aged 10-12 and 13-15 who met or exceeded the standard (or within the standard range) were low. Proteins and calcium are especially important during puberty and its ideal intake goal values are suggested below.

Protein

Figure 4-2 shows that protein supply among Asian countries increased significantly in the past 25 years, with a range from 4-15 g of increase in a decade (except Japan). While more protein is being consumed in these countries than in the past, increasing protein intake by 5-10g (from the current 45g to 50-55g) in next 10 years may be both ideal and feasible (Figure 4-2).

Figure 4-2: Changes in protein supply in Cambodia, neighboring countries, China, Korea and Japan (1990-2005)

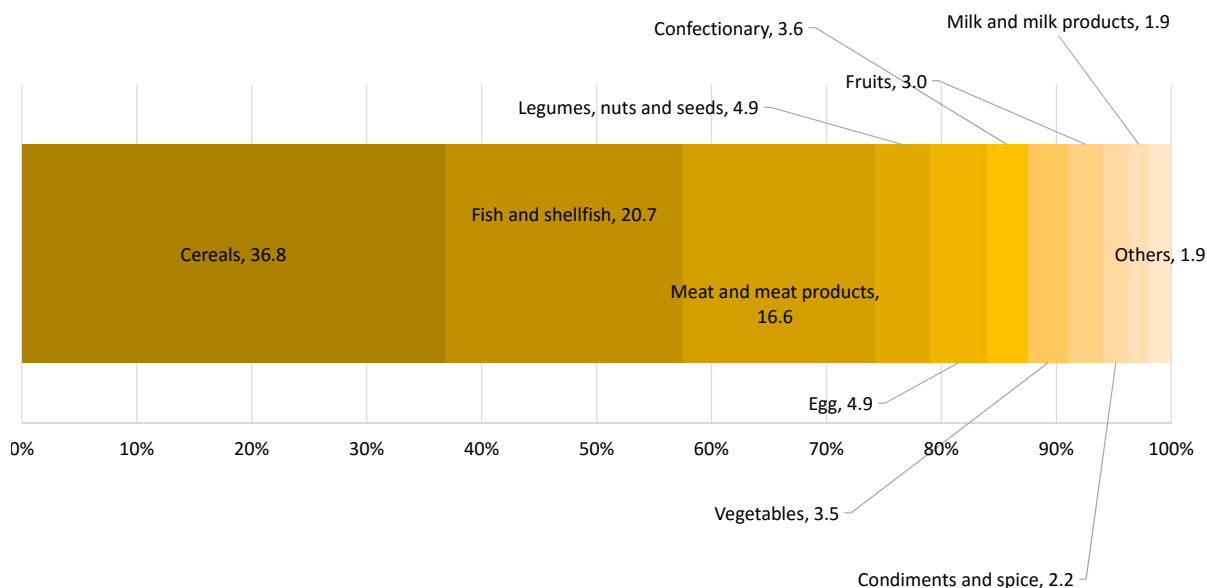


Change of average protein supply per 10 years (1990-2005) g/capita/day
 Japan: -4g Korea: 6g China: 15g Vietnam: 15g Myanmar: 15g Laos: 9g Thailand: 4g

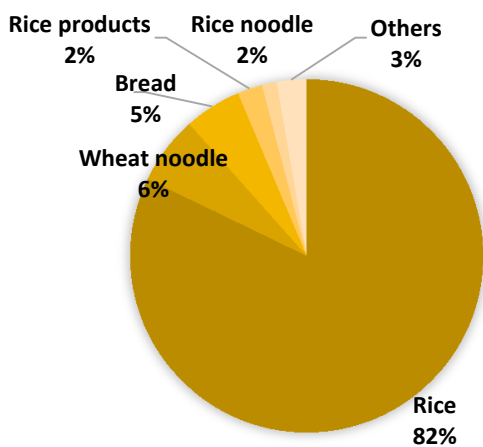
As demonstrated by the survey, students' protein intake mostly relied on cereal 36.8%, (82% of which is from rice, 6% from wheat noodle, and 5% from bread), followed by fish (20.7%), meat (16.6%), eggs (4.9%) and legumes (4.9%, 40% of which is from mung bean and 25% from soybean milk) (Figure 4-3). This indicates that students consumed protein mostly from rice. However, this may need to be shifted to protein-rich foods, such as fish, meat, or eggs.

The food portion equivalent to 6g of protein is about 30g of meat or fish, 1 egg, or 60g of legumes. When expressed in serving size, the average intake for protein-rich food (fish, meat, beans and eggs) is around 3 servings at the time of the survey, but should be increased by 1-2 servings, for a total of 4-5 servings.

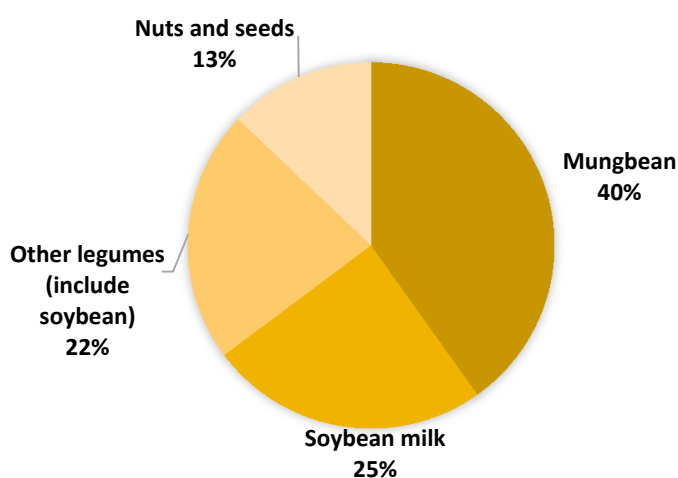
Figure 4-3: Ratio of food groups for protein source



[Figure 4-3a: Cereals]



[Figure 4-3b: Legumes]



Calcium

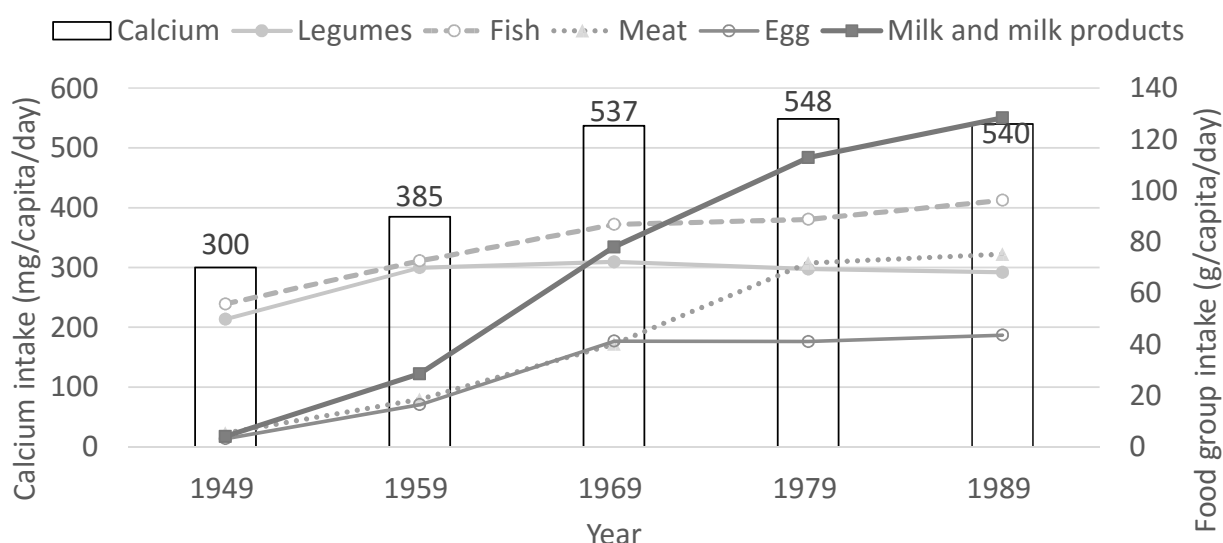
According to statistics for Japan, calcium intake among the intake among Japanese almost doubled over 30 years (from 300mg in 1949 to 548mg in 1979). This is mostly due to milk and milk products consumption, which increased from 4g to 113g over the same time period (Figure 4-4).

Figure 4-5 shows the milk supply in Cambodia and neighboring countries for the past 20 years. Countries such as Vietnam, Thailand, and Myanmar increased their milk supply by double over the two decades.

In Cambodia, milk supply remains low (Figure 4-5), along with milk and milk product consumption. However, this trend may change in future as these milk products can be an ideal source of calcium. In order to achieve the increases seen elsewhere in the region, intake would need to be increased by 50 to 100mg over the next 10 years (from the average of 396mg of current calcium intake to 450-500mg).

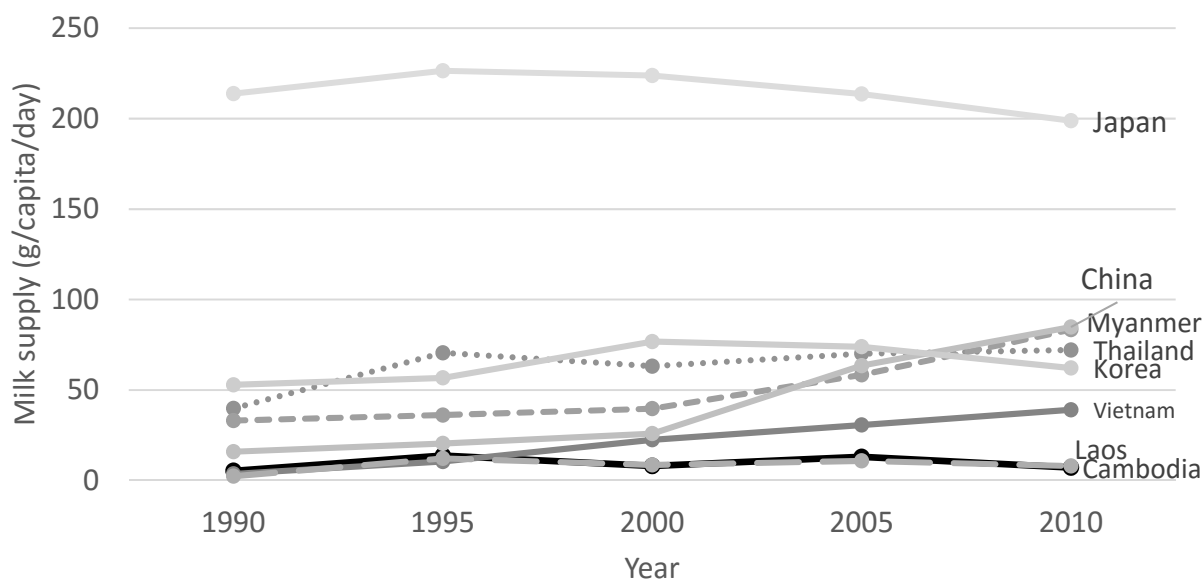
From the survey results, students' intake of calcium mostly relied on the condiments which accounted for 27.6% of calcium consumption (from this, 84% is coming from fish and shrimp paste, and 12% is from fish sauce), followed by cereals (13.9%), fish (12.7%), and vegetables (9.2%, mainly coming from leafy vegetables of 61%) (Figure 4-6). When converted into serving size, only about 0.3 servings were consumed from the calcium-rich foods. This should be increased to 2-3 servings. The food portion equivalent to 1 serving (100mg) of calcium is 100ml for milk, 40g for whole small fish, 60g of tofu, and 50g for amaranth (leafy green vegetables).

Figure 4-4: Changes in calcium intake and calcium food group (Legumes, fish, meat, eggs, milk and milk products) intakes in Japan



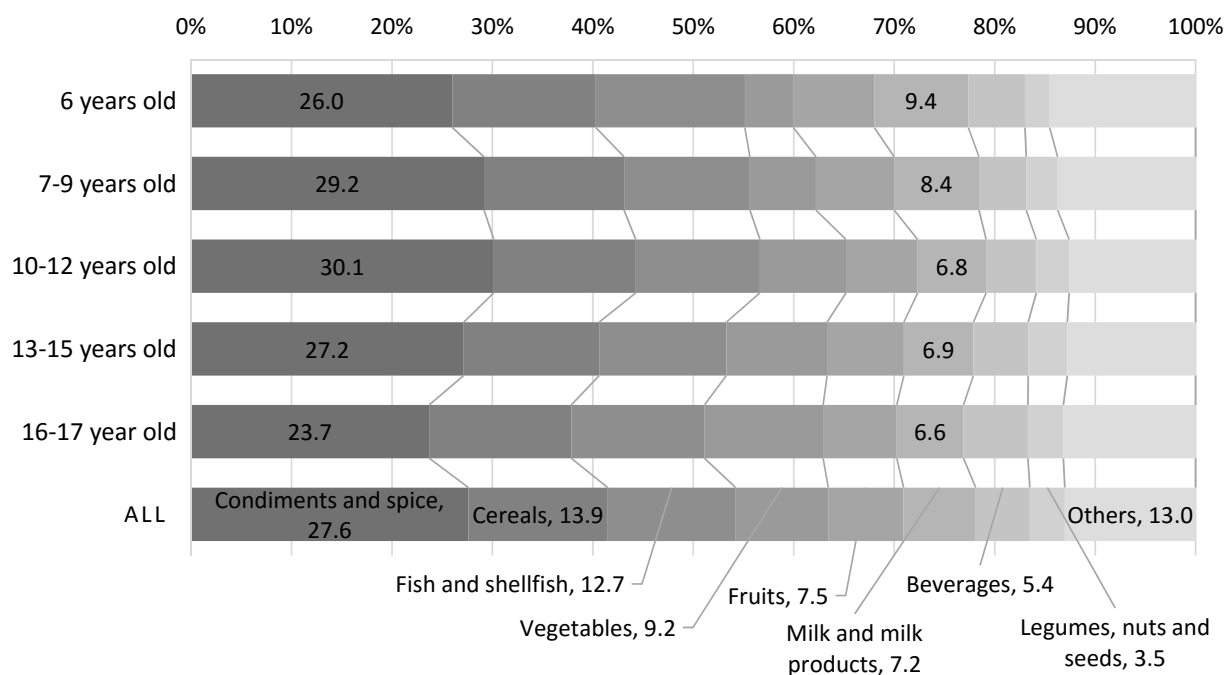
Source: Ministry of Health, Labour and Welfare, Japan: National nutrition survey

Figure 4-5: Changes in milk supply in Cambodia, Neighboring countries, China, Korea and Japan (1990-2005)

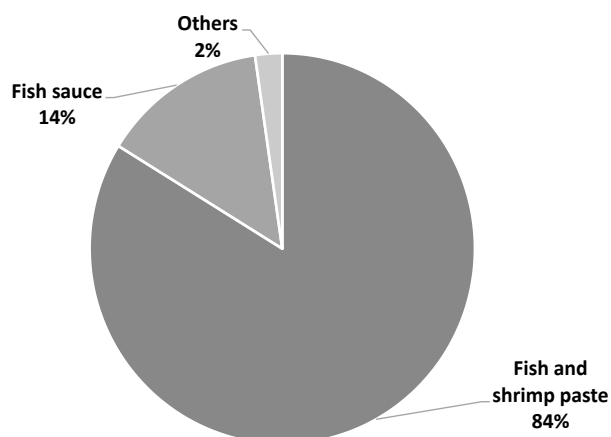


Source: FAO. FAOSTAT. Food Balance Sheets

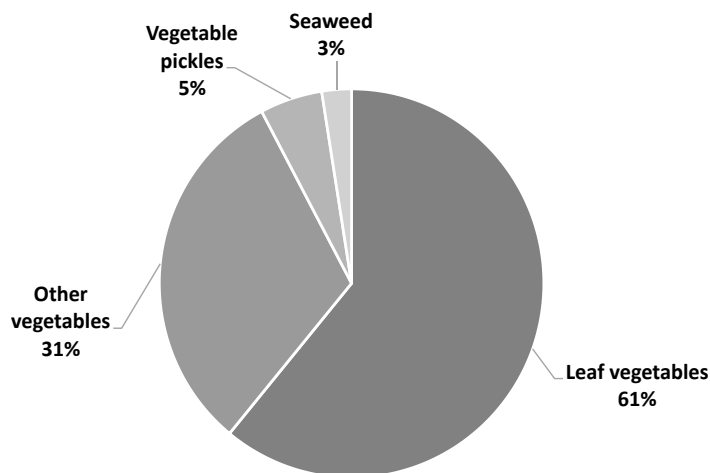
Figure 4-6: Ratio of food groups for calcium source by age group



[Figure 4-6a: Condiments]



[Figure 4-6b: Vegetables]



4.2.2 Ideal goals for height and weight

As shown by anthropometric results in earlier chapter, it is important to observe the physique of students at 6-17 years of age. Reducing the number of students who are underweight, stunted, and thin can be an optimal goal for their overall health and growth. Setting ideal goals for weight and height within the next 10 years is recommended using examples from other Asian countries.

In Asia, the children’s average height and weight increased over the past few decades. For instance, boys’ height increases ranged from 0.9 cm (Thailand) to 4.7 cm (Korea), and their weight increases ranged from 0.8 kg (Japan) to 5.3 kg (Korea) on average over years⁴²⁾⁻⁴⁸⁾ (Table 4-1, 4-2). Likewise, girls’ height increased 0.6 cm (Thailand) to 3.9 cm (Korea), and gained 0.8 kg (Japan) to 3.7 kg (Korea) on average over 10 years^{47),48)}. Taking into consideration the above data, weight increase of 1-3 kg and height increase of 1-4 cm from the current mean or median may be an ideal goal over the next 10 years (Table 4-3).

Table 4-1: Average of height increase per 10 years (Boys)

Age (Years)	Vietnam ⁴²⁾ (1976-2006)	Thailand ⁴³⁾ (1950-2000)	China -Rural ⁴⁴⁾ (1985-2005)	China -Urban ⁴⁵⁾ (1985-2005)	China ⁴⁶⁾ (1985-2005)	Korea ⁴⁷⁾ (1965-2005)	Japan ⁴⁸⁾ (1949-1989)
6	-	-	-	-	2.1 (1.9, 2.8, 1.7)**	2.6	2.0
7	-	-	2.6	2.2	-	3.1	2.3
8	-	-	2.8	2.6	-	3.1	2.5
9	-	-	2.9	2.6	-	3.1	2.7
10	-	-	3.0	2.8	-	3.3	2.9
11	-	0.9 (0.7, 1.1)*	3.3	3.1	-	3.7	3.4
12	-	-	4.0	3.8	-	4.4	3.9
13	-	-	3.6	3.2	-	4.7	4.5
14	-	-	3.6	2.9	-	4.5	4.4
15	-	-	3.3	2.3	-	3.6	3.4
16	2.7	-	2.2	1.7	-	2.4	2.7
17	-	-	1.8	1.3	-	1.8	2.3

*(Rural, Urban)

** (Urban, Suburban, Rural)

Table 4-2: Average of height increase per 10 years (Girls)

Age (Years)	Vietnam ⁴²⁾	Thailand ⁴³⁾	China -Rural ⁴⁴⁾	China -Urban ⁴⁵⁾	China ⁴⁶⁾	Korea ⁴⁷⁾	Japan ⁴⁸⁾
	(1976-2006)	(1950-2000)	(1985-2005)	(1985-2005)	(1985-2005)	(1965-2005)	(1949-1989)
6	-	-	-	-	2.0 (1.9, 2.6, 1.6)**	2.4	2.1
7	-	-	2.5	1.9		2.9	2.3
8	-	-	2.9	2.4	-	3.1	2.5
9	-	-	2.9	2.5	-	3.4	2.8
10	-	-	3.2	2.6	-	3.4	3.3
11	-	0.6 (0.5, 0.8)*	3.5	2.8	-	3.8	3.8
12	-	-	3.3	2.5	-	3.9	3.7
13	-	-	1.8	1.5	-	3.2	3.3
14	-	-	1.8	1.2	-	2.5	2.6
15	-	-	1.5	1.1	-	1.7	1.8
16	1.4	-	1.3	0.8	-	1.4	1.5
17	-	-	1.1	0.9	-	1.2	1.4

*(Rural, Urban)

** (Urban, Suburban, Rural)

Table 4-3: Average of weight increase per 10 years

Boys

Age (Years)	Korea ⁴⁷⁾ (1965-2005)	Japan ⁴⁸⁾ (1949-1989)
6	1.4	0.8
7	1.9	0.9
8	2.5	1.2
9	2.9	1.5
10	3.4	1.9
11	3.8	2.4
12	4.5	3.0
13	5.3	3.5
14	5.3	3.7
15	5.0	3.3
16	4.1	2.8
17	3.6	2.4

Girls

Age (Years)	Korea ⁴⁷⁾ (1965-2005)	Japan ⁴⁸⁾ (1949-1989)
6	1.0	0.8
7	1.6	1.0
8	2.0	1.2
9	2.3	1.6
10	3.1	2.0
11	3.4	2.5
12	3.6	2.9
13	3.7	2.7
14	3.4	2.3
15	2.7	1.7
16	2.0	1.2
17	1.6	0.9

The Cambodian Food-Based Dietary Guidelines -Cambodian Food for Healthy Growth-

As presented in Chapter 3, the CAM-RDA for school-aged children has been calculated based on the dietary intakes and nutritional status found through the nationwide survey conducted in 2014-15. In order to promote nutritional recommendations generated through the CAM-RDA to the public, this information needs to be translated into Food-Based Dietary Guidelines (FBDG) that comprise simple messages on healthy eating along with the food pyramid and other Information Education and Communication (IEC) materials that give guidance on specific foods and amount to be eaten each day from each food type.

These guidelines and accompanying IEC materials can be used as tools for nutrition education in schools as well as for interventions that promote healthy eating habits among the general public including caretakers of children.

5.1 Seven messages

The following 7 key messages were first drafted based on the scientific rationale from the survey. The wording of the messages and its statement were evaluated by the FBDG development team to ensure that they are appropriate for school-aged children. They were revised taking into account feedback from other interested parties and finalized by the FBDG development team after pilot testing.

- 1. Eat food from all food types with a well-balanced diet* everyday**
- 2. Consume calcium rich-food such as whole small fish, milk and milk products**
- 3. Eat protein-rich foods such as fish, meat, eggs or beans at least 2 to 3 times a day**
- 4. Eat plenty of fruits and vegetables regularly**
- 5. Eat cereal and starchy food such as rice, noodles, bread and its alternatives in an adequate amount**
- 6. Reduce food high in salt, sugar and fat**
- 7. Measure your body weight and height regularly and track your growth**

*Balanced diet is to eat food from all food types in proper amount and fit with physical activity⁴⁹⁾

5.2 Educational materials for dissemination

IEC materials play a very important role in drawing the attention of the target population to the guidelines and communicating its substance effectively. The Cambodian Food-Based Dietary Guidelines have been translated into the following 4 kinds of IEC materials.

Type of IEC material	Target audience	Contents
Poster	All school-aged children (6 – 17 years old), the general public	<ul style="list-style-type: none"> • Food pyramid • 7 key messages
Brochure	Primary school students	<ul style="list-style-type: none"> • Food pyramid • 7 key messages • Short statement of each message • Reference weight and height
Booklet	Secondary/High school students	<ul style="list-style-type: none"> • Food pyramid • Serving size information • 7 key messages • Explanation of each message • Basic nutrients • Malnutrition • Meal planning • Healthy recipe • Activity Checklist
Handbook (to be developed) *see the chapter 6 “For the next step”	Caretaker, health workers, community health volunteers, teachers	<ul style="list-style-type: none"> • Food pyramid • Serving size information • 7 key messages • Nutrition information and meal planning • Cooking technique and hygiene practices • Healthy Recipes



The meeting of FBDG development team actively discussing the food pyramid and the key messages.

(June 2017)

5.2.1 Poster

Target: All school-aged children and the general public

Content: The food items were selected from the top 50 most commonly consumed items reported by respondents during the nationwide survey in 2014-15. Young Cambodian artists drew all of the food items in the pyramid. The shape of pyramid was inspired by Angkor Wat Temple. The pyramid “Cambodian Food for Healthy Growth“ is designed to show the recommended proportion of food types to be consumed; i.e., low consumption at the top and higher consumption at the base of the pyramid. The food types are (1) cereals and starchy foods as main source of carbohydrate, (2) fruits and (3) vegetables as important sources of vitamins and minerals, (4) whole small fish, small dried shrimp, milk and milk products as the main source of calcium and (5) meat, fish, eggs, and beans as main sources of protein and (6) fat and condiments such as oil, animal fat, salt and sugar.

Examples of food types in the food pyramid:

- i. Cereals and starchy foods: rice, yellow noodle, white noodle, bread, corn, and potato.
- ii. Vegetables: morning glory, cucumber, carrot, tomato, spinach, pumpkin, wax gourd, bean sprout and snake gourd.
- iii. Fruits: banana, pineapple, water-melon, mango, papaya, orange, sapodilla, jack fruit and guava.
- iv. Protein-rich foods: fish, chicken, meat, eggs, snail, crab and beans.
- v. Calcium-rich foods: whole small fish, small dried shrimp, tofu, milk and milk products.
- vi. Salt, sugar, fat and oil: oil and pork fat, salt and sugar.

7 key messages are introduced on both sides of the pyramid expressing the connection between food types and messages by color.



5.2.2 Brochure

Target: Primary school students

Content: The main information is derived from the food pyramid with additional short statement about the 7 key messages. The short statement is to support each key message in order for children to understand the rationale behind the recommendations.

The short statement:

Message 1: Eat food from all food types with a well-balanced* diet everyday:

Eating food from different food types every day is to support your health and growth.

Message 2: Consume calcium-rich food such as whole small fish, milk and milk products:

Calcium is important to maintain healthy teeth and bones.

Message 3: Eat protein-rich food such as fish, meat, eggs or beans at least 2 to 3 times a day:

Protein-rich foods will help you build a strong body and muscles.

Message 4: Eat plenty of fruits and vegetables regularly:

Eating vegetables and fruits can help you prevent illness.

Message 5: Eat cereals and starchy foods such as rice, noodles, bread and its alternatives in an adequate amount:

The body needs to maintain a constant supply of energy. Providing energy is the major function of cereals and starchy foods.

Message 6: Reduce food high in salt, sugar and fat:

Try to limit sweetened drinks. You can choose to stay healthy through selecting foods that are low in fat, salt and sugar.

Message 7: Measure your body weight and height regularly and track your growth:

Knowing your body weight and height can help you manage healthy growth.

The ideal body weight and height for each age group are also introduced for boys and girls.

5.2.3 Booklet

Target: Secondary and high school students (13-17 years old)

Content: The below contents were selected taking into consideration the target age group that will soon be responsible for their own food choices and will soon reach their reproductive years.

1. Food pyramid

Food pyramid is introduced with illustration of food item and in which type each belongs to.

2. Serving size information “How much do we need to eat from each food type?”

In order for an individual to understand how much to eat from each food type, it is important to provide guidance on serving sizes. The information was prepared for both boys and girls from 13-17 years old or more, based on three of energy requirement levels from CAM-RDA. Students will be able to identify their required energy consumption by their age and their physical activity levels indicated alongside the table. However, this may need to be explained by school teachers or caretakers for better understanding. In addition, a standard serving size for each food type needs to be introduced along with the serving size guide⁵⁰). So far, only selected food items have been listed in the table, but the food list can be updated as necessary.

ស្តង់ដារសេវាម្តង (Standard of Serving)
ខាងក្រោមនេះគឺជាការពន្យល់ពីស្តង់ដារសេវាក្នុង១រង្វាល់



<p>ប្រភេទគ្រាប់ធញ្ញជាតិ និងពពួកម្សៅ ១រង្វាល់មាន កាបូអ៊ីប្រូត ៤០ក្រាម</p>	 បាយ១កូនចាន ឬ ១០ស្លាបព្រឺង (១៤០ក្រាម)	 ពោតស្ពោរ ១ផ្លែ (១១០ក្រាម)	 នំបញ្ចុក២២ង្កាយ (១៦៥ក្រាម)
	 នំប៉័ងធម្មតា១ដើម (៧០ក្រាម)		 នំប៉័ង ២បន្ទះ កន្លះ (៨០ក្រាម)
<p>ប្រភេទបន្លែ ១រង្វាល់មានបន្លែ ទម្ងន់៣០ក្រាម</p>	 បន្លែបៃតងឆ្អិន២ ស្លាបព្រឺង (៣០ក្រាម)	 ផ្លែល្ពៅឆ្អិន៣ដុំ (៣០ក្រាម)	 ត្រសក់នៅកន្លះផ្លែ ឬ ៤ចំនិត (៣០ក្រាម)


Table 5-1: Definition of 6 food types and standard of serving

Food type	Standard of Serving	Portion size of serving
Cereals and Starchy foods	1 serving is 40g of carbohydrate	<ul style="list-style-type: none"> • 1 small bowl or 10 spoons of cooked rice (140g) • 2 Changvay (set) of Khmer noodle (165g) • ½ of corn (65g) • 1 loaf of baguette (70g) • 2 ½ pieces of sandwich bread (80g)
Vegetables	1 serving is 30g of vegetables	<ul style="list-style-type: none"> • 2 spoons of green vegetable (30g) • 3 pieces of pumpkin (30g) • ½ or 4 pieces of cucumber (30g)
Fruits	1 serving is 100g of fruits	<ul style="list-style-type: none"> • 4 pieces of watermelon (100g) • 3 pieces of guava (100g) • 4 pieces of papaya (100g) • 1 ½ of banana (100g) • 4 pieces of ripe mango (100g)
Protein-rich foods	1 serving is 6g of protein	<ul style="list-style-type: none"> • 2 spoons of chopped or slice meat (20g) • 4 pieces of fish meat (30g) • 1 chicken egg (50g) • 3 spoons of mungbean (60g)
Calcium-rich foods	1 serving is 100mg of calcium	<ul style="list-style-type: none"> • 2 spoons of small fish (40g) • 7 small dried fish (10g) • 1 cup of yoghurt (100g) • ½ glass of milk (100ml) • 5/9 pieces of tofu (60g)
Fat and oils	<ul style="list-style-type: none"> • 1 teaspoon of butter (5g) • 1 teaspoon of oil/fat (5g) <p>- Try to choose vegetable oil rather than animal fat.</p> <p>- Fat is also contained in other food types.</p> <p>- Limit your fat intake by 2-3 teaspoons (10-15g) per day only.</p>	

Table 5-3: Energy-based ideal serving size for boys



Level of Activity	Age (years)	Required Energy	1. Cereals and starchy foods	2. Vegetables	3. Fruits	4. Protein-rich foods	5. Calcium-rich foods
Less Active	13-17	2000 (kcal)	5-7 servings	4-5 servings	2 servings	3 servings	2-3 servings
More Active		2500 (kcal)	7-9 servings	5-6 servings	2-3 servings	4 servings	2-3 servings



Level of Activity	Age (years)	Required Energy	1. Cereals and starchy foods	2. Vegetables	3. Fruits	4. Protein-rich foods	5. Calcium-rich foods
Less Active	13-15	2000 (kcal)	5-7 servings	4-5 servings	2 servings	3 servings	2-3 servings
	16-17	2500 (kcal)	7-9 servings	5-6 servings	2-3 servings	4 servings	2-3 servings
More Active	13-15	2500 (kcal)	7-9 servings	5-6 servings	2-3 servings	4 servings	2-3 servings
	16-17	3100 (kcal)	9-11 servings	6-7 servings	2-3 servings	5 servings	2-3 servings

3. Ideal Menus

To better illustrate the phrase “good variety, well-balanced diet”, an ideal menu for a day (breakfast, lunch, dinner, and snack) was created in the next page. Each menu was calculated for energy and nutrients using FIDR Nutrition Calculation Database, created based on ASEAN Food Composition Table ⁵¹⁾ and was converted into serving sizes for each food type.

Table 5-4: Ideal menu with serving size

Counting food group servings in the menu for one day at 2,000 calories							
Recipe	Main dish	Cereals and starchy foods	Vegetables	Fruits	Protein-rich foods	Calcium-rich foods	Energy
Breakfast							
Cooked rice		2					367
Pork	Marinated fried pork and egg with cucumber				1		181
Duck egg							
Fresh cucumber			1				
Fresh milk						2.5	155
Banana				1			105
Lunch							
Cooked rice		2					367
Snackhead Fish	Samlor Samlork				1.5		96
Pumpkin			3				
Ivygourd							
Wax Gourd							
Snack							
Sweet potato, boiled	Sweet potato	1					160
Dinner							
Cooked rice		2					367
Pork belly	Fried amaranth with 3 layers pork				1		230
Amaranth			2			1	
Sapodilla, ripe				1			85
2,000 kcal	Total	7	6	2	3.5	3.5	2,113
2,500 kcal	Total	8	8	2.5	4	4	
3,100 kcal	Total	10.5	9	2.5	5.5	4	

Table 5-5: Ideal menu with nutrients data

	Calorie Level		
	2,000	2,500	3,100
Ideal menu and food type servings at 3 calorie levels			
Number of Servings			
Cereals and starches	7	8	10.5
Protein-rich foods	3.5	4	5.5
Calcium-rich foods	4.5	4.5	5
Vegetables	6	8	9
Fruits	2	2.5	2.5
Nutrient Data			
Energy (kcal)	2,113	2,461	3,101
Carbohydrates / g	364.4	420.1	534
Protein / g	53.8	63.9	80.1
Fat / g	48.2	57.8	70.7
Calcium / mg	735	816	918
Iron / mg	10.4	12.9	16.1
Vitamin A / μ g	663	926	1183
Thiamine (VB1) / mg	0.82	0.97	1.22
Riboflavin (VB2) / mg	1.3	1.51	1.79
Niacin (VB3) / mg	10.1	12.2	15.1
Vitamin C / mg	108	138	142

4. Basic nutrients

It is important to provide the basic information of essential nutrients such as carbohydrates, protein, fat, vitamins and minerals. Some of their major functions are introduced so that students are able to learn and reflect on choosing better foods.

5. Malnutrition

Students are able to learn more about how under and over nutrition affect their health. Particular information on sugar, salt, vitamin A and calcium as well as information related to non-communicable diseases (NCDs) are provided.

6. FBDG messages and explanations:

The 7 key messages are mentioned and followed by explanation in order for the students to understand the reason of such recommendations.

Message 1: Eat food from all food types with a well-balanced diet everyday

Our body cannot synthesize nutrients on its own -- or not to an adequate amount -- and must be provided by the diet. Eating a variety of food ensures you'll get all the nutrients you need. Choose food items from all the different food types to get the most nutrients.

Message 2: Consume calcium-rich food such as whole small fish, milk and milk products

We need to consume a certain amount of calcium to build and maintain strong bones and teeth. When we don't get enough calcium for our body's needs, it is taken from our bones, which can lead to bone loss, low bone density and even broken bones. Calcium also facilitates a healthy communication between the brain and various parts of the body. Calcium can also be found in leafy green vegetables.

Message 3: Eat protein-rich food such as fish, meat, eggs or beans at least 2 to 3 times a day

Protein is an essential nutrient found in animal products (meat, fish, and eggs), nuts, and beans. Our cells and organs, our muscles, and even our bones could not hold together without the help of protein.

Message 4: Eat plenty of fruits and vegetables regularly

Vegetables and fruits contain important vitamins, minerals and fiber. Scientific research shows that if you regularly eat lots of fruits and vegetables, you can lower risk of developing diseases or health problems.

Message 5: Eat cereals and starchy foods such as rice, noodle, bread and its alternatives in an adequate amount

Cereals and starchy foods—rice, noodle, bread, potato, corn, and so on—are rich in carbohydrates. Carbohydrate is the preferred energy source for most of the body's functions, especially brain. Eating cereals and starchy foods should be in conjunction with daily physical exercise to maintain ideal weight and health.

Message 6: Reduce food high in fat, salt, and sugar

Many health problems are linked to poor eating habits. Many people eat too much saturated fat (especially animal fat), added salt (fish sauce and salty condiments) and added sugar (sugary beverages). Reducing these by small amounts can make us healthier by helping us manage our weight and reducing our risk of diseases.

Message 7: Measure your body weight and height regularly and track your growth

It is important to know your body weight. Being overweight or underweight can increase your risk for serious diseases and health conditions. Try to measure your weight on a regular basis to control and manage your healthy body.

7. Meal Planning

After introducing basic nutrients and issues related to under and over nutrition, students will learn how to plan their own meals with healthy food choices. Examples of recommended daily eating habit and overall patterns for a healthier diet are introduced by providing several options applicable to both urban and rural populations.

8. Recipe

A recipe is introduced based on traditional Cambodian dishes. These will encourage students to appreciate the Cambodian food culture that consists of variety of vegetables, meat, fish, tropical fruits and rice as the main staple food for Cambodians. They are rich in nutrient and well-balanced food. Nutrition facts and cooking instructions are also illustrated.

9. Review checklist

Students can review their current own eating habits and reflect with what they learned throughout the booklet.

5.3 The Pilot Study

The purpose of the pilot study was to assess practicality, comprehensibility and cultural acceptability of the developed FBDG. IEC materials, including a food pyramid poster as well as brochures were also shown to target audiences in order to get feedback for revision.

5.3.1 The First Pilot Study

The first-pilot study was conducted in two rounds in 6 provinces: Takeo, Kep, Kampong. Speu, Kampong. Cham, Siem Reap and Preach Vihear. Eight schools (4 primary and 4 secondary schools) were selected in the four regions: Tonle Sap, Plateau and Mountain, Plain and Coastal. The respondents were students, caretakers and teachers, totaling 365 (round 1) and 345 (round 2). Three tools were developed and tested: (1) questionnaire and (2) quiz for students to assess their knowledge and understanding of nutrition education and (3) feedback from teachers to seek their recommendations on IEC and teaching materials (see Appendix 4 for the list of the schools).



FIDR staff explaining the food pyramid to Grade 4 students and their parents at Sbov Primary School in Kep

Table 5-6: Summary of the activities of the 1st pilot study

Pilot study round 1	Pilot study round 2
<ol style="list-style-type: none"> 1. Administer questionnaire to students in class. 2. Conduct reflection session on the posters (Pyramid poster and Angkor Wat posters) 3. Conduct Nutrition Education Session with all students 4. Administer Quiz to all students 5. Conduct Q and A session 6. Receive feedback from teachers 	<ol style="list-style-type: none"> 1. Administer questionnaire to the same students from Pre Pilot. 2. Conduct reflection session on the poster and brochure (primary brochure) 3. <No Nutrition Education was given> 4. Administer Quiz to all students 5. Conduct Q and A session and games 6. Receive feedback from teachers

Result

- **Students:** Primary and secondary school students were willing to learn the nutrition topics. They seemed to understand the importance and the relationship between nutrition and health. However, it is difficult to change their eating habits due to the environment at school and at home.
- **Caretakers:** Most of caretakers said they had not paid much attention to what their children should eat. After the session, they understood the importance of nutrition, especially for their children’s healthy growth and they showed their willingness to prepare meals from a variety of food for their family.

This pilot study was useful for learning the areas that should be revised or modified within the IEC materials. The key messages were mostly accepted by students, teachers and caretakers. Some revisions were made by the FBDG development team based on the feedback from the pilot study.



The FBDG development team member from the School Health Department of MoEYS joined to evaluate the pilot study at Mrum Khang Tboung Secondary School in Kg. Speu

5.3.2 The Second Pilot Study

The second-pilot study was conducted at 2 schools (primary school and secondary school) in Kampong Chhnang and 2 schools (primary school and high school) in Phnom Penh in July 2017 in order to ensure that the target audience understood the revised IEC materials. The pilot study was conducted in focus-group discussions to collect qualitative information. A total of 37 students and 5 teachers participated in the discussions.

The design and wording were discussed again within the FBDG development team for future adjustment based on the feedback from the students.



Students finding weight and height on the brochure
Svay Chrom Primary School, Kg. Chhnang



The concept of the serving size is explained to the students
Sovannaphumi High School, Phnom Penh



Students checking food items in the food pyramid
Sovannaphumi primary school, Phnom Penh



High school student from Sovannapumi School
clarifies the serving of Tofu.

Chapter 6

For the next step

Once the Cambodian FBDG is established, the next step is to disseminate the information/messages and implement activities for the target audience.

To increase awareness of FBDG, it needs to be communicated to the public (and target audience) through a variety of materials and methods. As already discussed in the previous chapter, FBDG will be primarily introduced through print materials (poster, brochure, and booklet) accompanied by a visual aid (food pyramid) and will be distributed to school children as part of their educational materials.

For further outreach, FBDG and the information will be disseminated through:

6.1 A handbook for parents and caretakers

Specific instructional materials are needed for parents, caretakers, and health or social workers among the local communities. These groups are made up of key persons who have direct contact with school-aged children. Information on how to use or read FBDG and related information such as food types, serving sizes, basic nutrients and their functions, as well as how to prepare healthy meals will be introduced in the handbook. This will be accompanied by food preparation techniques and information on the risk of diet-related diseases.

6.2 Training programs and workshops for school teachers

School teachers and educational curriculum are the key channels for implementation and communication of FBDG. Training programs for educators should be developed to improve understanding and knowledge of the FBDG and related information. Also, embedding FBDG into the school curriculum and accompanying text books are recommended for implementing nutrition education in schools.

Other possible implications and considerations are:

6.3 Mass media usage

The Cambodian FBDG can be introduced through the web sites of relevant stakeholders and authorities. In addition, information can be compiled into a visual or audio file to reach larger numbers of people at community or other events.

6.4 Campaigns and promotion activities

Face to face communication will be ideal for putting FBDG into practice. However, campaigns or promotion activities alone are inadequate to be adopted and improve

recognition of FBDG. To be effective, provision of further assistance for nutrition education and involvement of multiple sectors may be needed in the future. Additionally, bringing more nutritional information to the public will be necessary to make FBDG more practical on daily basis.

6.5 Application in healthcare institutions

FBDG can be introduced at multiple institutions, including health centers and hospitals where nutrition information should be shared with health professionals and patients. IEC materials can be used to educate patients on healthy diets and RDA can also be used when managing and providing hospital meals.

6.6 Monitoring and evaluation

In addition to the strategies above, FBDG should be monitored and evaluated on a regular basis to identify whether the messages are applicable and relevant to the target population. People’s lifestyles, eating patterns, and access to food are changing rapidly at present. Therefore, their dietary intakes must also be assessed by a wide range of stakeholders in order to make relevant updates to the FBDG and its messages. An ideal evaluation plan is suggested in Table 6-1.

Table 6-1: Suggested monitoring and evaluation plan

Evaluation criteria	Objectives for school-aged children (6 – 17 years old)	Frequency and method
Improvement in physique	<ul style="list-style-type: none"> Percentage of underweight, short stature, thinness and overweight will decrease Body height and weight will increase 	<ul style="list-style-type: none"> Once a year by antropometric measurement
Improvement in nutrition status	<ul style="list-style-type: none"> Intakes of protein will increase Intakes of calcium will increase 	<ul style="list-style-type: none"> Every 5-10 years by 24-hour dietary recall for 1-2 days
Improvement in food intakes	<ul style="list-style-type: none"> Intakes of food from the protein-rich food will increase Intakes of food from the calcium-rich food will increase 	<ul style="list-style-type: none"> Once a year or before and after interventions by Food Frequency Questionnaire (FFQ) *

* A FFQ should be developed and verified based on the Cambodian dietary contexts to use as a tool of monitoring for the FBDG. FFQ is suitable for large sample sizes and it requires relatively less time and lower costs than 24-hour dietary recall.

References

Chapter 1

- 1) National Institute of Statistics, Directorate General for Health, and ICF Macro, 'Cambodia Demographic and Health Survey 2014', Phnom Penh, Cambodia and Calverton, Maryland, USA, September 2015.
- 2) National Nutrition Strategy 2009-2015, Ministry of Health, Cambodia, pp. 13-19.
- 3) Food and Agriculture Organization of United Nations / World Health Organization, World Declaration and Plan of Action for Nutrition, Rome, 1992, p. 32.
- 4) Hoksrum A, A report of Regional Consultation on Food-Based Dietary Guidelines for countries in the Asia Region: Food and Agriculture Organization of the United Nations, World Health Organization and Institute of Home Economics, University of Delhi, New Delhi, India, 6-9 December 2010, p. 26.
- 5) Food and Agriculture Organization of the United Nations / World Health Organization, Preparation and Use of Food-Based Dietary Guidelines, Geneva, 1998, WHO Technical Report Series 880.
- 6) Institute of Medicine, 'Dietary Reference Intakes: Applications in Dietary Assessment', Washington, DC, 2000, pp. 2-3.
- 7) World Health Organization, Dietary recommendations / Nutritional requirements. Available from: <http://www.who.int/nutrition/topics/nutrecomm/en/>
- 8) Food and Agriculture Organization of the United Nations, 'A manual from the English-Speaking Caribbean: Developing Food-Based Dietary Guidelines', 2007.
- 9) Barbara Burlingame, et al., Nutrition and Consumer Protection Division, Food and Agriculture Organization of the United Nations, 'Sustainable diets and biodiversity', 2012, p. 7.

Chapter 2

- 10) Standardized Monitoring & Assessment of Relief & Transitions (SMART), 'Sampling Methods and Sample Size Calculation for the SMART Methodology', 2012.

- 11) World Health Organization, 'Training course on child growth assessment: interpreting growth indicators', World Health Organization, 2008. [cited May 9 2017]. Available from: http://www.who.int/childgrowth/training/module_h_directors_guide.pdf
- 12) Foundation for International Development/Relief, 'Picture Book for portion size of ingredients and food item', 2014.
- 13) World Health Organization, 'WHO AnthroPlus for personal computers Manual: Software for assessing growth of the world's children and adolescents', WHO, Geneva, 2009. Available from: <http://www.who.int/growthref/tools/en>
- 14) Puwastien P, Burlingame B, Raroengwichit M, Sungpuag P., 'ASEAN Food Composition Tables of Nutrition', Mahidol University, Thailand, 2000.
- 15) World Health Organization, 'The WHO Child Growth Standards', [cited June 5 2017]. Available from: <http://www.who.int/childgrowth/standards/en/>
- 16) De Onis M, Blössner M., 'WHO global database on child growth and malnutrition', Geneva: World Health Organization, Geneva, 1997, pp. 49–50. [cited July 2 2017]. Available from: http://apps.who.int/iris/bitstream/10665/63750/1/WHO_NUT_97.4.pdf
- 17) Ibid.
- 18) Institute of Medicine, 'Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation', Washington, DC, 2012. Available from: <https://doi.org/10.17226/13275>
- 19) National Institute of Statistics, Directorate General for Health, and ICF Macro, 'Cambodia Demographic and Health Survey 2014', Phnom Penh, Cambodia and Calverton, Maryland, USA, September 2015.
- 20) World Health Organization, 'Global report on diabetes', World Health Organization, Geneva, 2016.

Chapter 3

- 21) E-Siong T, Rodolfo, F., 'Recommended Dietary Allowances: Harmonization in Southeast Asia', International Life Sciences Institute-Southeast Asia Region, 2005. P 16.
- 22) Institute of Medicine, 'Dietary Reference Intakes', 3.
- 23) E-Siong T, 20-21.

- 24) Ibid., 22-41.
- 25) Ibid., 28.
- 26) Ministry of Health Labour Welfare, Japan., 'Dietary Reference Intakes for Japanese, 2015', Tokyo, 2015. [in Japanese]. Available from: <http://www.mhlw.go.jp/stf/shingi/0000041824.html>
- 27) Ibid.
- 28) E-Siong T, 61.
- 29) Ministry of Health Labour Welfare, Japan., 'Dietary Reference Intakes for Japanese, 2015'.
- 30) Hawkins WW., 'Iron, copper and cobalt. In: Beaton GH, McHenry EW, eds. Nutrition: a comprehensive treatise', Academic Press, New York, 1964, pp. 309–72.
- 31) Beaton GH, Corey PN, Steele C., 'Conceptual and methodological issues regarding the epidemiology of iron deficiency and their implications for studies of the functional consequences of iron deficiency', *Am J Clin Nutr*, vol. 50, 1989, pp. 575–88.
- 32) Dallman PR., 'Iron deficiency in the weanling: a nutritional problem on the way to resolution', *Acta Paediatr Scand*, vol. 323, 1986, (Suppl) pp. 59–67.
- 33) Yokoi K., 'Numerical methods for estimating iron requirements from population data', *Biol Trace Elem Res*, vol. 95, 2003, pp. 155–72.
- 34) Chisako Yano, et al., 'A general survey on what constitutes a "Normal" menstrual cycle', *Japanese Journal of Maternal Health*, vol. 4, 2005, pp. 496-502. [in Japanese]
- 35) Ministry of Health Labour Welfare, Japan., 'Dietary Reference Intakes for Japanese, 2015'.
- 36) Ibid.
- 37) Pereira MA et al., 'Dietary fiber and risk of coronary heart disease: pooled analysis of cohort studies', *Arch Intern Med*, vol. 164, 2004, pp. 370-6.
- 38) Ministry of Health Labour Welfare, Japan., 'Dietary Reference Intakes for Japanese, 2015'.
- 39) World Health Organization, 'Guideline: Sodium intake for adults and children', WHO, Geneva, 2012, pp. 18-9.
- 40) World Health Organization, 'Guideline: Potassium intake for adults and children', WHO, Geneva, 2012, pp. 16-7.

41) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and Nutrition Board, Institute of Medicine, 'Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride', National Academies Press, USA, 1997.

Chapter 4

42) Khan NC, Tue HH, Mai le B, Vinh le G, Khoi HH., 'Secular trends in growth and nutritional status of Vietnamese adults in rural Red River delta after 30 years (1976-2006)', *Asia Pac J Clin Nutr*, vol. 19, no 3, 2010, pp. 412-6.

43) Jordan S, Lim L, Seubsman SA, Bain C, Sleigh A., 'Thai Cohort Study Team: Secular changes and predictors of adult height for 86 105 male and female members of the Thai Cohort Study born between 1940 and 1990', *J Epidemiol Community Health*, vol. 66, no. 1, January 2012, pp. 75-80.

44) Chen TJ, Ji CY., 'Secular changes of stature in rural children and adolescents in China, 1985-2010', *Biomed Environ Sci*, vol. 27, no. 8, August 2014, pp. 573-81.

45) Chen TJ, Ji CY., 'Secular change in stature of urban Chinese children and adolescents, 1985-2010', *Biomed Environ Sci*, vol. 26, no. 1, January 2013, pp. 13-22.

46) Li H, Zong X, Zhang J, Zhu Z., 'Physical growth of children in urban, suburban and rural mainland China: a study of 20 years change' *Biomed Environ Sci*, vol. 24, no. 1, February 2011, pp. 1-11.

47) Kim JY, Oh IH, Lee EY, Choi KS, Choe BK, Yoon TY, Lee CG, Moon JS, Shin SH, Choi JM., 'Anthropometric changes in children and adolescents from 1965 to 2005 in Korea', *Am J Phys Anthropol*, vol. 136, no. 2, June 2008, pp. 230-6.

48) Ministry of Education, Culture, Sports, Science and technology, Japan: Annual Report of School Health Statistics Research. [in Japanese].

Available from: http://www.mext.go.jp/b_menu/toukei/chousa05/hoken/1268826.htm

Chapter 5

49) សៀវភៅអាហារ និងសុខភាពសម្រាប់បឋមសិក្សា៖ នាយកដ្ឋានសុខភាពសិក្សាឆ្នាំ២០១៣

50) Takemi Y, Yoshiike N., 'Shokuji baransu gaido o katsuyo shita eiyo kyoiku shokuiku jissen manyuaru', the Japan Dietetic Association, Japan, 2006, pp. 8-16. [in Japanese].

51) Puwastien P, 'ASEAN Food Composition Tables of Nutrition'.

Appendix

Appendix 1: Member list of Food-Based Dietary Guidelines Development Team

ល.រ No	ឈ្មោះ Name	តួនាទី Title	អង្គការ Institution
១	លោកស្រីបណ្ឌិត កើត ពេជ្រចិន្ដា Ms. Koeut Pichenda	អនុប្រធាន Deputy director	នាយកដ្ឋានការពារសុខភាព ក្រសួងសុខាភិបាល Preventive Medicine Department (PMD)/MoH
២	លោកស្រីវេជ្ជ. ឈុន លន់ Dr. Chhun Loun	ប្រធាន Chief of NCD	ការិយាល័យប្រយុទ្ធនឹងជំងឺមិនឆ្លង ក្រសួងសុខាភិបាល Non-communicable Disease / PMD/MoH
៣	លោកស្រីវេជ្ជ. ហុក ស៊ីរ៉ានី Dr. Hok Sirany	អនុប្រធាន Vice Chief of NCD	ការិយាល័យប្រយុទ្ធនឹងជំងឺមិនឆ្លង ក្រសួងសុខាភិបាល Non-communicable Disease / PMD/MoH
៤	លោកស្រីវេជ្ជ. ជា ម៉ារី Dr. Chea Mary	អនុប្រធាន Deputy Manager	កម្មវិធីជាតិអាហារូបត្ថម្ភ ក្រសួងសុខាភិបាល National Nutrition Program/MoH
៥	លោកស្រីវេជ្ជ. សូ ឆវីរត្ត Dr. So Chhavyroth	អនុប្រធាន Deputy director	នាយកដ្ឋានសុខភាពសិក្សា ក្រសួងអប់រំ យុវជន និងកីឡា School Health Department/MoYES
៦	លោកវេជ្ជ. សយ អ៊ុង Dr. Say Ung	ប្រធាន Director Department	នាយកដ្ឋានសុខាភិបាល សន្តិសុខស្បៀង និងអាហារូបត្ថម្ភ Department of Health, Food Security and Nutrition, office of the Council of Ministers
៧	លោកស្រីវេជ្ជ. លាង សុភាព Dr. Leang Supheap	បុគ្គលិក Staff	វិទ្យាស្ថានសុខភាពសាធារណៈ National Institute of Public Health
៨	លោក ហ៊ូ ក្រើន Mr. Hou Koeun	នាយករងប្រចាំ ប្រទេស Deputy Country Director	អង្គការហេឡែនខេល័រអន្តរជាតិ Helen Keller International

៩	លោកវេជ្ជ. ឃឹម សំអាត Dr. Khim Sam Ath	មន្ត្រីគ្រប់គ្រងកម្មវិធី ជំងឺមិនឆ្លង និងលើ កម្មសុខភាព Technical officer for Non- communicable Diseases and Health Promotion	អង្គការសុខភាពពិភពលោក World health Organization
១០	Ms. Hanneke Vandyke	មន្ត្រីកម្មវិធី Technical Officer	កម្មវិធីស្បៀងអាហារពិភពលោក World Food Program
១១	លោកស្រី ឌិន ស៊ាងឡាយ Ms. Din Seanglay	ជំនួយការកម្មវិធី Program Assistant	កម្មវិធីស្បៀងអាហារពិភពលោក World Food Program
១២	មូលនិធិសម្រាប់ការអភិវឌ្ឍន៍ និងជំនួយសង្គ្រោះអន្តរជាតិ Foundation for International Development/Relief (FIDR)		

Appendix 2.1: The List of 136 Schools

Province	Nb	District	Commune	School	School Level	Province	Nb	District	Commune	School	School Level
បន្ទាយមានជ័យ Banteay Meanchey	1	មង្គលបុរី Mongkol Borei	សៀ Soeu	សៀ Soeu	បឋមសិក្សា Primary School	កំពង់ចាម Kampong Cham	17	សៀង Sangkae	អន្លង់វិល Anlung Vil	អន្លង់វិល Anlung Vil	វិទ្យាល័យ High School
	2	សិរីសោភ័ណ Serei Sophoan	កំពង់ស្វាយ Kampong Svay	សម្រស់កុមារ Samros Komar	បឋមសិក្សា Primary School		18	ចំការលើ Chamkar Leu	ល្វាលើ Lovea Leu	ក្បាលហង្ស Kbal Hang	បឋមសិក្សា Primary School
	3	ប៉ៃបត់ Poipet	និមីត្ត Nimith	ថ្មីសែន Thmar Sen	បឋមសិក្សា Primary School		19	កងមាស Kang Meas	ព្រែកកុយ Prek Kuy	កោះ Koh	បឋមសិក្សា Primary School
	4	អូរព្រៃ O Chreuv	គុត្តតាសត Kuttasat	គុត្តតាសត Kuttasat	អនុវិទ្យាល័យ Secondary School		20	ព្រៃឈរ Prey Chhor	ល្វា Lovea	ល្វា Lovea	បឋមសិក្សា Primary School
	5	មង្គលបុរី Mongkol Borei	ឫស្សីព្រែក Russey Kroak	មង្គលបុរី Mongkol Borei	វិទ្យាល័យ High School		21	ស្ទឹងត្រង់ Steung Trang	ពាមកោះស្នា Peam Koh Sna	ហ៊ុននាងដើរើ Hun Neng Dei Leu	បឋមសិក្សា Primary School
	6	ម៉ាឡៃ Malai	ម៉ាឡៃ Malai	ម៉ាឡៃ Malai	វិទ្យាល័យ High School		22	បាធាយ Batheay	ជើងព្រៃ Cheung Prey	ជើងព្រៃ Cheung Prey	អនុវិទ្យាល័យ Secondary School
	7	ថ្មគោល Thmar Kaul	អន្លង់រុន Anlung Run	ចប កាប់ Chop Kap	បឋមសិក្សា Primary School		23	កំពង់ចាម Kampong Cham	វាលវង់ Veal Vong	ទួលថ្ម Tuol Thmar	អនុវិទ្យាល័យ Secondary School
	8	បរវល Bavel	ព្រៃខ្ពស់ Prey Khpuos	ព្រៃខ្ពស់ Prey Khpuos	បឋមសិក្សា Primary School		24	កោះសុទិន Koh Sotin	ពង្រ Pongror	ពង្រ Pongror	អនុវិទ្យាល័យ Secondary School
	9	មោងឫស្សី Maung Russey	ព្រៃតូច Prey Tauch	ព្រៃតូច Prey Tauch	បឋមសិក្សា Primary School		25	ព្រៃឈរ Prey Chhor	ក្រាច Krauch	ទួលខ្ពស់ Tuol Khpuos	អនុវិទ្យាល័យ Secondary School
	10	កំរៀង Kamrieng	តាសែន Ta Saen	សាមគ្គីសក់ក្រវ៉ា Samaki Sakawa	បឋមសិក្សា Primary School		26	ចំការលើ Chamkar Leu	ស្វាយទាប Svay Teap	ហ៊ុនសែនចំការលើ Hun Sen	វិទ្យាល័យ High School
	11	រុក្ខក្រវ៉ា Rukhak Kiri	ព្រៃកង្កែប Prek Chik	ផ្លែខ្ចាញ់ស្រស់ Chker Khnam Preus	បឋមសិក្សា Primary School		27	កងមាស Kang Meas	កងតាណឹង Kang Ta Neung	ហ៊ុនសែនកងតា Hun Sen Kang Ta	វិទ្យាល័យ High School
	12	បាណែន Banan	បាយជ័រ Bay Damram	បាយជ័រ Bay Damram	អនុវិទ្យាល័យ Secondary School		28	ស្ទឹងត្រង់ Steung Trang	មេសាជ័យ Mesar Chrey	មេសាជ័យ Mesar Chrey	វិទ្យាល័យ High School
	13	បាត់ដំបង Battambang	បាត់ដំបង Battambang	អូរម៉ាល់ Ou Mal	អនុវិទ្យាល័យ Secondary School		29	ត្បូងឃ្មុំ Tboung Khmum	រោកាព្រា Roka Por Pram	ចុងអូរ Chong O	បឋមសិក្សា Primary School
	14	មោងឫស្សី Maung Russey	ព្រៃស្វាយ Prey Svay	ព្រៃស្វាយ Prey Svay	អនុវិទ្យាល័យ Secondary School		30	អូររាំងខ្ចី O Raing Euv	ព្រះធាតុ Preah Theat	ទួលឃ្លាំង Tuol Khlaing	បឋមសិក្សា Primary School
	15	កំរៀង Kamrieng	បឹងរាំង Boeung Raing	បឹងរាំង Boeung Raing	អនុវិទ្យាល័យ Secondary School		31	អូររាំងខ្ចី O Raing Euv	ទួលសុភី Tuol Sophy	ទួលសុភី Tuol Sophy	អនុវិទ្យាល័យ Secondary School
	16	បាត់ដំបង Battambang	ស្វាយប៉ោ Svay Pao	ព្រះមន្ទីរវង្ស Preah Monivong	វិទ្យាល័យ High School		32	អូររាំងខ្ចី O Raing Euv	កងជ័យ Kong Chey	ហ៊ុនសែនអូររាំងខ្ចី Hun Sen O Raing	វិទ្យាល័យ High School

Province	No	District	Commune	School	School Level	Province	No	District	Commune	School	School Level
កំពង់ឆ្នាំង Kampong Chhnang	33	មេមត់	ដំ ក្រវៀន	ក្បាលស្រែង	បឋមសិក្សា	កំពង់ធំ Kampong Thom	49	បាយ័ន	ដើមដូង	សំរោងលួន	បឋមសិក្សា
		Merot	Choam Kravean	Kbal Seng	Primary School			Baray	Cheung Deung	Sampeu Loun	Primary School
	34	ដំបូ	សេដា	សេដាសែនជ័យ	បឋមសិក្សា		50	កំពង់ស្វាយ	ត្រពាំងឫស្សី	សំរោង	បឋមសិក្សា
		Dambe	Seda	Seda Sen Chey	Primary School			Kampong Svay	Trapainng Russey	Samrong	Primary School
	35	ត្បូងឃ្មុំ	ទន្លេបិទ	ទន្លេបិទ	អនុវិទ្យាល័យ		51	សន្ទុក	បឹងល្វា	ត្បូងសង្ក្រាន្ត	បឋមសិក្សា
		Tbaung Khnum	Tonie Bet	Tonie Bet	Secondary School			Santouk	Boeung Lovea	Tberg Sangkrus	Primary School
	36	កំពង់លែង	ប្រឡាយមាស	ហ៊ុនសែនកោះឫស្សី	បឋមសិក្សា		52	កំពង់ស្វាយ	សានគរ	សានគរ (២)	អនុវិទ្យាល័យ
		Kampong Leng	Pralay Meas	Hun Sen Koh	Primary School			Kampong Svay	San Kor	San Kor (B)	Secondary School
	37	សាមគ្គីមានជ័យ	ស្វាយ	ត្រពាំងថ្ម	បឋមសិក្សា		53	សន្ទុក	បឹងល្វា	បឹងល្វាលើ	អនុវិទ្យាល័យ
		Samaki Mearchey	Svay	Trapainng Timar	Primary School			Santouk	Boeung Lovea	Boeung Lovea	Secondary School
38	កំពង់ត្រឡាច	លង្វែក	លង្វែក	អនុវិទ្យាល័យ	54	បាយ័ន	ស្វយាង	ហ៊ុនសែនតាំងតាក	វិទ្យាល័យ		
	Kampong Tralach	Lungvek	Lungvek	Secondary School		Baray	So Yaung	Hun Sen Tainng	High School		
39	ទឹកដុស	ក្បាលទឹក	ក្បាលទឹក	អនុវិទ្យាល័យ	55	សន្ទុក	តាំងត្រសាំង	តាំងត្រសាំង	វិទ្យាល័យ		
	Teuk Phnos	Kbal Teuk	Kbal Teuk	Secondary School		Santouk	Tainng Krasaing	Tainng Krasaing	High School		
40	កំពង់ឆ្នាំង	កំពង់ឆ្នាំង	ព្រះបាទសុរាមវិទ្យុ	វិទ្យាល័យ	56	អង្គជ័យ	បំប៊ី	អង្គជ័យ	បឋមសិក្សា		
	Kampong Chhnang	Kampong	Praeh Bat	High School		Angkor Chey	Champe	Ang Chaut	Primary School		
41	ប្បូរមន	រោង	ភូមិថ្មី	បឋមសិក្សា	57	ល្វក	តាកែន	ត្រពាំងបី	បឋមសិក្សា		
	Chbar Morn	Roka Thom	Phoum Thmei	Primary School		Chhouk	Ta Ken	Trapainng Bei	Primary School		
42	ឧដុង្គ	មានជ័យ	ទំពូង	បឋមសិក្សា	58	ទឹកល្អ	បឹងទុក	បឹងទុក	បឋមសិក្សា		
	Oudong	Mearchey	Tumpoung	Primary School		Teuk Chhou	Boeung Touk	Boeung Touk	Primary School		
43	សំរោងទង	ខ្ញុំក្រាំង	ភាគៈ	បឋមសិក្សា	59	បន្ទាយមាស	ស្រែចង្កាខាងជើង	ជ្រុងស្រែឡា	អនុវិទ្យាល័យ		
	Samrong Torng	Khtum Kraing	Pheatarak	Primary School		Banteay Meas	Sdech Kong	Charung Stralao	Secondary School		
44	ប្បូរមន	ស្វាយក្រវាស់	ម្រំខាងត្បូង	អនុវិទ្យាល័យ	60	ល្វក	សត្វពង	ហ៊ុនសែនល្វក	វិទ្យាល័យ		
	Chbar Morn	Svay Kravann	Marum Kraung	Secondary School		Chhouk	Sat Porng	Hun Sen Chhouk	High School		
45	ឧដុង្គ	យុទ្ធសាមគ្គី	ត្រពាំងល្អក់	អនុវិទ្យាល័យ	61	កៀនស្វាយ	ដីកង្កែប	ដីកង្កែប	បឋមសិក្សា		
	Oudong	Yuthsamaki	Trapainng Lopeak	Secondary School		Kean Svay	Dei Eth	Dei Eth	Primary School		
46	សំរោងទង	ស្កុស	ភ្នំជ្រៀល	អនុវិទ្យាល័យ	62	កោះធំ	ជ្រោយតាកែវ	ជ្រោយតាកែវ	បឋមសិក្សា		
	Samrong Torng	Skous	Phnom Cheal	Secondary School		Koh Thom	Chroy Takeo	Duum Po	Primary School		
47	បាស៊ីន	ពោធិ៍សែនជ័យ	២៤កញ្ញា	វិទ្យាល័យ	63	មុខកំពូល	ព្រែកអញ្ញាញ	ពេជ្រទាល	បឋមសិក្សា		
	Barset	Po Angkrang	24 Kanha	High School		Muk Kamppoul	Prek Anhchanh	Chheu Teal	Primary School		
48	ឧដុង្គ	វាលពង	វាលពង	វិទ្យាល័យ	64	ពញាញ	ទំនប់ធំ	ដំណាក់ព្រីង	បឋមសិក្សា		
	Oudong	Veal Pong	Veal Pong	High School		Ponhea Leu	Tumrup Thom	Dammak Pring	Primary School		

Province	No	District	Commune	School	School Level	Province	No	District	Commune	School	School Level
	65	តាខ្មៅ Takhmao	កំពង់សំណាញ់ Kampong	កំពង់សំណាញ់ Kampong	បឋមសិក្សា Primary School		81	ទួលគោក Tuol Kouk	ទឹកល្អក់ទី៣ Teuk La-Ak 3	អូរំបកក្រុម O Bek Ka-Am	អនុវិទ្យាល័យ Secondary School
	66	ក្រែនស្វាយ Kean Svay	បន្ទាយដំរី Banteay Dek	បន្ទាយដំរី Banteay Dek	អនុវិទ្យាល័យ Secondary School		82	ចំការមន Chamkar Morn	ទួលទំពូងទី១ Tuol Tumpoung 1	ទួលទំពូង Tuol Tumpoung	វិទ្យាល័យ High School
	67	ខ្សាច់កណ្តាល Khsach Kandal	ស៊ីសរ Sithor	សាកាម៉ូតូ ទួលបា Sakamoto Tuol	អនុវិទ្យាល័យ Secondary School		83	ដូនពេញ Daun Penh	ស្រះចក់ Sras Chak	ហ៊ុនសែនប៊ុនរ៉ានី Hun Sen Bun	វិទ្យាល័យ High School
	68	ល្វាឯម Lovea Em	កោះរ៉ះ Koh Reah	កោះរ៉ះ Koh Reah	អនុវិទ្យាល័យ Secondary School		84	ឫស្សីកែវ Russey Keo	ស្វាយបាក់ Svay Pak	ជាស៊ីមប៊ីនីវីត្តិ Chea Sim	វិទ្យាល័យ High School
	69	កង្កែបក្រវាត់ Kandal Slung	កោះរ៉ះ Koh Reah	កោះរ៉ះ Koh Reah	អនុវិទ្យាល័យ Secondary School		85	ទួលគោក Tuol Kouk	បឹងកក់ទី២ Boeung Kak 2	ឥន្ទ្រវរ្ម័ន Indrakrtey	វិទ្យាល័យ High School
	70	ពញាឮ Ponhea Leu	កំពង់ល្វង Kampong Luong	កំពង់ល្វង Kampong Luong	វិទ្យាល័យ High School		86	សែនសុខ Sen Sok	ទឹកថ្លា Teuk Thla	ហ៊ុនសែនប៊ុរី Hun Sen Borei	វិទ្យាល័យ High School
	71	កោះធំ Koh Thom	សំពៅពួន Sampeuv Poun	សំពៅពួន Sampeuv Poun	វិទ្យាល័យ High School		87	គុលស Koulen	ស្រយង់ Srayong	ស្រយង់ Srayong	បឋមសិក្សា Primary School
	72	តាខ្មៅ Takhmao	តាខ្មៅ Takhmao	តាខ្មៅ Takhmao	វិទ្យាល័យ High School		88	គុលស Koulen	ភ្នំត្បែង Tbeng 2	ភូមិភ្នំត្បែង Phoum Tbeng 2	អនុវិទ្យាល័យ Secondary School
	73	មណ្ឌលសីមា Mondul Seima	បាក់ខ្នង Pak Khlang	បាក់ខ្នង Pak Khlang	អនុវិទ្យាល័យ Secondary School		89	កំបាយមារ Kamchay Mear	ក្របាច់ Krabao	ក្របាច់ Prey Tuol Thmei	បឋមសិក្សា Primary School
	74	ព្រៃក្របសព្វ Prek Prasap	ព្រៃក្របសព្វ Chroy Banteay	ព្រៃក្របសព្វ Chroy Banteay	បឋមសិក្សា Primary School		90	កញ្ជ្រៀប Kanhchreach	ជួន Thmar Poun	អង្គប្រាជ្ញដុំ Ang Prachum	បឋមសិក្សា Primary School
ក្រចេះ Kratie	75	ចិត្របុរី Chith Borei	ចង្រង Changkrong	ចង្រង Changkrong	បឋមសិក្សា Primary School	91	ពាមរ Peam Ror	ព្រៃក្រខ្សាយ ក Prek Khsay (A)	ព្រៃក្រខ្សាយ Prek Khsay	បឋមសិក្សា Primary School	
	76	សំបូរ Sambo	វង្ស្រុន Vathanak	វង្ស្រុន Vathanak	អនុវិទ្យាល័យ Secondary School	92	ព្រះស្តេច Preah Sdech	រំចែក Rumchek	ព្រៃផ្កា Prey Phdao	បឋមសិក្សា Primary School	
ភ្នំពេញ Phnom Penh	77	ដង្កោ Dangkor	ពងទឹក Porng Teuk	ព្រៃពងសាលា Trapeang Sala	បឋមសិក្សា Primary School	93	កញ្ជ្រៀប Kanhchreach	គោកគង់លើប Kauk Kong Lech	គោកគង់ Kauk Kong	អនុវិទ្យាល័យ Secondary School	
	78	មានជ័យ Meanchey	ច្បារអំពៅទី១ Chbar Ampeuv 1	ច្បារអំពៅទី១ Chbar Ampeuv 1	បឋមសិក្សា Primary School	94	ពារាំង Pearaing	កញ្ជ្រាង Kanhchom	កញ្ជ្រាង Kanhchom	អនុវិទ្យាល័យ Secondary School	
	79	ទួលគោក Tuol Kouk	ទឹកល្អក់ទី១ Teuk La-Ak 1	សន្ទូរម៉ក Santhor Muk	បឋមសិក្សា Primary School	95	បាណ្ឌ Ba Phnom	ជើងភ្នំ Cheung Phnom	បាណ្ឌ Ba Phnom	វិទ្យាល័យ High School	
	80	ពោធិ៍សែនជ័យ Po Senchey	ចោមចៅ Chom Chao	ជំរុន Chumpou Voan	បឋមសិក្សា Primary School	96	ពាមជ័រ Peam Chor	ព្រៃក្របាច់ Prek Krabao	ព្រៃក្របាច់ Prek Krabao	វិទ្យាល័យ High School	

Province	No	District	Commune	School	School Level	Province	No	District	Commune	School	School Level
	97	ស៊ីវិក ណ្តាល	ព្រែកចង្កាន	ព្រែកសណ្តែក	វិទ្យាល័យ		113	វ៉ាន	ស្វាយស	ស្វាយស	អនុវិទ្យាល័យ
		Sithor Kandal	Prek Changkran	Prek Sandek	High School			Varim	Svay Sar	Svay Sar	Secondary School
	98	បាកាន	បឹងបត់កណ្តាល	រង្សាស	បឋមសិក្សា		114	ពួក	ពួក	ពួក	វិទ្យាល័យ
		Bakan	Boeung Bot	Robang Romess	Primary School			Puok	Puok	Puok	High School
ពោធិ៍សាត់	99	ក្រករ	ឃើត្តិ	ក្បាលទាបាន	បឋមសិក្សា	ព្រះសីហនុ	115	ព្រៃទប់	អណ្តូងថ្ម	ហ៊ុនសែនអណ្តូងថ្ម	បឋមសិក្សា
		Krakor	Chheu Tom	Kaol Teahean	Primary School	Preah		Prey Nup	Andaung Timar	Hun Sen	Primary School
Pausat	100	បាកាន	ស្នួលព្រះ	ស្នួលព្រះ	អនុវិទ្យាល័យ	Shihanouke	116	ព្រះសីហនុ	សង្កាត់៤	ហ៊ុនសែនមិត្តភាព	វិទ្យាល័យ
		Bakan	Snam Preah	Snam Preah	Secondary School			Preah Sihanouk	Sangkat 4	Hun Sen	High School
	101	ពោធិ៍សាត់	ផ្ទះព្រៃ	ពោធិ៍សាត់	អនុវិទ្យាល័យ		117	ប៉ាឡាបារីក	ព្រះកិតិល	អន្លង់ស្វាយរលី	បឋមសិក្សា
		Pursat	Phas Prey	Pursat	Secondary School	ស្ទឹងត្រែង		Thala Barvat	Preah Rumkel	Anlung Svay Ler	Primary School
	102	ពោធិ៍សាត់	ផ្ទះព្រៃ	ពោធិ៍សាត់	វិទ្យាល័យ	Stung Treng	118	ស្ទឹងត្រែង	សាមគ្គី	ហ៊ុនសែនសាមគ្គី	អនុវិទ្យាល័យ
		Pursat	Phas Prey	Pursat	High School			Stung Treng	Samaki	Hun Sen Samaki	Secondary School
ត្បូងឃ្មុំ	103	បាកាន	កាចាញ	ប្តីកុំមារា ៤	បឋមសិក្សា		119	រមាសរំហែក	សម្បត្តិមានជ័យ	ចំការកោះ	បឋមសិក្សា
		Ratanakiri	Banlung	Borai Kamakar 4	Primary School			Romeas Hek	Sambath	Chamkar Koh	Primary School
មណ្ឌលគីរី	104	កោះញឹក	វៀសសង្កែម	ហ៊ុនសែនកែវសីម៉ា	វិទ្យាល័យ		120	ស្វាយទាប	សំបូរ	សាមគ្គីរង្សី	បឋមសិក្សា
		Mondul Kiri	Sre Sangkum	Hun Sen Keo	High School	ស្វាយរៀង		Svay Teap	Sambour	Samaki Rainsei	Primary School
	105	អង្គជុំ	ចារល្បក	តាត្រកៀត	បឋមសិក្សា	Svay Rieng	121	រមាសរំហែក	ក្រសាំង	ព្រៃបិទមាស	អនុវិទ្យាល័យ
		Angkor Chum	Char Chhouk	Kor Trakeat	Primary School			Romeas Hek	Krasaing	Prey Bet Meas	Secondary School
	106	ដីក្រែង	គោកផ្លាតលើ	តាភ្នំ	បឋមសិក្សា		122	រមាសរំហែក	អំពិល	សម្បត្តិស៊ីម	វិទ្យាល័យ
		Chi Kreng	Kauk Thlok Leu	Ta Prhear	Primary School			Romeas Hek	Ampil	Sandech Chea	High School
	107	ពួក	ពួក	ពួក	បឋមសិក្សា		123	បារីក	ប្រកម្មស	ជីនូ	វិទ្យាល័យ
		Puok	Puok	Puok	Primary School			Bavet	Chrak Mates	Chi Phou	High School
សៀមរាប	108	សៀមរាប	សាលាកំរើក	វត្តបូព៌	បឋមសិក្សា		124	បូរីជលសា	កំពង់ក្រសាំង	កំពង់ក្រសាំង	បឋមសិក្សា
		Siemreap	Sala Kamreuk	Wat Bo	Primary School			Borei Chnusa	Kampong	Kampong	Primary School
សៀមរាប	109	ស្វយន្តិកម	ពពេល	ក្រាលពង	បឋមសិក្សា		125	ព្រៃកប្បាស	ព្រៃល្វា	ព្រៃល្វា	បឋមសិក្សា
		Saut Nikum	Popel	Kreal Porng	Primary School			Prey Kabas	Prey Lowea	Prey Lowea	Primary School
សៀមរាប	110	បន្ទាយស្រី	រុនតាងក	រុនតាងក	អនុវិទ្យាល័យ	តាកែវ	126	ត្រែតក់	លាយបុរី	លាយបុរី	បឋមសិក្សា
		Banteay Srey	Run Ta Ek	Run Ta Ek	Secondary School	Takeo		Trankak	Leay Bo	Leay Bo	Primary School
	111	ពួក	រើល	រើល	អនុវិទ្យាល័យ		127	អង្គរបុរី	ព្រែកផ្កាល	សុខានុព្រែកផ្កាល	បឋមសិក្សា
		Puok	Reul	Reul	Secondary School			Angkor Borei	Prek Phtaul	Sok An Prek	Primary School
	112	សៀមរាប	សំបូរ	សំបូរ	អនុវិទ្យាល័យ		128	កីរីវង្ស	សោម	ហ៊ុនសែនសិរីវង្ស	អនុវិទ្យាល័យ
		Siemreap	Sambour	Sambour	Secondary School			Kiri Vong	Som	Hun Sen Serei	Secondary School

Province	No	District	Commune	School	School Level	Province	No	District	Commune	School	School Level
	129	ជួនកែវ Daunkeo	រកាក្រៅ Roka Krao	តុំ Tom	អនុវិទ្យាល័យ Secondary School	កែប Kep	133	កែប Kep	ព្រៃធំ Prey Thom	ស្នួរ Sbov	បឋមសិក្សា Primary School
	130	សំរោង Samrong	បឹងត្រាញ់ខាងជើង Boeung Trah	ហ៊ុនសែងអង្គព្រះ Hun Sen Ang	វិទ្យាល័យ High School		134	ដំណាក់ចម្ពើរ Damnak Chang Oeur	អង្គាល Angkoal	ហ៊ុនសែនអង្គាល Hun Sen Angkoal	អនុវិទ្យាល័យ Secondary School
	131	ត្រាំកក់ Tramkak	អង្គតាសោម Ang Ta Som	សម្ពុចតេជោហ៊ុន Samdech Techo	វិទ្យាល័យ High School	ឧត្តមានជ័យ Oddar Meanchey	135	សំរោង Samrong	បុស្សី Bosbov	ក្រសាំង Krasaing	បឋមសិក្សា Primary School
	132	ត្រាំង Traing	សន្លុង Sanlong	សន្លុង Sanlong	វិទ្យាល័យ High School		136	ត្រាំងព្រៃសាទ Traipaing Prasat	ត្រាំងព្រៃសាទ Traipaing Prasat	អូក្រូច O Krauch	អនុវិទ្យាល័យ Secondary School

Note:

Blue color is round 1 and pink color is round 2

Total province: 23

Total City: 01

Total School: 136

Total Primary School: 61

Total Secondary School: 40

Total High School: 35

Appendix 2.2: Questionnaire-School Children Anthropometry

Survey Questionnaire-Anthropometry

Questionnaire ID: - - - - -

(in sequence of province, district, commune, village, school, and Survey Subject code)

Date: __ / __ / __ __ __ / Time started ____:____ Time finished ____:____

Name of Interviewer 1: _____ Code: __ Name of Interviewer 2: _____ Code: __

1. Children Anthropometry				
1.1	Child's health condition associated with disability	0= No 1= Yes Specify: _____ 88= Don't know		__
1.2	Grade	Grade range from Grade 1 to Grade 12: ____		__
1.3	Child's date of birth	____/____/____ 88= Don't know	Age in years: ____ 88= Don't know	__
1.4	Child's sex	1= Boy	2= Girl	__
1.5	Child's religion	1= Buddhism 2= Christianity 3= Islam 88= Don't know 99= Other (Specify: _____)		__
1.6	Child's weight (kilogram)	1st measurement: __ . __ kg	2nd measurement: __ . __ kg	__ . __ kg
1.7	Child's height (centimeter)	1st measurement: __ . __ cm	2nd measurement: __ . __ cm	__ . __ cm
1.8	Oedema	0= No	1= Yes	__

Appendix 2.3: Questionnaire for 24 hour recall

Survey Questionnaire Household

Date: __ / __ / ____ / Time started ____: ____ Time finished ____: ____

Name of Interviewer 1: _____ Code: __ Name of Interviewer 2: _____ Code: __

Questionnaire ID: - - - - -
(in sequence of province, district, commune, village, school, and Survey Subject code)

No.	Question	Response Options	Code
1.	Household demographic		
1.1	Sex of respondent:	1= Male 2= Female	__
1.2	Date of birth: __/__/____	Age in years: ____	__
1.3	Marital status	1=Single 2=Divorced/Separated 3=Widowed 4=Married 88= Don't know 99= Other	__
1.4	Relationship to child	1= Mother 2= Father 3= Aunty 4= Grandmother 5= Relatives 6= Self 88= Don't know	__
1.5	Who is the direct caretaker of child?	1= Mother 2= Father 3= Aunty 4= Grandmother 5= Relatives 88= Don't know	--
1.6	Education of respondent	Grade (1-12): ____ 0= No education 13= University 88= Don't know 99= Other	--
1.7	Occupation of respondent	1= Farmer 2= Fisherman; 3= Small business 4= Garment worker 5=Government official 6= Casual labour 88= Don't know 99= Other	--
1.8	How many children do you have?	Number of children: ____	__
1.9	Do you have ID Poor Equity Card?	0= No →Skip to Q 1.11 1= Yes	__

1.10	If yes, which one?	1= Poor Level 1 2= Poor Level 2 3= Other 88= Don't know	--
1.11	What are the religions of this household? <i>(multiple answers)</i>	1= Buddhism 2= Christianity 3= Islam 88= Don't know 99= Other	-- --
1.12	Do you own land for farming?	0= No →Skip to Q 1.14 1= Yes	--
1.13	What is the size of land?	1=Acres	--'--
		2=Hectares	--'--
		88= Don't know 99= Other	--
1.14	Do you grow vegetables?	0= No →Skip to Q 1.16 1= Yes	--
		If Yes, which season? 1 = Rainy season 2 = Dry season 3 = Both 88= Don't know	--
1.15	How are the vegetables used?	1= Eating 2= Sold 3= Both (eat and sell) 88= Don't know 99= Other	--
1.16	Do you plant fruit trees?	0= No →Skip to Q 1.18 1= Yes	--
1.17	How is the fruit used?	1= Eating 2= Sold 3= Both (eat and sell) 88= Don't know 99= Other	--
1.18	Do you raise chicken, duck, bird or any animals?	0= No →Skip to Q 1.20 1= Yes	--
1.19	How are these animals used? <i>(multiple answers)</i>	1= Eating 2= Sold 3= Both (eat and sell) 4= Farming 88= Don't know 99= Other	--
1.20	What is the house's wall?	1= Grass/thatch/Bamboo 2= Metal/Zinc/Tin sheeting 3= Cement 4= Plywood 5= Wood/Logs 99= Other	--

1.21	Where do you get the water you use at home? <i>(include water for all purposes – drinking, cooking, cleaning, garden, etc. Record all answers)</i>	1= Public water tap 2= Private water tap 3= Well 4= Rain water collection 5= River/Stream/Pond 88= Don't know 99= Other	--
2. Income generation			
2.1	Taking the past year, can you tell me what the average earnings of the household have been? <i>(Record only one, Not all 3)</i>	Per week : _ _ _ _ _ →Go to Q 3.1 Or per month : _ _ _ _ _ →Go to Q 3.1 Or per year : _ _ _ _ _ →Go to Q 3.1 88= Don't know	
2.2	If you don't know the amount, can you give an estimate of the annual household income if I read some options to you? Is it <i>(Read Options)</i>	1= ≤ 320 USD 2= More than 321-397 USD 3= More than 398-456 USD 4= More than 456-579 USD 5= More than 580 USD 88= Don't know	--
3. Hygiene, Sanitation and Health			
3.1	Where do you get your water for drinking at home?	1= Water tap/ protect well/ rain water 2= Un protected well/ river/ stream/pond 88= Don't know 99= Other	--
3.2	Do you normally treat water before household drinks?	0= No →Skip to Q 3.4 1= Yes 88= Don't know →Skip to Q 3.4	--
3.3	If "yes" how do you normally treat water for drinking? <i>(note all responses in prioritize)</i>	1= Boiled 2= Added chlorine 3= Filtered by cloth 4= Water filtered tank 99= Other	-- -- --
3.4	Have your children had any diseases in the past month?	1= Fever 2= Cold 3= Diarrhoea 4= Not sick 88= Don't know 99= Other	--
4. Food Security			
4.1	Are there any time in the past 12 months when family has to limit number of meals or quantity of food because of	0= No → Skip to Q 5.1 1= Yes	Month with food shortage: 1= Jan; 2= Feb; 3= Mar; 4= Apr; 5= May; 6= Jun; 7= Jul; 8= Aug; 9= Sep; 10= Oct; 11= Nov; 12= Dec

	food deficit? If “Yes”, which month(s)?			
5. Food consumption				
5.1	In a typical week, how many days does your child eat fruits?	Number of day: ____ 1= Don’t eat fruit 2= Rarely 88= Don’t know/can’t say		—
5.2	In a typical week, how many days does your child eat vegetables?	Number of day: ____ 1= Don’t eat vegetable 2= Rarely 88= Don’t know/can’t say		—
5.3	In a typical of week, how many days does your child eat red meat or organ (liver, kidney, heart)?	Number of day: ____ 1= Don’t eat red meat and organ 2= Rarely 88= Don’t know/can’t say		—
5.4	In a typical of week, how many days does your child consume milk?	Number of day: ____ 1= Don’t consume milk → Skip to Q 5.6 2= Rarely 88= Don’t know/can’t say		—
5.5	What type of milk does your child usually consume?	1= Whole plain milk 2= Whole sweeten milk 3= Low/reduced fat 4= Skim milk 5= Sweetened condensed 6= Soya milk 88= Don’t know 99= Other		--
5.6	In a typical week, how often does your child eat junk food?	Number of day: ____ 1= Don’t eat 2= Rarely 88= Don’t know/can’t say		
5.7	In a typical week, how often does your child drink soft drink?	Number of day: ____ 1= Don’t drink 2= Rarely 88= Don’t know/can’t say		
6. Eating pattern				
6.1	Who often cook meals in your family?	1= Respondent 2= Spouse 3= Child 4= Helper 5= Relatives 88= Don’t know 99= Other		--
6.2	How many family members usually eat meals together using same pot/dishes?	Number: _____persons		—

6.3	What is the typical meal composition usually consumed with rice by your family?	1= Rice with Soup 2= Rice with Stir fried dish/grilled/deep fried 3= Rice with Soup and stir fried dish/grilled/deep fried 88= Don't know 99= Other	--
6.4	What are the most prepared recipes in your family? (list all name of recipes mention in ordering)	1 = 2 = 3 =	
6.5	Last month, what are the seasoning normally used by family?	Palm sugar: 0=No; 1= Yes White sugar: 0=No; 1= Yes Fish sauce: 0=No; 1= Yes Soy sauce: 0=No; 1= Yes Oyster sauce: 0=No; 1= Yes Salt: 0=No; 1= Yes MSG/Rosdee/Knorr: 0=No; 1= Yes Chilli sauce: 0=No; 1= Yes Vinegar: 0=No; 1= Yes Oil/Fat: 0=No; 1= Yes 99= Other	
6.6	How many meal and snacks consumed by children per day (days and night)?	Breakfast: 0=No; 1= Yes Morning snack: 0=No; 1= Yes Lunch: 0=No; 1= Yes Afternoon snack: 0=No; 1= Yes Dinner: 0=No; 1= Yes After dinner snack: 0=No; 1= Yes	

Appendix 3-1: Dietary intakes and CAM-RDA for boys

Nutrients/ Number of subject	Boys						7-9 yrs						10-12 yrs						13-15 yrs						16-17 yrs						Boys all			
	CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		Mean	SD	Median	
	g	kcal	EER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR		
Energy	g	kcal	1,300-1,700	1,461	462	1,398	1,500-1,900	1,409	501	1,367	1,800-2,300	1,584	555	1,485	2,200-2,700	1,845	612	1,769	2,500-3,100	2,053	582	2,008	1,709	608	1,630	476	20.3	43.9						
Protein	g	EAR	25	40.9	14.1	41.7	30	39.3	15.8	37.7	40	43.7	21.0	38.9	45	52.0	20.5	48.4	45	57.2	19.5	54.8	400	246	345									
Calcium	mg	EAR	450	302	143	270	500	342	215	296	650	361	226	303	750	447	274	379	650	460	244	407	400	246	345									
Iron	mg	EAR	4.5	7.6	4.4	7.2	5.5	7.7	3.8	6.9	5.0	9.0	4.9	7.9	9.0	10.1	4.6	9.1	7.5	11.5	4.6	10.7	9.5	4.7	8.7									
Zinc	mg	RDA	5.5	0.5	0.5	0.4	5.5	0.6	0.6	0.4	6.0	0.7	0.7	0.5	8.0	0.8	0.7	0.7	8.5	0.9	0.8	0.8	0.74	0.68	0.58									
VitaminA	mcg	RDA	450	196	153	144	450	294	332	201	550	310	288	250	550	422	353	347	600	518	496	406	375	368	286									
VitaminC	mg	RDA	30	54.8	62.4	38.2	30	68.0	107.8	32.8	60	60.6	85.7	35.9	60	78.8	95.4	47.8	60	84.2	92.3	57.7	71.9	94.6	41.9									
Thiamin (VB1)	mg	RDA	0.6	0.6	0.4	0.5	0.8	0.5	0.3	0.4	1.2	0.6	0.4	0.5	1.1	0.7	0.5	0.6	1.1	0.8	0.4	0.7	0.66	0.42	0.56									
Riboflavin (VB2)	mg	RDA	0.6	0.5	0.3	0.5	0.8	0.7	0.7	0.5	1.3	0.7	0.6	0.6	1.2	0.9	1.0	0.7	1.2	1.2	1.4	0.9	0.85	0.94	0.66									
Niacin (VB3)	mg	RDA	8	8.1	3.5	7.7	11	8.2	3.7	7.6	16	9.2	3.8	8.6	15	11.0	4.3	10.3	15	12.8	4.5	12.0	10.2	4.4	9.4									
Fat	%E	DG	20-30	14.6	6.1	12.4	20-30	15.9	6.8	15.5	20-30	13.7	5.4	13.6	20-30	13.9	6.0	13.7	20-30	14.6	6.4	14.0	14.4	6.1	14.0									
Dietary Fibre	g	DG	8	7.7	4.8	6.7	8	8.1	6.4	6.4	10	9.7	6.9	7.9	12	11.3	7.3	9.2	14	13.3	7.9	10.9	10.4	7.3	8.5									
Sodium	mg	DG	600-1,600	1,595	806	1,303	600-1,600	1,640	1,243	1,317	600-1,600	1,859	1,284	1,528	600-2,000	1,995	1,202	1,709	600-2,000	2,282	1,326	1,846	1,922	1,259	1,625									
Salt (Sodium Chloride)	g	DG	1.5-4	4.1	2.0	3.3	1.5-4	4.2	3.2	3.3	1.5-4	4.7	3.3	3.9	1.5-5	5.1	3.1	4.3	1.5-5	5.8	3.4	4.7	4.9	3.2	4.1									
Potassium	mg	DG	1,300	592	273	582	1,400	606	330	546	1,700	733	404	663	2,000	880	413	818	2,300	968	396	906	790	409	704									
Phosphorus	mg	DG	500	494	158	517	600	498	218	458	850	542	248	489	950	649	264	614	950	707	260	683	594	259	544									
Copper	mg	EAR	0.4	0.1	0.1	0.1	0.4	0.2	0.7	0.1	0.5	0.3	2.5	0.1	0.6	0.3	1.3	0.1	0.7	0.3	1.5	0.1	0.29	1.60	0.12									

Appendix 3-2: Dietary intakes and CAM-RDA for girls

Nutrients/ Number of subject	Girls						7-9 yrs						10-12 yrs						13-15 yrs						16-17 yrs						Girls all					
	CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		CAM-RDA		Mean		SD		Mean	SD	Median			
	g	kcal	EER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR	ER	EAR				
Energy	g	kcal	1,300-1,600	1,231	469	1,128	1,500-1,900	1,315	491	1,243	1,700-2,200	1,490	556	1,389	2,000-2,500	1,595	587	1,530	2,100-2,600	1,642	559	1,505	1,502	565	1,414											
Protein	g	EAR	25	32.5	13.1	29.5	30	36.3	16.7	31.9	40	41.1	18.3	37.5	40	45.1	18.7	42.2	40	48.3	20.4	42.8	42.1	18.7	38.8											
Calcium	mg	EAR	400	313	195	268	550	322	229	257	700	407	249	365	600	419	246	362	550	428	253	373	393	246	332											
Iron	mg	EAR	4.5	5.8	3.1	4.9	5.5	6.9	4.2	6.1	9.5*	8.4	4.1	7.7	10.0*	9.3	4.6	8.2	8.0*	10.0	5.2	8.6	8.5	4.6	7.6											
Zinc	mg	RDA	5.5	0.4	0.3	0.3	5.5	0.5	0.6	0.4	5.5	0.7	0.6	0.5	7.0	0.8	0.8	0.6	7.0	0.9	0.7	0.7	0.72	0.73	0.54											
VitaminA	mcg	RDA	400	178	182	123	450	265	305	177	550	330	368	248	550	465	1,163	321	600	423	337	338	370	734	273											
VitaminC	mg	RDA	30	54.1	72.5	30.5	30	52.7	73.3	29.3	60	66.0	85.6	40.2	60	91.2	111.1	54.8	60	86.2	108.0	51.9	74.3	97.0	45.7											
Thiamin (VB1)	mg	RDA	0.6	0.5	0.4	0.4	0.8	0.5	0.4	0.4	1.1	0.6	0.5	0.5	1.1	0.7	0.4	0.6	1.1	0.7	0.5	0.6	0.62	0.43	0.51											
Riboflavin (VB2)	mg	RDA	0.6	0.5	0.3	0.5	0.8	0.6	0.5	0.5	1.0	0.7	0.5	0.6	1.0	0.8	0.5	0.7	1.0	1.0	1.1	0.7	0.74	0.63	0.61											
Niacin (VB3)	mg	RDA	8	6.4	3.4	5.8	11	7.5	3.8	6.5	16	8.5	3.8	7.8	16	9.5	4.3	9.1	16	9.7	4.3	8.9	8.7	4.2	7.9											
Fat	%E	DG	20-30	15.3	6.4	15.0	20-30	16.1	7.1	15.8	20-30	14.3	6.4	13.7	20-30	15.6	6.4	14.8	20-30	17.4	6.7	17.1	15.6	6.6	14.9											
Dietary fibre	g	DG	7	8.3	9.3	5.1	8	7.2	5.9	5.8	10	9.4	7.1	7.5	12	10.5	7.0	8.4	12	10.4	6.8	8.4	9.4	7.0	7.5											
Sodium	mg	DG	600-1,600	1,576	1,083	1,275	600-1,600	1,658	1,371	1,283	600-1,600	1,777	1,395	1,471	600-2,000	2,023	1,394	1,728	600-2,000	2,245	1,706	1,858	1,898	1,442	1,552											
Salt (Sodium Chloride)	g	DG	1.5-4	4.0	2.7	3.2	1.5-4	4.2	3.5	3.3	1.5-4	4.5	3.5	3.7	1.5-5	5.1	3.5	4.4	1.5-5	5.7	4.3	4.7	4.8	3.7	3.9											
Potassium	mg	DG	1,400	501	250	443	1,700	564	323	498	2,000	711	390	655	2,200	825	479	741	2,300	843	519	716	730	441	646											
Phosphorus	mg	DG	450	432	226	369	550	454	230	397	850	527	241	489	900	572	251	524	900	599	259	528	534	250	485											
Copper	mg	EAR	0.3	0.1	0.1	0.1	0.4	0.4	2.5	0.1	0.4	0.3	2.3	0.1	0.5	1.1	6.2	0.1	0.6	1.2	5.4	0.1	0.74	4.49	0.12											

* EAR for menstruation

Appendix 3-3: Energy intakes and CAM-RDA

Energy	Number of subject	EER* of CAM-RDA	Mean	SD	Percentile					Ratio over EER (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	1,300-1,700	1,461	462	896	1,133	1,398	1,696	2,161	63%	647	769	2,440	2,904
	7-9 yrs	200	1,500-1,900	1,409	501	812	1,076	1,367	1,662	2,036	39%	530	682	2,367	3,248
	10-12 yrs	251	1,800-2,300	1,584	555	918	1,195	1,485	1,904	2,396	28%	601	783	2,650	3,255
	13-15 yrs	310	2,200-2,700	1,845	612	1,113	1,399	1,769	2,206	2,629	25%	744	944	3,123	3,502
	16-17 yrs	166	2,500-3,100	2,053	582	1,310	1,618	2,008	2,464	2,802	23%	830	1,153	3,057	3,566
	All	959	-	1,709	608	999	1,289	1,630	2,063	2,530	30%	604	831	2,822	3,427
Girls	6 yrs	40	1,300-1,600	1,231	469	808	886	1,128	1,428	1,926	35%	503	644	2,429	2,693
	7-9 yrs	222	1,500-1,900	1,315	491	794	934	1,243	1,564	1,982	28%	551	754	2,225	2,869
	10-12 yrs	281	1,700-2,200	1,490	556	880	1,109	1,389	1,791	2,274	29%	408	725	2,591	3,194
	13-15 yrs	360	2,000-2,500	1,595	587	910	1,162	1,530	1,926	2,383	22%	554	743	2,646	3,499
	16-17 yrs	158	2,100-2,600	1,642	559	1,035	1,300	1,505	1,880	2,346	15%	780	964	2,840	3,833
	All	1,061	-	1,502	565	874	1,109	1,414	1,789	2,272	25%	545	775	2,576	3,299
All	2,020	-	1,600	595	908	1,183	1,507	1,931	2,410	27%	577	790	2,724	3,381	

Unit: kcal

* Range from 'light level' to 'High level' of physical activity

EAR (light level) is used to assess the diets of groups

Appendix 3-4: Protein intakes and CAM-RDA

Protein	Number of subject	EAR	Mean	SD	Percentile					Ratio over EAR (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	25	40.9	14.1	21.2	32.7	41.7	47.2	57.5	91%	10.1	12.4	70.0	81.0
	7-9 yrs	200	30	39.3	15.8	22.6	28.3	37.7	47.0	59.5	71%	13.9	18.7	70.9	97.3
	10-12 yrs	251	40	43.7	21.0	23.7	29.9	38.9	53.4	69.2	47%	13.3	19.8	82.8	117.8
	13-15 yrs	310	45	52.0	20.5	28.9	37.7	48.4	63.0	80.4	59%	17.9	24.1	87.6	122.3
	16-17 yrs	166	45	57.2	19.5	31.2	41.6	54.8	70.4	86.2	69%	23.6	29.2	91.7	102.7
	All	959	-	47.7	20.4	25.7	33.4	43.9	58.4	74.5	61%	15.3	22.3	86.2	112.5
Girls	6 yrs	40	25	32.5	13.1	18.9	23.4	29.5	41.2	48.3	68%	13.1	17.4	64.2	67.1
	7-9 yrs	222	30	36.3	16.7	19.6	24.6	31.9	44.3	58.9	55%	11.8	16.5	68.8	105.7
	10-12 yrs	281	40	41.1	18.3	20.7	28.6	37.5	51.3	64.0	43%	9.0	18.0	74.1	108.3
	13-15 yrs	360	40	45.1	18.7	23.7	31.3	42.2	56.1	70.8	56%	13.2	18.3	81.8	98.1
	16-17 yrs	158	40	48.3	20.4	27.5	35.2	42.8	55.1	78.5	62%	19.7	24.3	96.5	118.0
	All	1,061	-	42.2	18.8	22.1	28.7	38.8	51.8	66.0	54%	12.0	18.6	78.4	106.6
All	2,020	-	44.8	19.7	23.9	30.7	41.2	54.7	70.7	57%	13.5	19.4	83.4	108.3	

Unit: g

EAR is used to assess the diets of groups

Appendix 3-5: Calcium intakes and CAM-RDA

Calcium	Number of subject	EAR	Mean	SD	Percentile					Ratio over EAR (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	450	302	143	139	192	270	388	477	13%	86	119	632	750
	7-9 yrs	200	500	342	215	130	183	296	437	621	19%	65	105	822	1,082
	10-12 yrs	251	650	361	226	145	222	303	438	622	6%	86	117	700	1,543
	13-15 yrs	310	750	447	274	188	265	379	543	777	10%	84	152	989	1,614
	16-17 yrs	166	650	460	244	229	291	407	558	723	14%	116	177	1,035	1,404
	All	959	-	400	246	165	237	345	497	678	12%	85	127	876	1,416
Girls	6 yrs	40	400	313	195	101	164	268	426	548	30%	66	75	809	916
	7-9 yrs	222	550	322	229	115	172	257	405	614	15%	68	86	742	1,273
	10-12 yrs	281	700	407	249	145	232	365	524	713	10%	75	116	902	1,291
	13-15 yrs	360	600	419	246	165	240	362	544	734	17%	81	132	910	1,352
	16-17 yrs	158	550	428	253	197	250	373	494	771	21%	97	172	1,018	1,426
	All	1,061	-	393	246	143	221	332	508	714	16%	73	112	895	1,313
All	2,020	-	396	246	156	228	339	501	693	14%	77	121	886	1,333	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-6: Iron intakes and CAM-RDA

Iron	Number of subject	EAR	Mean	SD	Percentile					Ratio over EAR (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	4.5	7.6	4.4	3.7	5.5	7.2	8.7	10.7	88%	2.9	3.2	17.1	28.5
	7-9 yrs	200	5.5	7.7	3.8	3.8	5.1	6.9	9.4	12.5	68%	1.8	3.4	15.3	22.3
	10-12 yrs	251	5.0	9.0	4.9	4.0	5.8	7.9	11.1	14.0	82%	2.3	3.2	19.0	28.6
	13-15 yrs	310	9.0	10.1	4.6	5.3	6.9	9.1	11.9	16.5	51%	2.8	4.8	19.3	25.3
	16-17 yrs	166	7.5	11.5	4.6	6.1	8.1	10.7	13.5	18.4	82%	4.2	5.4	21.9	25.2
	All	959	-	9.5	4.7	4.6	6.1	8.7	11.6	15.7	69%	2.8	3.8	18.8	25.1
Girls	6 yrs	40	4.5	5.8	3.1	2.5	3.3	4.9	7.2	10.9	65%	2.2	2.4	13.0	14.9
	7-9 yrs	222	5.5	6.9	4.2	3.3	4.5	6.1	8.6	11.0	59%	1.7	2.7	13.3	22.1
	10-12 yrs	281	9.5*	8.4	4.1	4.0	5.4	7.7	10.5	14.6	31%	1.9	3.3	16.8	22.1
	13-15 yrs	360	10.0*	9.3	4.6	4.3	6.1	8.2	11.6	15.4	34%	2.4	3.6	18.0	25.8
	16-17 yrs	158	8.0*	10.0	5.2	5.3	6.3	8.6	11.7	16.3	53%	3.5	4.5	21.6	32.4
	All	1,061	-	8.5	4.6	3.9	5.4	7.6	10.6	14.6	43%	2.2	3.3	17.1	23.2
All	2,020	-	9.0	4.7	4.2	5.8	8.1	11.0	15.0	55%	2.3	3.4	18.0	24.2	

Unit: mg

*menstruation

EAR is used to assess the diets of groups

Appendix 3-7: Zinc intakes and CAM-RDA

Zinc	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	5.5	0.5	0.5	0.0	0.2	0.4	0.9	1.5	0%	0.00	0.01	1.70	1.71
	7-9 yrs	200	5.5	0.6	0.6	0.1	0.2	0.4	0.9	1.5	0%	0.00	0.02	1.75	3.33
	10-12 yrs	251	6.0	0.7	0.7	0.1	0.3	0.5	0.9	1.4	0%	0.00	0.02	2.03	3.58
	13-15 yrs	310	8.0	0.8	0.7	0.1	0.4	0.7	1.1	1.6	0%	0.00	0.07	2.17	3.19
	16-17 yrs	166	8.5	0.9	0.8	0.2	0.4	0.8	1.1	1.7	0%	0.01	0.09	2.25	4.97
	All	959	-	0.7	0.7	0.1	0.3	0.6	1.0	1.6	0%	0.00	0.03	2.03	3.34
Girls	6 yrs	40	5.5	0.4	0.3	0.0	0.1	0.3	0.5	0.9	0%	0.00	0.01	1.17	1.45
	7-9 yrs	222	5.5	0.5	0.6	0.0	0.2	0.4	0.7	1.1	0%	0.00	0.01	1.46	4.40
	10-12 yrs	281	5.5	0.7	0.6	0.1	0.3	0.5	0.9	1.5	0%	0.01	0.03	1.75	3.12
	13-15 yrs	360	7.0	0.8	0.8	0.2	0.3	0.6	1.1	1.8	0%	0.00	0.08	2.26	3.32
	16-17 yrs	158	7.0	0.9	0.7	0.2	0.4	0.7	1.1	1.7	0%	0.02	0.11	2.27	4.63
	All	1,061	-	0.7	0.7	0.1	0.2	0.5	1.0	1.5	0%	0.00	0.03	2.03	3.20
All	2,020	-	0.7	0.7	0.1	0.3	0.6	1.0	1.5	0%	0.00	0.03	2.03	3.31	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-8: Vitamin A intakes and CAM-RDA

Vitamin A	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	450	196	153	20	71	144	331	441	6%	6	11	488	533
	7-9 yrs	200	450	294	332	31	97	201	381	616	19%	3	20	902	1,803
	10-12 yrs	251	550	310	288	38	121	250	427	652	14%	5	16	795	1,549
	13-15 yrs	310	550	422	353	59	167	347	561	912	25%	7	28	1,137	1,688
	16-17 yrs	166	600	518	496	123	241	406	607	1,115	26%	8	96	1,416	3,474
	All	959	-	375	368	48	135	286	490	765	21%	5	24	1,087	1,665
Girls	6 yrs	40	400	178	182	9	33	123	294	415	10%	3	6	461	880
	7-9 yrs	222	450	265	305	20	75	177	363	515	15%	1	12	828	1,666
	10-12 yrs	281	550	330	368	40	110	248	428	646	16%	0	12	901	1,937
	13-15 yrs	360	550	465	1163	72	165	321	489	858	21%	1	37	1,166	2,704
	16-17 yrs	158	600	423	337	106	216	338	545	806	22%	13	54	1,039	1,940
	All	1,061	-	370	734	44	122	273	448	721	18%	1	16	998	1,827
All	2,020	-	373	589	47	128	279	467	748	19%	4	20	1,046	1,719	

Unit: mcg

RDA is used to assess the diets of groups

Appendix 3-9: Vitamin C intakes and CAM-RDA

Vitamin C	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	30	54.8	62.4	4.9	14.2	38.2	56.3	187.5	56%	0.0	0.4	221.6	238.8
	7-9 yrs	200	30	68.0	107.8	3.4	11.0	32.8	69.9	181.9	52%	0.0	0.8	317.7	654.0
	10-12 yrs	251	60	60.6	85.7	5.5	17.6	35.9	65.0	137.7	28%	0.0	0.8	226.7	420.8
	13-15 yrs	310	60	78.8	95.4	10.9	23.2	47.8	99.4	187.0	40%	0.5	7.1	277.1	480.8
	16-17 yrs	166	60	84.2	92.3	15.8	27.2	57.7	107.4	185.0	48%	0.0	8.8	262.4	537.8
	All	959	-	71.9	94.6	7.6	19.1	41.9	81.5	173.2	41%	0.0	2.1	251.5	481.9
Girls	6 yrs	40	30	54.1	72.5	3.2	12.5	30.5	54.5	184.9	50%	0.0	0.9	223.0	349.3
	7-9 yrs	222	30	52.7	73.3	3.2	10.2	29.3	63.2	123.1	49%	0.0	0.5	216.0	451.1
	10-12 yrs	281	60	66.0	85.6	6.0	16.0	40.2	80.6	163.4	36%	0.0	0.3	200.8	525.8
	13-15 yrs	360	60	91.2	111.1	12.9	27.1	54.8	97.8	217.4	47%	0.2	7.0	356.7	555.2
	16-17 yrs	158	60	86.2	108.0	12.5	27.5	51.9	112.3	172.7	45%	0.6	5.1	254.0	737.7
	All	1,061	-	74.3	97.0	7.2	19.4	45.7	87.4	168.5	44%	0.0	2.2	256.7	528.8
All	2,020	-	73.2	95.8	7.4	19.1	44.1	83.6	172.4	43%	0.0	2.2	254.1	488.7	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-10: Thiamin (VB1) intakes and CAM-RDA

Thiamin (VB1)	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	0.6	0.6	0.4	0.2	0.3	0.5	0.6	1.0	25%	0.10	0.12	1.53	2.44
	7-9 yrs	200	0.8	0.5	0.3	0.2	0.3	0.4	0.6	0.9	17%	0.10	0.16	1.24	1.71
	10-12 yrs	251	1.1	0.6	0.4	0.2	0.3	0.5	0.8	1.0	7%	0.09	0.17	1.24	2.44
	13-15 yrs	310	1.1	0.7	0.5	0.3	0.4	0.6	0.9	1.3	15%	0.15	0.24	1.78	2.49
	16-17 yrs	166	1.1	0.8	0.4	0.4	0.5	0.7	1.0	1.4	19%	0.25	0.34	1.66	2.49
	All	959	-	0.7	0.4	0.3	0.4	0.6	0.8	1.2	14%	0.11	0.19	1.52	2.28
Girls	6 yrs	40	0.6	0.5	0.4	0.2	0.2	0.4	0.7	0.9	28%	0.09	0.14	1.41	2.41
	7-9 yrs	222	0.8	0.5	0.4	0.2	0.3	0.4	0.6	1.0	15%	0.07	0.13	1.19	2.10
	10-12 yrs	281	1.1	0.6	0.5	0.2	0.3	0.5	0.7	1.2	11%	0.09	0.16	1.52	2.26
	13-15 yrs	360	1.1	0.7	0.4	0.3	0.4	0.6	0.9	1.2	13%	0.13	0.18	1.55	1.97
	16-17 yrs	158	1.1	0.7	0.5	0.3	0.4	0.6	0.8	1.2	13%	0.17	0.28	1.63	2.86
	All	1,061	-	0.6	0.4	0.2	0.3	0.5	0.8	1.1	13%	0.10	0.17	1.49	2.10
All	2,020	-	0.6	0.4	0.2	0.4	0.5	0.8	1.1	14%	0.10	0.18	1.50	2.16	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-11: Riboflavin (VB2) intakes and CAM-RDA

Riboflavin (VB2)	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	0.6	0.5	0.3	0.2	0.4	0.5	0.7	0.9	34%	0.14	0.17	1.13	1.38
	7-9 yrs	200	0.8	0.7	0.7	0.3	0.4	0.5	0.8	1.2	25%	0.15	0.21	1.50	3.19
	10-12 yrs	251	1.3	0.7	0.6	0.3	0.4	0.6	0.8	1.1	8%	0.15	0.21	1.50	5.16
	13-15 yrs	310	1.2	0.9	1.0	0.4	0.5	0.7	1.0	1.5	17%	0.18	0.31	2.00	5.61
	16-17 yrs	166	1.2	1.2	1.4	0.5	0.6	0.9	1.2	1.5	23%	0.33	0.41	2.06	10.61
	All	959	-	0.8	0.9	0.3	0.5	0.7	0.9	1.4	18%	0.17	0.24	1.69	5.89
Girls	6 yrs	40	0.6	0.5	0.3	0.2	0.3	0.5	0.7	1.1	33%	0.14	0.16	1.13	1.71
	7-9 yrs	222	0.8	0.6	0.5	0.2	0.3	0.5	0.7	1.0	19%	0.11	0.18	1.52	3.00
	10-12 yrs	281	1.0	0.7	0.5	0.3	0.4	0.6	0.8	1.2	16%	0.12	0.22	1.56	2.82
	13-15 yrs	360	1.0	0.8	0.5	0.3	0.5	0.7	0.9	1.3	20%	0.16	0.23	1.60	3.27
	16-17 yrs	158	1.0	1.0	1.1	0.4	0.5	0.7	1.0	1.5	24%	0.23	0.30	2.26	7.90
	All	1,061	-	0.7	0.6	0.3	0.4	0.6	0.9	1.2	20%	0.15	0.22	1.59	3.27
All	2,020	-	0.8	0.8	0.3	0.4	0.6	0.9	1.3	19%	0.15	0.23	1.64	5.29	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-12: Niacin (VB3) intakes and CAM-RDA

Niacin (VB3)	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	8	8.1	3.5	4.3	5.8	7.7	10.5	12.4	38%	2.5	2.7	15.1	19.8
	7-9 yrs	200	11	8.2	3.7	4.2	5.7	7.6	9.7	12.7	17%	2.5	3.5	15.4	23.6
	10-12 yrs	251	16	9.2	3.8	4.7	6.5	8.6	11.3	14.2	7%	2.8	4.0	15.8	20.1
	13-15 yrs	310	15	11.0	4.3	6.3	8.1	10.3	13.5	16.5	16%	3.6	5.4	19.6	23.4
	16-17 yrs	166	15	12.8	4.5	7.6	9.5	12.0	15.8	18.7	29%	5.2	6.5	20.5	26.6
	All	959	-	10.2	4.4	5.2	7.0	9.4	12.4	16.0	17%	2.9	4.3	18.4	23.8
Girls	6 yrs	40	8	6.4	3.4	3.2	4.0	5.8	8.0	9.3	25%	2.1	2.4	15.3	19.7
	7-9 yrs	222	11	7.5	3.8	3.7	4.8	6.5	9.2	12.4	16%	1.6	2.9	14.7	21.3
	10-12 yrs	281	16	8.5	3.8	4.5	6.1	7.8	10.1	12.8	7%	2.2	3.4	16.1	23.1
	13-15 yrs	360	16	9.5	4.3	4.8	6.3	9.1	11.8	15.3	11%	2.7	3.8	18.4	23.6
	16-17 yrs	158	16	9.7	4.3	5.3	6.7	8.9	11.6	14.2	8%	3.6	4.7	16.5	29.7
	All	1,061	-	8.7	4.2	4.4	5.8	7.9	10.7	13.9	11%	2.3	3.6	16.5	23.0
All	2,020	-	9.4	4.3	4.7	6.4	8.7	11.7	15.3	14%	2.5	3.8	17.8	23.5	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-13: Copper intakes and CAM-RDA

Copper	Number of subject	EAR	Mean	SD	Percentile					Ratio over EAR (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	0.4	0.1	0.1	0.0	0.0	0.1	0.2	0.3	6%	0.0	0.0	0.4	0.5
	7-9 yrs	200	0.4	0.2	0.7	0.0	0.0	0.1	0.2	0.3	9%	0.0	0.0	0.6	2.1
	10-12 yrs	251	0.5	0.3	2.5	0.0	0.1	0.1	0.2	0.3	4%	0.0	0.0	0.4	2.1
	13-15 yrs	310	0.6	0.3	1.3	0.0	0.1	0.1	0.2	0.4	5%	0.0	0.0	0.7	3.2
	16-17 yrs	166	0.7	0.3	1.5	0.0	0.1	0.1	0.3	0.4	5%	0.0	0.0	0.7	7.7
	All	959	-	0.3	1.6	0.0	0.1	0.1	0.2	0.4	6%	0.0	0.0	0.5	2.2
Girls	6 yrs	40	0.3	0.1	0.1	0.0	0.0	0.1	0.1	0.2	5%	0.0	0.0	0.4	0.8
	7-9 yrs	222	0.4	0.4	2.5	0.0	0.0	0.1	0.1	0.3	9%	0.0	0.0	0.5	16.6
	10-12 yrs	281	0.4	0.3	2.3	0.0	0.1	0.1	0.2	0.4	12%	0.0	0.0	0.5	1.9
	13-15 yrs	360	0.5	1.1	6.2	0.0	0.1	0.1	0.3	0.6	12%	0.0	0.0	1.5	38.3
	16-17 yrs	158	0.6	1.2	5.4	0.0	0.1	0.1	0.3	0.9	13%	0.0	0.0	2.4	38.2
	All	1,061	-	0.7	4.5	0.0	0.1	0.1	0.2	0.4	11%	0.0	0.0	0.8	27.2
All	2,020	-	0.5	3.4	0.0	0.1	0.1	0.2	0.4	9%	0.0	0.0	0.7	9.7	

Unit: mg

RDA is used to assess the diets of groups

Appendix 3-14: Fat intakes and CAM-RDA

Fat (E%)	Number of subject	DG	Mean	SD	Percentile					Ratio within DG (%)				
					10	25	50	75	90		1	5	95	99
Boys	6 yrs	20-30(25)	14.6	6.1	8.0	10.6	12.4	17.6	25.5	13%	6.9	7.2	28.7	30.7
	7-9 yrs	20-30(25)	15.9	6.8	7.6	10.8	15.5	20.5	25.7	25%	3.5	6.4	28.2	34.3
	10-12 yrs	20-30(25)	13.7	5.4	7.4	9.7	13.6	16.9	20.8	11%	3.6	5.4	24.3	28.7
	13-15 yrs	20-30(25)	13.9	6.0	6.8	9.3	13.7	17.1	22.1	13%	2.9	5.4	25.8	31.2
	16-17 yrs	20-30(25)	14.6	6.4	6.7	9.9	14.0	18.1	23.1	17%	3.4	5.4	25.9	37.0
	All	959	20-30(25)	14.4	6.1	7.2	10.0	14.0	17.9	22.6	16%	3.5	5.5	25.8
Girls	6 yrs	20-30(25)	15.3	6.4	7.4	9.9	15.0	19.7	24.3	20%	1.9	6.0	27.9	31.2
	7-9 yrs	20-30(25)	16.1	7.1	7.8	11.0	15.8	20.0	25.4	21%	3.0	5.4	28.8	36.9
	10-12 yrs	20-30(25)	14.3	6.4	6.3	9.9	13.7	18.6	23.6	18%	3.4	5.2	26.1	31.7
	13-15 yrs	20-30(25)	15.6	6.4	7.7	10.8	14.8	19.7	23.8	22%	4.1	6.0	26.9	34.1
	16-17 yrs	20-30(25)	17.4	6.7	8.6	12.1	17.1	22.6	27.2	30%	3.8	7.2	29.6	31.5
	All	1,061	20-30(25)	15.6	6.6	7.5	10.7	14.9	19.9	24.4	22%	3.7	5.9	27.5
All	2,020	20-30(25)	15.0	6.4	7.3	10.3	14.4	18.9	23.9	19%	3.6	5.7	26.8	32.4

Unit: energy%

DG is used to assess the diets of groups

Appendix 3-15: Dietary fibre intakes and CAM-RDA

Dietary Fibre	Number of subject	DG	Mean	SD	Percentile					Ratio over DG (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	8	7.7	4.8	2.8	4.3	6.7	10.5	12.7	41%	1.2	1.4	19.8	25.0
	7-9 yrs	200	8	8.1	6.4	2.8	4.2	6.4	9.3	16.7	37%	1.5	2.3	21.1	40.5
	10-12 yrs	251	10	9.7	6.9	3.8	5.6	7.9	11.5	17.8	34%	1.8	3.0	22.8	38.0
	13-15 yrs	310	12	11.3	7.3	4.9	6.7	9.2	13.3	19.2	29%	2.4	3.6	26.0	47.7
	16-17 yrs	166	14	13.3	7.9	6.2	7.9	10.9	16.5	25.0	33%	3.9	5.1	28.6	48.5
	All	959	-	10.4	7.3	3.9	5.9	8.5	12.5	19.0	33%	2.0	3.0	24.0	39.8
Girls	6 yrs	40	7	8.3	9.3	2.2	3.5	5.1	9.8	16.6	40%	1.0	1.4	32.8	51.0
	7-9 yrs	222	8	7.2	5.9	2.9	3.6	5.8	8.5	13.2	29%	1.6	2.2	17.7	32.1
	10-12 yrs	281	10	9.4	7.1	3.3	4.7	7.5	11.8	17.8	32%	1.7	2.8	23.4	35.9
	13-15 yrs	360	12	10.5	7.0	3.8	5.9	8.4	13.4	20.0	30%	2.0	3.1	25.5	35.8
	16-17 yrs	158	12	10.4	6.8	4.2	5.7	8.4	12.4	19.9	27%	2.1	3.5	26.2	35.1
	All	1,061	-	9.4	7.0	3.3	4.8	7.5	11.7	18.2	30%	1.7	2.8	23.5	34.4
All	2,020	-	9.9	7.1	3.5	5.3	8.0	12.0	18.6	32%	1.9	2.9	23.5	35.9	

Unit: g

DG is used to assess the diets of groups

Appendix 3-16: Sodium intakes and CAM-RDA

Sodium	Number of subject	DG	Mean	SD	Percentile					Ratio within DG (%)				
					10	25	50	75	90		1	5	95	99
Boys	6 yrs	(600-)-1600	1,595	806	750	1,023	1,303	2,180	2,891	50%	171	352	3,242	3,594
	7-9 yrs	(600-)-1600	1,640	1,243	528	846	1,317	2,023	3,126	47%	280	423	3,992	5,610
	10-12 yrs	(600-)-1600	1,859	1,284	695	1,007	1,528	2,262	3,321	46%	379	520	4,616	7,344
	13-15 yrs	(600-)-2000	1,995	1,202	780	1,158	1,709	2,535	3,540	55%	365	572	4,389	6,172
	16-17 yrs	(600-)-2000	2,282	1,326	984	1,272	1,846	3,020	4,152	52%	443	774	4,978	6,960
	All	959	-	1,922	1,259	727	1,064	1,625	2,467	3,465	50%	353	523	4,413
Girls	6 yrs	(600-)-1600	1,576	1,083	551	839	1,275	2,098	3,565	45%	315	336	4,421	4,782
	7-9 yrs	(600-)-1600	1,658	1,371	504	843	1,283	1,976	3,070	45%	186	389	3,787	9,278
	10-12 yrs	(600-)-1600	1,777	1,395	541	864	1,471	2,149	3,464	44%	138	377	4,461	8,282
	13-15 yrs	(600-)-2000	2,023	1,394	677	1,022	1,728	2,522	3,628	53%	330	553	4,696	7,687
	16-17 yrs	(600-)-2000	2,245	1,706	704	1,112	1,858	3,009	4,093	49%	116	587	5,319	10,948
	All	1,061	-	1,898	1,442	617	962	1,552	2,367	3,548	48%	252	450	4,460
All	2,020	-	1,909	1,358	647	997	1,585	2,418	3,499	49%	289	497	4,443	7,299

Unit: mg

DG is used to assess the diets of groups

Appendix 3-17: Salt (Sodium chloride) intakes and CAM-RDA

	Salt (Sodium Chloride)	Number of subject	DG	Mean	SD	Percentile					Ratio within DG (%)				
						10	25	50	75	90		1	5	95	99
Boys	6 yrs	32	(1.5)-4	4.1	2.0	1.9	2.6	3.3	5.5	7.3	50%	0.4	0.9	8.2	9.1
	7-9 yrs	200	(1.5)-4	4.2	3.2	1.3	2.1	3.3	5.1	7.9	48%	0.7	1.1	10.1	14.2
	10-12 yrs	251	(1.5)-4	4.7	3.3	1.8	2.6	3.9	5.7	8.4	45%	1.0	1.3	11.7	18.7
	13-15 yrs	310	(1.5)-5	5.1	3.1	2.0	2.9	4.3	6.4	9.0	54%	0.9	1.5	11.1	15.7
	16-17 yrs	166	(1.5)-5	5.8	3.4	2.5	3.2	4.7	7.7	10.5	52%	1.1	2.0	12.6	17.7
	All	959	-	4.9	3.2	1.8	2.7	4.1	6.3	8.8	50%	0.9	1.3	11.2	16.5
Girls	6 yrs	40	(1.5)-4	4.0	2.7	1.4	2.1	3.2	5.3	9.1	48%	0.8	0.9	11.2	12.1
	7-9 yrs	222	(1.5)-4	4.2	3.5	1.3	2.1	3.3	5.0	7.8	43%	0.5	1.0	9.6	23.6
	10-12 yrs	281	(1.5)-4	4.5	3.5	1.4	2.2	3.7	5.5	8.8	44%	0.4	1.0	11.3	21.0
	13-15 yrs	360	(1.5)-5	5.1	3.5	1.7	2.6	4.4	6.4	9.2	52%	0.8	1.4	11.9	19.5
	16-17 yrs	158	(1.5)-5	5.7	4.3	1.8	2.8	4.7	7.6	10.4	48%	0.3	1.5	13.5	27.8
	All	1,061	-	4.8	3.7	1.6	2.4	3.9	6.0	9.0	47%	0.6	1.1	11.3	21.0
All	2,020	-	4.8	3.4	1.6	2.5	4.0	6.1	8.9	49%	0.7	1.3	11.3	18.5	

Unit: g

DG is used to assess the diets of groups

Appendix 3-18: Potassium intakes and CAM-RDA

	Potassium	Number of subject	DG	Mean	SD	Percentile					Ratio over DG (%)				
						10	25	50	75	90		1	5	95	99
Boys	6 yrs	32	1,300	592	273	232	378	582	712	1,051	0%	99	101	1,121	1,136
	7-9 yrs	200	1,400	606	330	254	372	546	762	1,058	4%	137	181	1,339	1,758
	10-12 yrs	251	1,700	733	404	331	464	663	876	1,203	4%	167	282	1,543	2,216
	13-15 yrs	310	2,000	880	413	433	575	818	1,078	1,467	2%	286	384	1,697	2,147
	16-17 yrs	166	2,300	968	396	513	641	906	1,198	1,497	0%	329	429	1,727	2,205
	All	959	-	790	409	359	500	704	1,012	1,341	3%	160	286	1,580	2,093
Girls	6 yrs	40	1,400	501	250	243	302	443	646	856	0%	156	190	1,070	1,249
	7-9 yrs	222	1,700	564	323	245	343	498	695	1,011	0%	96	176	1,102	1,638
	10-12 yrs	281	2,000	711	390	301	439	655	883	1,229	1%	152	237	1,521	2,016
	13-15 yrs	360	2,200	825	479	349	525	741	1,006	1,407	1%	148	290	1,682	2,952
	16-17 yrs	158	2,300	843	519	389	532	716	1,042	1,493	3%	121	279	1,654	3,548
	All	1,061	-	730	441	300	438	646	889	1,263	1%	135	242	1,555	2,480
All	2,020	-	759	427	326	464	680	943	1,307	2%	153	256	1,564	2,094	

Unit: mg

DG is used to assess the diets of groups

Appendix 3-19: Phosphorus intakes and CAM-RDA

Phosphorus	Number of subject	RDA	Mean	SD	Percentile					Ratio over RDA (%)					
					10	25	50	75	90		1	5	95	99	
Boys	6 yrs	32	500	494	158	228	404	517	570	701	63%	121	131	778	792
	7-9 yrs	200	600	498	218	250	338	458	627	764	28%	125	205	932	1,178
	10-12 yrs	251	850	542	248	299	373	489	656	844	9%	161	251	1,045	1,533
	13-15 yrs	310	950	649	264	357	444	614	801	1,031	15%	216	293	1,172	1,438
	16-17 yrs	166	950	707	260	389	504	683	871	1,090	17%	252	337	1,185	1,404
	All	959	-	594	259	306	405	544	731	952	18%	172	258	1,122	1,409
Girls	6 yrs	40	450	432	226	212	279	369	516	767	40%	169	200	1,059	1,080
	7-9 yrs	222	550	454	230	216	302	397	581	739	28%	115	184	883	1,367
	10-12 yrs	281	850	527	241	239	360	489	653	890	12%	135	197	994	1,271
	13-15 yrs	360	900	572	251	284	383	524	709	918	11%	178	233	1,063	1,240
	16-17 yrs	158	900	599	259	330	429	528	701	954	11%	232	290	1,179	1,520
	All	1,061	-	534	250	260	359	485	662	884	16%	150	210	1,023	1,303
All	2,020	-	563	256	284	378	511	697	914	17%	156	224	1,079	1,327	

Unit: mg

RDA is used to assess the diets of groups

This book is jointly written by:

Foundation for International Development/Relief (FIDR)

Dr. Khim Sam Ath (World Health Organization)

Prof. Kaoru Kusama (Aomori University of Health and Welfare, Japan)

Proofread by:

Prof. Nobuo Yoshiike (Aomori University of Health and Welfare, Japan)

Dr. Chea Mary (National Nutrition Program, Ministry of Health)

Team of Preventive Medicine Department (Ministry of Health)

FBDG and IEC materials developed by:

FIDR and FBDG Development Team

Illustrations and design of IEC materials by:

Yamada School of Art and FIDR

Special thanks to:

Kyoto Morning Rotary Club, Japan

Yoko Horiuchi (Department of Human Life Science, Aomori University of Health and Welfare, Japan)

Suguru Okami (Graduate School of System Design and Management, Keio University, Japan)

Hanneke Vandyke (World Food Program)

