CHAPTER I
INTRODUCTION

1.1 Background

Sodium is an essential mineral which is found in extracellular fluid compartment, major functions as acid-base balance and fluids balance in the body. Sodium provides salty taste. Most sodium can be all so bed in the small intestine unlike others minerals. Over consumption of sodium can cause kidney failure, hypertension which are risk factor of cardiovascular disease (1).

Normal requirement of sodium intake per days should not less than 500 mg/day and not more than 2,300 mg/day (about 1 teaspoonful) but for those who have edema should not have sodium more than 1,500 mg/day. The incident of finding sodium deficiency is very rare. But found more on excessive sodium intake.

Currently sodium play more important in to enhancing flavor and to preserve food. From survey of sodium chloride sourcing in Thai food by the Bureau of Nutrition, Department of Health, Ministry of Public Health and Faculty of Public Health, Mahidol University, (2) found that sodium came from two main sources, the major one is seasonings. The top 5 products are fish sauce, soya sauce, table salt, shrimp paste, and oyster sauce. The other source is instant food and ready to eat food. The top 10 of them are instant noodles with seasoning, canned fish, mackerel braised, chili sauce, pickled fish, boiled corn, meatball, streaky pork, potato chip, and salted egg respectively.

From Bureau of Nutrition, Department of Health, Ministry of Public Health and Faculty of Public Health, Mahidol University found that the average of sodium chloride consumption of Thai people was 10,879 mg/person/day of sodium chloride. Northern people have highest sodium chloride intake. This study reported that rural population has higher sodium chloride intake than urban population (2).

Refer to Mulder KA et al., 2011(3) found that the sodium intake of 91.6% of children-aged between 1-6 years were higher than the recommendation (1,000 to 1,200 mg/day). From other study in Greek, 2011 (4) found that the sodium intake of 23.0% of children-aged between 10-12 years were higher than the recommendation (2,200 mg/day).

From several studies found that in each gram of excessive sodium chloride intake per day will cause the increasing in the systolic blood pressure 0.4 mm Hg, which is one of the major risk factors for the occurrence of hypertension.

Criteria for hypertension is high blood pressure >140/90 mmHg, systolic blood pressure > 140 mmHg or diastolic blood pressure >90 mmHg.

Mortality statistics from Bureau of Health Policy and Strategy Ministry of Public Health from between 2006-2010 (5), the number of deaths in Thailand with hypertension and cardiovascular disease are increasing every year. In 2010, the number of deaths by hypertension was 20,018/100,000 = 27.9% which were higher than 2009. In 2010, hypertension patients is the secondary last number of inpatients number of hypertension inpatients to all inpatient was 1,059/100,000 = 7.6% which were higher than 2009. And most inpatients came from the Northern part.

The study of Bibbin-Domingo K in 2010 (6) found that reducing salt intake by 3 g/day or 1,200 mg of sodium/day can reduce the rate of coronary heart disease in new patients by 60,000-120,000 people/year and reduce in the rate of stroke by 32,000 to 66,000 people / year and reduce the rate of myocardial death by 54,000 to 99,000 persons/year.

A study by Feber J and Ahmed M in 2010 (7), the rate of high blood pressure in children and teenager is higher. In a study of He FJ et al in 2008 (8) showed that the average of the salt intake in children aged 4 years was 4.7 g/day, systolic blood pressure 110 mmHg and the average salt intake was increased to 6.8 g/day for young people age 18 years which would cause a systolic blood increased to 118 mmHg. The study of Chen X and Wang Y (9) found that people with high blood pressure tentatively having high blood pressure since childhood.

In conclusion, the excessive sodium is a major cause of hypertension. There are many other nutritional risk factors could cause hypertension such as obesity and high cholesterol (10).

In 2010, Rattanayosee Y and Leelahagul P (11) study in 821 students of Secondary school-age students of Princess Chulabhron's college Chiangrai found that prevalence of obesity in male and female students was 22.1 % and 28.1 % receptively and hypercholesterolemic in male and female students was 16.0% and 24.2% receptively.

In the, Waisaihealth (2012) (12) in 833 students of Secondary school-age students of Princess Chulabhron's college Chiangrai found that prevalence of obesity in male and female students was 11.4% and 3.7 %, receptively and hypercholesterolemic in male and female students was 19.9 % and 14.4% receptively.

Refer to studies mentioned above, show that the prevalence of obese and hypercholesterolemic students in 2012 declined from the previous year. However the decreasing in 2012 was still high percentage. Obesity and hypercholesterolemic were the main risk factor for cardiovascular disease in the future. In addition, the researches which mentioned above explained about the high sodium intake was another important risk factor for heart disease and cardiovascular disease. However, there were very few studies on sodium intake in children.

Therefore, in this study, the researcher is interested in the dietary sodium intake in Secondary school-age students of Princess Chulabhron's college Chiangrai. The study also assesses the association of sodium chloride intakes and nutritional disease. Moreover, the researcher is intended to develop the methods in reducing dietary sodium intake in the risk group.

1.2 Objectives

1.2.1 To assess the daily sodium intake in Secondary school-age students of Princess Chulabhorn's college Chiangrai.

1.2.2 To assess the daily sodium intake in obese and hypercholesterolemic students.

1.2.3 To study the relationships between the sodium intakes and obese or hypercholesterolemic students.

1.2.4 To study and develop the means of nutrition education to reduce sodium intake in obese or hypercholesterolemic students.

CHAPTER II
LITERATURE REVIEW

2.1 Sodium

Sodium (Na) is one of the chemical elements found in various foods including table salt. Table salt, also known as sodium chloride (NaCl), is 40% of sodium and 60% of chloride (13). Sodium is an important mineral and electrolyte necessary for many functions in the body. It has an important role in maintaining water balance within cells, and is involved in proper functioning of both nerve impulses and muscles within the body. Sodium plays crucial role in blood pressure regulation. Sodium is only needed in small quantities, and the kidneys are responsible for excreting extra sodium from the body (14).

2.1.1 Sources of sodium

Sodium is found naturally in food but a lot of it added during processed foods in the form of salt. Salt may be added for flavor enhancement and to extend the shelf life of certain foods. Salt is added to most canned foods, pickled foods, fast foods, smoked and cured meats, and some frozen vegetables including cheeses, sauces, soups, salad dressings, many breakfast cereals, and snack. Moreover commercially prepared condiments and seasonings are also high in sodium (14).

2.1.2 Functions of sodium

2.1.2.1 Fluid balance

When fluid volume decreases sodium concentration in the blood increases. The increased sodium with stimulate the hypothalamus. The hypothalamus will next stimulate the posterior pituitary gland the release antidiuretic hormone (ADH). ADH will travel in the blood to the kidneys, and then ADH will cause the kidneys to save more water. When the kidneys save water there will be less water excreted in the urine. The extra water will return the blood volume back to normal and maintain homeostasis for fluid balance (15).

2.1.2.2 Acid base balance

Hydrogen ions and sodium ions exchange places throughout the formation of urine. For every H+ which enters the urine, one sodium ion is reabsorbed from the urine into the blood and is conserved. For every H+ ion excreted and every Na+ ion conserved, one bicarbonate ion is also reabsorbed into the blood. The charges on sodium and bicarbonate are thus always balanced. Na_2HPO_4 is actually the "salt" in the following dissociation reaction: H_2PO_4- <===> $H^+ + HPO_4^{-2}$ (16).

2.1.2.3 Maintenance of viscosity of blood

The basolateral Na-K-ATPase pump maintains a low intracellular concentration of Na^+ (primary active transport). The resulting concentration difference between luminal and intracellular Na^+ provides energy for absorption of Na^+ and glucose into the cell through the Sodium-Glucose cotransporter transporter protein (secondary active transport). The glucose diffuses from the cell into the interstitial space though the basolateral Glucose transporter protein (facilitated diffusion); the Na^+ is removed from the cell by the Na-K-ATPase pump. The accumulation of Glucose and Na^+ in the interstitial fluid causes osmotic absorption of H_2O (osmosis). The accumulating Na^+, Glucose, and H_2O are removed from the interstitial space by diffusion into the intestinal capillaries (simple diffusion) which the circulatory system distributes to the remainder of the body (bulk flow) (17).

2.1.2.4 Neuromuscular excitability

The nervous system functions by conducting an electrical signal or impulse along the length of the nerve and transmitting it across a junction (called the synaptic cleft) to another nerve or to a muscle fiber. Channels for the ions Na^+ and Ca^{2+} play crucial roles in the transmission of a nerve impulse (18).

2.1.3 Recommendation for sodium intake

According to the Institute of Medicine in Canada, recommended intake for sodium classify by age show in the Table below (19).

Healthy	**Adequate Intake (AI)**	**Tolerable Upper Limit (UL)**
Infants 0-6 months	120 mg/day	No data
Infants 7-12 months	370 mg/day	No data
Children 1-3 years	1000 mg/day	1500 mg/day
Children 4-8 years	1200 mg/day	1900 mg/day
Teens 9-13 years	1500 mg/day	2200 mg/day
Adults 14-50 years	1500 mg/day	2300 mg/day
Older adults 51-70 years	1300 mg/day	
Older adults over 70 years	1200 mg/day	
Pregnancy	1500 mg/day	

In some people, sodium increases blood pressure because it holds excess fluid in the body, placing an added burden on the heart. If blood pressure is 120/80 mm/Hg or above, the American Heart Association (AHA) recommends consuming no more than 1,500 mg of sodium a day (20). Moreover, if age more than 51 years, or have diabetes, or have chronic kidney disease consume no more than 1,500 mg of sodium per day (21).

Sodium Recommended Daily Allowance (RDA) is to consume less than 2,400 milligrams (mg) of sodium a day. This is about 1 teaspoon of table salt per day. It includes all salt and sodium consumed, including sodium used in cooking and at the table (22).

According to Thai Recommended Daily Intakes (RDI) for Thais ages of 6 years and up (Thai RDI) is to be used as criteria for displaying of nutrition value on food labels or the so-called “Nutrition Labeling”. By the use of basic values from Recommended Daily Dietary Allowances for Healthy Thais (Thai RDA), and based upon the demand energy of 2,000 kilocalories per day for as basic or mean values in calculation for displaying of nutrition labeling only. The true demand energy for individual may be higher or lower than 2,000 kilocalories per day which is depending on others factors such as age, gender, and the difference of individual physical activity level. Thus Thai RDI of sodium intake less than 2,400 mg (23).

2.2 Sodium status

The major cation of the extracellular fluid is sodium. The typical daily diet contains 130-280 mmol (8-15 g) sodium chloride, (3,148-5,897 mg of sodium). The body requirement is a small amount (e.g., between about 180 mg and 500 mg per day) of sodium to keep our bodies working properly, so the excess is excreted by the kidneys in the urine (21), reference range (intervals) for sodium show in the Table below (24).

Reference range (intervals) for sodium	
Serum	136-145 mmol/L
Cerebrospinal fluid	130-150 mmol/L
Sweat	10-40 mmol/L
Urine (varies with intake)	40-220 mmol/day

Assessment of sodium status used to blood sodium test for detect abnormal concentrations of sodium, termed hyponatremia (low sodium) and hypernatremia (high sodium) and urine sodium test are typically tested in patients who have abnormal blood sodium levels to help determine whether an imbalance is from. Method of determination sodium in the body consisted of the flame photometer method, colorimetric method, and ion selective electrode method (24).

2.3 Assessment of sodium intake

Sodium intake can be estimated either indirectly from questionnaires or food consumption data, or directly by the measurement of urinary excretion.

2.3.1 Dietary assessment method

Dietary assessment methods with the individual level following food records, 24-hour dietary recalls, and food frequency questionnaires often are used to monitor intake. A food record is a written record of all foods and beverages and the amounts of each consumed over one or more days. A 24-hour dietary recall collects information on all food and beverage intake by an individual from the previous day or

24 hours. A food frequency questionnaire is a report of the usual frequency of consumption from a list of foods over a specific period of time (25).

Dietary survey methods require that data on intakes of various foods are converted into nutrient intakes using standardized food tables. Such method are prone to numerous errors including inaccurate or incomplete food composition tables, reporting errors, sampling bias, and coding errors. Specific sources of error with regard to sodium intake include difficulties in estimating the amount of sodium chloride added during cooking (including in restaurants) and at the table, variation in the sodium content of processed foods and in sodium concentration of local water supplies, and variation in the proportion of salt added during cooking that is retained by the food, plate losses (i.e. salt left behind on the plate) (26).

As a consequence of these sources of error, estimates based on the food diary, weighed records, food–frequency questionnaire or 24-h recall approach tend to underestimate sodium intakes as compared with intakes estimated from duplicate diets or 24-h urine collections (26).

2.3.2 Measurement of urinary excretion

The measurement of 24-hour urinary sodium excretion is considered the "gold standard" method of obtaining data on sodium intakes in population surveys. This method has the advantage of being unaffected by subjective reporting of dietary intakes but takes no account of electrolyte loss other than via the kidney, so it will tend to underestimate true intake by 10% or 15% (26).

Both overnight and spot (casual) urine collections have been suggested as alternatives to 24-h urine collections as there is less participant burden and there is the added advantage that a timed collection is not required. With regard to spot (casual) urine samples, some studies have suggested that these may be representative of the sodium intake of the group despite the fluctuations in values for individuals over the course of a day. As spot urines are readily and cheaply obtained they may prove to be of value in monitoring sodium intakes, particularly in resource-poor settings or where 24-h urine collections are not deemed feasible. However, spot urines have not been extensively tested in epidemiological surveys and further validation is required.

Regarding overnight urine collections, there is evidence to suggest that their use may result in biased estimates of sodium excretion (26).

2.4 Nutritional status with sodium status

Intake of a diet sufficient to meet or exceed the needs of the individual will keep the composition and function of the otherwise healthy individuals within the normal range.

Whenever, one who had exceed of intake effect to diet-related chronic diseases such obesity, diabetes mellitus, and hypercholesterol are main risk factor of cardiovascular diseases (27). Moreover, the researches explained about the excess sodium intake were another important risk factor for cardiovascular disease (28). Furthermore excess sodium intake since childhood and adolescent affect the behavior when they entering adulthood and is it an important risk factor of cardiovascular disease (29).

He FJ, et al., (8) studied in 1,658 individuals, aged 4-18 years was identified from a postal sift of addresses selected from the Postcode Address File. A weighted dietary record of all food and drink consumed over 7 consecutive days was kept by parent and/or young person depending on age. Dietary salt intake was estimated from the 7-day dietary record, blood pressure was measured using the Dinamap 8100 oscillometric monitor. The average salt intake, which did not include salt added in cooking or at the table, at the age 4 years salt intake was 4.7$\pm$0.2 g/day and blood pressure was 101$\pm$0.9/55$\pm$0.8 mmHg, and at the age 18 years salt intake was 6.8$\pm$0.2 g/day and blood pressure was 118$\pm$1.3/59$\pm$0.8 mmHg.

Marrero NM, et al., (30) studied in 340 children: young children (5-6 years), intermediate-aged children (8-9 years), and adolescents (13-17 years), found dietary salt intake was assessed by 24-hour urinary sodium excretion, was3.75 g/day, 4.72 g/day, and 7.55 g/day, respectively. Moreover 66% of young children, 73% of intermediate-aged children, and 73% of adolescents had salt intake higher than daily sodium intake recommended (based on BSA: calculated from height and weight data obtained from the National Diet and Nutrition Survey rolling survey). This study

demonstrates that salt intake in children in South London is high, with most of the salt coming from processed foods.

Pinho AP, et al., (31) studied in girls aged between 12 and 18 years from a high school in Brazil. Girls were divided in two groups: overweight/obese (n=30) and control (n=39). The following were evaluated: weight, height, skinfolds, and biochemical parameters (glucose, lipid profile, urea, creatinine, and sodium) found overweight and obese girls had higher levels of blood pressure, glucose, triglycerides, uric acid, and lower HDL cholesterol com-pared with the control group. The analysis of risk factors clusters showed that 76.7% of adolescents from the over-weight/obese group had two or more risk factors associated with metabolic syndrome, while 79.5% of the adolescents in the control group had one or none risk factors. Beside of in this study found 24-hour urinary sodium excretion in overweight/obese more than control although not significant.

From Zhu H, et al., (32) studied in 766 healthy white and African American adolescents, aged 14-18 years. Dietary sodium intake was estimated by 7-day 24-hour dietary recall, percent body fat was measured by dual-energy x-ray absorptiometry, subcutaneous abdominal adipose tissue and visceral adipose tissue was assessed using magnetic resonance imaging, and fasting blood sample were measured for tumor necrosis factor-α, leptin and adiponectin found that mean sodium intake was 3,280 mg/day of adolescents more than twice the daily intake recommended by American Heart Association (Na<1,500 mg/day), moreover found positive association of high sodium intake with body weight (β=0.23), percent body fat (β=0.17), fat mass (β=0.23), adiposity and inflammation independent of total energy intake and sugar-sweetened soft drink consumption.

2.5 Sodium reduction

Bibbins-Domingo K. et al., (33) studied in Coronary Heart disease (CHD) Policy Model to quantify the benefits of potentially achievable, population-wide reduction in dietary salt of up to 3 g/day (1,200 mg/day of sodium) found reduce the annual number of new cases of CHD by 60,000-120,000, stroke by 32,000-66,000,

myocardial infarction by 54,000-99,000, and reduce the annual number of deaths from any cause by 44,000 to 92,000. Moreover reduction in dietary salt of up to 3 g/day would save quality-adjusted life-years and money in health care costs annually. Thus modest reduction in dietary salt could substantially reduce cardiovascular events and medical costs and should be a public health target.

He FJ. et al., (34) studied in 280 children aged≈11 years and 560 adult family members in northern China. Children in the intervention group will be educated on how to reduce salt intake. They will then be empowered to deliver the salt reduction message home to their families. In particular, children need to persuade the person who does the cooking to reduce the amount of salt used during food preparations. The duration of the intervention is one school term (≈4.5 months). The primary outcome is the difference between the intervention and the control group in the change in 24 hour urinary sodium and the secondary outcome is the difference between the intervention and control group in the change of blood pressure.

2.6 Adolescent

WHO identifies adolescence as the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to19 years. Biological processes drive many aspects of this growth and development, with the onset of puberty marking the passage from childhood to adolescence. This period has seen many changes over the past century namely the earlier onset of puberty, later age of marriage, urbanization, global communication, and changing sexual attitudes and behaviors (35).

Adolescent were divided 3 period: early adolescence (10-14 years of age), middle adolescence (15-16 years of age), and late adolescence (17-21 years of age), which the feelings and behaviors of adolescent period difference categorized into five broad areas: moving toward independence, future interests and cognitive development, sexuality, physical changes, and ethics and self-direction (36).

CHAPTER III
MATERIALS AND METHODS

3.1 Study design

This study was a 32-week prospective study in students aged 12-18 years who have obese or hypercholesterolemic and follow up every 8 weeks throughout the study. The study assess the daily sodium intake and develop the mean of nutritional education to reduce sodium intake in the risk group who had high sodium intake.

3.2 Subjects

3.2.1 Inclusion criteria

3.2.1.1 All students who have obesity from fat mass excess the recommendation.

3.2.1.2 All students who have hypercholesterolemic.

3.3.2 Exclusion criteria

3.3.2.1 Student who can not participate throughout this study

3.3.2.2 Student who have some chronic diseases, e.g. liver disease, kidney disease, heart disease, thyroid disease and thalassemia

3.2.3 Subjects enrollment and informed consent

The researchers invited the students to participate in this research project via the school meeting. The researchers explained in detail to all students who gave written informed consent at the beginning of the study.

3.3 Ethical approval remarks

This study was approved by the Ethical Clearance Committee on Human Rights Related to Research Involing Haman Subjects Faculty of Medicine, Ramathibodi Hospital, Mahidol University. Written informed consent was obtained. (Appendix A)

3.4 Data collections

3.4.1 General information assessed by questionnaires at week 0. (Appendix B)

3.4.1.1 Primary information

3.4.1.2 Economy and society information

3.4.1.3 Health information

3.4.2 Nutritional status

3.4.2.1 Body composition

Body composition assessment was performed at weeks 0, 16, 24, and 32. Height was measured with calibrated stadiometer and body composition was assessed by using TANITA BC-420MA Body Composition Analyzer, Tanita Co., Ltd., Tokyo, Japan (37).

3.4.2.2 Blood chemistry

Blood chemistry assessment was performed at weeks 0, 16, 32 including hemoglobin, uric acid, HDL-cholesterol, LDL-cholesterol, triglyceride and fasting plasma glucose. Biochemical assessment was analyzed by using an automate blood BS-400 Chemistry Analyzer, Mindray Bio-Medical Electronics Co., Ltd (38).

3.4.2.3 Dietary assessment

3.4.2.3.1 To analyze daily nutrient intakes

The 166 main course menus, 20 desserts menus and 95 snack menus were analyzed the nutritional values at week 0.

3.4.2.3.2 Using questionnaires to assess the following parameters about sodium at week 8 and week 32 (Appendix C)

1) Sodium knowledge
2) Sodium and health
3) Sodium and food behavior

3.4.2.3.3 24-hour dietary records

Three-days 24-hour dietary record are analyzed for energy intake and distribution of nutrients including carbohydrate, protein and fat. (39).

3.4.2.3.4 24-hour urinary sodium excretion

At week 8 and week 32, 24-hour urinary sodium excretion was analyzed by Potentiometric method (ISE) (40).

3.5 Criteria for nutritional assessment

3.5.1 Body weight status was classified by BMI of WHO 2007 (41). Obesity was classified by the body fat reference curves for children 2006 (42).

3.5.2 Dyslipidemia was classified by criteria of American Heart Association 2003 (43); low HDL-cholesterol (HDL < 40 mg/dL), high LDL-cholesterol (LDL >130 mg/dL), high triglyceride (TG >150 md/dL).

3.5.3 Plasma glucose status was classified by criteria of American Diabetes Association (44); impaired fasting glucose (glucose =110-125 mg/dL) and diabetes (glucose ≥126 mg/dL).

3.5.4 Anemia was classified by criteria of WHO 2001 (45) (hemoglobin < 12 g/dL).

3.5.5 Hyperuricemia was classified by criteria of Feig DI and Johnson RJ (46) (uric acid > 5.5 mg/dL).

3.5.6 High blood pressure > 140/90 mmHg (47).

3.5.7 Dietary sodium intake should be less than 2,400 mg/day (48).

3.6 Nutritional Assessment

3.6.1 Body composition measurement

Body composition measurement was included height and body composition.

Height was measured with calibrated stadiometer. The students was asked to stand straight in barefoot on horizontal platform with the head in horizontal plane, shoulders, hip, heel, back and knee straight with vertical plane. Height was recorded nearest 0.1 millimeter.

Body composition was included body weight (kg), body fat (%bw), fat mass (kg), fat free mass (FFM: kg), muscle mass (kg), total body water (%), bone mass (kg), and body mass index (BMI: kg/m^2) was assessed by using TANITA BC-420MA Body Composition Analyzer, Tanita Co.Ltd, Tokyo, Japan (37). The measurement procedure required the subject to stand in bare feet on the analyzer.

3.6.2 Biochemical measurement

Twenty milliliters of venous blood were collected from students in the morning after ten hours overnight fast at PCCCR. It was submitted for the determination of blood chemistry including fasting plasma glucose, serum hemoglobin (Hb), serum uric acid, triglyceride (TG), high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL) (38).

3.7 Nutritional therapy (Appendix D)

The subjects participated in nutritional therapy for reducing the obesity, hypercholesterolemia and dietary sodium intake especially in group which had high sodium intake at weeks 8, 16, 24, and 32 by

3.7.1 Power point, pamphlet, poster, and video to explain.

3.7.2 Demonstrate the food groups such as low calorie food, low cholesterol food, processed food, preserved food, seasonings, beverages, and snacks.

3.8 Statistical analysis

All statistical analysis was performed with SPSS version 18 for windows (49)

3.8.1 Descriptive Statistic

Descriptive statistic will be used for comparing the data such as percent, standard deviation (SD), and Confidence interval 95% (95% CI) in primary information analyze the questionnaires and nutritional information (Anthropometric measurement, Biochemical measurement and Dietary assessment).

3.8.2 Inferential Statistic

Explain a correlation analysis between dietary sodium intake and obesity, hypercholesterolemic by using the chi-Square test and linear regression analysis.

Compare the difference data between before and after in subject group by using Paired t-test. Compare the difference data between sex and class in subject group by using Independent t-test. The compared difference data will be considered to be statistically significant when $P<0.05$ and confidence interval 95%. The version 18 SPSS software will be used for statistical analysis.

CHAPTER IV
RESULTS

4.1 Subjects

At the beginning of academic year in 2012, 813 Secondary school-age students of Princess Chulabhron's college Chiangrai (PCCCR) had completed body composition and blood chemistry assessments.

According to percentage of body fat, over and excess body fat, 44 subjects were classified as obesity with normal blood chemistry (obese subjects). We selected all of hypercholesterolemic subject to participate in this study (n=117, LDL subjects), as well as 11 obese subjects with hypercholesterolemia (obese + LDL subjects) were included.

At the end of study, the overall subject's data were analyzed after excluding the 97 subjects, twenty-eight (28%) of 97 subjects had incomplete collection of a 24-hour urine specimen (less than 500 mL) (50), 59 (61%) of 97 subjects did not finish 3-day 24 hour dietary records, 1 (1%) of 97 subjects had not completed questionnaires, and 9 (9%) of 97 subjects lost to follow-up.

Therefore our subjects consisted of 21 obese subjects, 50 LDL subjects, and 4 obese + LDL subjects.

4.2 Characteristics of PCCCR subjects

Table 4.1 shows number and percentage of 813 subjects classified by class levels and sex, including 317 males and 496 females, 49.0% were at M.1–M.3 levels and 51.0% were at M.4–M.6 levels. The number of M.1 and M.4 subject were lower than those of the other levels because of new education system, science high school limited 24 students/ classroom. The majority of in 21 obese subjects were males (71.4%) and 47.6% of them were in M.1 level, most of 50 LDL subjects were in M.3 level, whereas in 4 obese + LDL subjects were males.

Table 4.1 Characteristic of PCCCR subjects classified by sex and class level

Levels	Total (n=813)			Obese (n=21)			LDL (n=50)			Obese + LDL (n=4)		
	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females
	n (%[a])	*n* (%[b])	*n* (%[b])	*n* (%[a])	*n* (%[b])	*n* (%[b])	*n* (%[a])	*n* (%[b])	*n* (%[b])	n (%[a])	*n* (%[b])	*n* (%[b])
M 1	93(11.4)	38(40.9)	55(59.1)	10(47.6)	7(70.0)	3(30.0)	6(12.0)	3(50.0)	3(50.0)	-	-	-
M 2	131(16.1)	52(39.7)	79(60.3)	4(19.0)	3(75.0)	1(25.0)	9(18.0)	2(22.2)	7(77.8)	-	-	-
M 3	175(21.5)	73(41.7)	102(58.3)	3(14.3)	2(66.7)	1(33.3)	14(28.0)	7(50.0)	7(50.0)	1(25.0)	1(100.0)	-
M 4	152(18.8)	55(36.2)	97(63.8)	3(14.3)	3(100.0)	-	7(14.0)	3(42.9)	4(57.1)	2(50.0)	2(100.0)	-
M 5	147(18.1)	56(38.1)	91(61.9)	1(4.8)	-	1(100.0)	11(22.0)	5(45.5)	6(54.5)	1(25.0)	1(100.0)	-
M 6	115(14.1)	43(37.4)	72(62.6)	-	-	-	3(6.0)	-	3(100.0)	-	-	-
Total	813(100.0)	317(39.0)	496(61.0)	21(100.0)	15(71.4)	6(28.6)	50(100.0)	20(40.0)	30(60.0)	4(100.0)	4(100.0)	-

[a] % of total subjects, [b]% of total in each level

4.3 Questionnaires (813 Total subjects)

4.3.1 General information

In general information were divided into 3 parts: primary information, socio-economic information, and health information.

4.3.1.1 Primary information

In 813 total subjects, the most of subjects were Buddhist (98.2%). Most of fathers were in middle adulthood (45-64 years), and mothers were in young adulthood (25-44 years), 59.9% and 58.3%, respectively. 64.7% of total subjects had a number of siblings 2.

4.3.1.2 Socio-economic information

Most parents (81.7%) were in married status and they live together with their children (77.9%). The majority of family income was 20,001-30,000 Baht/month (22.4%). The most of total subjects (65.7%) allowances from their parents were 500-1,000 Baht/month, most of their expenses (58.4%) were used for snack **(Table 4.2)**.

Most of fathers and mothers were government official/state enterprise (46.6% and 39.9%, respectively) **(Table 4.3)**.

The most father and mother completed bachelor's degree (41.3% and 44.6%, respectively). The highest educational level was doctorate degree (0.1%-0.2%) whereas the lowest educational level was less than primary school (0.2%-0.7%) **(Table 4.4)**.

4.3.1.3 Health information

Percentage of current illness in students was 23.4%. The first five orders of underlying diseases were allergy, gastritis/peptic ulcer, Glucose-6-phosphate dehydrogenase deficiency, epilepsy, and asthma, respectively. The first five order of family medical history related to diet-related chronic disease were hypertension, diabetes, hypercholesterolemia, obesity, and gout **(Table 4.5 I)**.

Table 4.2 Socio-economic informations

Socio-economic data	*n*	% of total
Person who live with		
Father & mother	633	77.9
Father	22	2.7
Mother	107	13.2
Relatives	51	6.2
Parent's marital status		
Married	664	81.7
Divorced	102	12.6
Father passed away	36	4.4
Mother passed away	9	1.1
Father & mother passed away	2	0.2
Family income (Baht/month)		
<10,000	34	4.2
10,000-20,000	160	19.7
20,001-30,000	182	22.4
30,001-40,000	161	19.8
40,001-50,000	127	15.6
>50,000	149	18.3
Money expenses (Baht/month)		
<500	42	5.2
500-1,000	536	65.9
1,001-10,000	227	27.9
>10,000	8	1.0
The most of expenses		
Stationery	120	14.8
Snack	475	58.4
Personal	218	26.8

Table 4.3 The parental occupations*

Occupation	Father		Mother	
	n	**% of total**	***n***	**% of total**
Government official /State enterprise	379	46.6	324	39.9
Business/Trade	279	34.3	287	35.3
Personal	53	6.5	58	7.1
Employee	41	5.0	31	3.8
Househusband/Housewife	7	0.9	92	11.3
Agriculture	16	2.0	10	1.2

*fathers passed away n=38, mothers passed away n=11

Table 4.4 Education level of parents*

Educational level	Father		Mother	
	n	**% of total**	***n***	**% of total**
Less than primary school	2	0.2	6	0.7
Primary school	56	6.9	73	9.0
Secondary school	40	4.9	38	4.7
High school	124	15.3	140	17.2
Vocational certificate	47	5.8	54	6.6
High vocational certificate	57	7.0	50	6.2
Bachelor’s degree	336	41.3	363	44.6
Master’s degree	111	13.7	77	9.5
Doctorate degree	2	0.2	1	0.1

*fathers passed away n=38, mothers passed away n=11

Table 4.5 Health informations I

Disease	*n*	% of total
Underlying disease		
Allergy	132	16.2
Gastritis/ peptic ulcer	36	4.4
Glucose-6-Phosphate Dehydrogenase deficiency	10	1.2
Epilepsy	9	1.1
Asthma	8	1.0
Thalassemia trait	5	0.6
Migraine	3	0.4
Cardiac arrhythmia	1	0.1
Systemic lupus erythematosus	1	0.1
Thyroidism	1	0.1
Cardiovascular disease	1	0.1
Family medical history related to diet-related chronic diseases		
Hypertension	287	35.3
Diabetes	249	30.6
Hypercholesterolemia	108	13.3
Obesity	89	10.9
Gout	32	3.9
Hypertriglyceridemia	26	3.2
Cardiovascular disease	21	2.6
Cancer	18	2.2
Anemia	7	0.9
Thyroidism	2	0.2
Not available	183	22.5

Most of the students had exercise (86.8%), 46.4% of them exercised less than 3 times/week, 37.7% of them exercised 3-5 times/week, and 15.9% of them exercised more than 5 times/week. Most of the students exercised by playing sports (54.1%), jogging (15.2%), walking (14.4%), physical exercises; aerobics (12.8%), and

others (3.5%). The students had spent time for watching TV, playing on computer more than or equal to 3 times/week (68.6%) and more than or equal to 30 minutes/time (77.6%). Most of the students slept 6-8 hours a night (66.5%) **(Table 4.6 II)**.

Table 4.6 Health informations II

Activity	*n*	% of total
Frequency of exercise (*n*=706)		
< 3 times/week	328	46.4
3-5 times/week	266	37.7
> 5 times/week	112	15.9
Duration of exercise (*n*=706)		
< 30 minutes	191	27.0
30-60 minutes	396	56.1
> 60 minutes	119	16.9
Type of exercise (*n*=706)		
Sports	382	54.1
Physical exercises; aerobics	90	12.8
Jogging	107	15.2
Walking	102	14.4
Housework	17	2.4
Fitness	6	0.8
Hula-Hoop	2	0.3
Frequency of watching TV, play on the computer (n=813)		
< 3 times/week	255	31.4
≥ 3 times/week	558	68.6
Duration of watching TV, play on the computer (n=813)		
< 30 minutes	182	22.4
≥ 30 minutes	631	77.6
How many hour of sleep a night? (n=813)		
< 6 hours	272	33.5
6-8 hours	541	66.5

4.4 Nutritional therapy on nutritional status (813 Total subjects)

Nutritional status were assessed from body composition and blood chemistry data. Body composition of 813 subjects are shown in **Tables 4.7 -4.11** and blood chemistry data are shown in **Tables 4.12 - 4.14**.

4.4.1 Body composition

Body composition data were divided to M.1-M.3 and M.4-M.6, due to M.1-M.3 aged 12-16 years (early adolescence) and M.4-M.6 aged 15-18 years (late adolescence) which have different growth rate and nutritional requirement.

Mean (±SD) of age and body composition parameters of 399 M.1-M.3 subjects during the study are shown in **Table 4.7**. The mean height, weight, BMI, fat free mass, and muscle mass of 399 M.1-M.3 subjects at the end of study were significantly higher than those at the baseline.

The mean height, weight, fat free mass, muscle mass, and TBW (kg,%bw) of 163 M.1-M.3 males at the end of study were significantly higher than those at the baseline, whereas mean body fat (%bw) and fat mass at the end of this study were significantly lower than those at the baseline. However, mean height, weight, BMI, body fat (%bw) and fat mass of 236 M.1 – M.3 females at the end of this study were significantly higher than those at the baseline, whereas mean TBW (%bw) at the end of this study was significantly lower than that at the baseline.

During the study mean height, weight, body fat (%bw), fat mass, fat free mass, muscle mass, and TBW (kg, %bw) of M.1-M.3 males were significantly higher than those of females.

Mean (±SD) of age and body composition parameters of 414 M.4-M.6 subjects during the study are shown in **Table 4.8**. The mean height, weight, BMI, body fat (%bw), and fat mass of 414 M.4-M.6 subjects at the end of this study were significantly higher than those at the baseline, whereas mean fat free mass and TBW (kg, %bw) at the end of this study were significantly lower than those at the baseline.

The mean height, weight, BMI, body fat (%bw), fat mass, fat free mass, and muscle mass of 154 M.4-M.6 males at the end of this study were significantly higher than those at the baseline, whereas mean TBW (kg, %bw) at the end of this study was significantly lower than that at the baseline. The mean height, weight, body

fat (%bw), and fat free mass of 260 M.4-M.6 females at the end of this study were significantly higher than those at the baseline, whereas muscle mass and TBW at the end of this study were significantly lower than those at the baseline.

During the study, except BMI, mean height, weight, body fat (%bw), fat mass, fat free mass, muscle mass, and TBW (kg, %bw) of M.4-M.6 males were significantly higher than those of females.

Table 4.7 Means (±SD) of age and body composition parameters of M1-M3 subjects classified by sex.

Parameters	Total (n=399)		Males (n=163)		Females (n=236)	
	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32
Age (y) range	12 - 16	12 - 17	12 - 15	13 - 16	12 - 16	12 - 17
Height (cm)	159.1 ± 7.3	160.9 ± 7.3 ^{k1}	162.9 ± 8.1	165.9 ± 7.3 ^{k1}	156.5 ± 5.2 ^{l1}	157.5 ± 5.0 $^{k1, l1}$
Weight (kg)	50.8 ± 11.1	52.2 ± 10.3 ^{k1}	54.0 ± 13.2	55.6 ± 12.1 ^{k1}	48.6 ± 8.8 ^{l1}	49.8 ± 8.1 $^{k1, l1}$
BMI (kg/m^2)	19.9 ± 3.4	20.0 ± 3.1 ^{k5}	20.2 ± 3.9	20.1 ± 3.4	19.8 ± 3.1	20.0 ± 2.9 ^{k1}
Body fat (%bw)	20.4 ± 8.5	20.6 ± 8.7	15.8 ± 9.3	13.7 ± 7.7 ^{k1}	23.5 ± 6.2 ^{l1}	25.4 ± 5.7 $^{k1, l1}$
Fat mass (kg)	11.0 ± 7.2	11.1 ± 6.4	9.6 ± 9.0	8.4 ± 7.1 ^{k1}	11.9 ± 5.3 ^{l3}	13.0 ± 5.1 $^{k1, l1}$
Fat free mass (kg)	39.8 ± 6.4	41.0 ± 7.3 ^{k1}	44.4 ± 6.5	47.2 ± 6.7 ^{k1}	36.7 ± 4.1 ^{l1}	36.8 ± 3.6 ^{l1}
Muscle mass (kg)	37.6 ± 6.1	38.7 ± 6.9 ^{k1}	42.0 ± 6.2	44.7 ± 6.4 ^{k1}	34.5 ± 3.8 ^{l1}	34.6 ± 3.4 ^{l1}
TBW (kg)	29.2 ± 4.7	30.0 ± 5.3 ^{k1}	32.5 ± 4.8	34.6 ± 4.9 ^{k1}	26.8 ± 3.0 ^{l1}	26.9 ± 2.7 ^{l1}
TBW (%bw)	58.3 ± 6.2	58.1 ± 6.4	61.6 ± 6.8	63.2 ± 5.6 ^{k1}	56.0 ± 4.5 ^{l1}	54.6 ± 4.2 $^{k1, l1}$

Significant different from week 0, ^{k1} $p < 0.0005$ and ^{k5} $p < 0.05$

Significant different from sex, ^{l1} $p < 0.0005$ and ^{l3} $p < 0.005$

Table 4.8 Means (±SD) of age and body composition parameters of M4-M6 subjects classified by sex.

Parameters	Total (n=414)		Males (n=154)		Females (n=260)	
	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32
Age (y) range	15 - 18	15 - 19	15 - 18	16 - 19	15 - 18	15 - 18
Height (cm)	163.4 ± 7.5	163.9 ± 7.6^{k1}	170.2 ± 5.8	170.9 ± 5.8^{k1}	159.4 ± 5.0^{l1}	159.7 ± 5.0^{k1,l1}
Weight (kg)	54.9 ± 10.5	55.7 ± 10.5^{k1}	60.6 ± 11.6	62.2 ± 11.2^{k1}	51.5 ± 8.0^{l1}	51.9 ± 7.8^{k3,l1}
BMI (kg/m^2)	20.5 ± 3.2	20.7 ± 3.1^{k1}	20.9 ± 3.5	21.3 ± 3.5^{k1}	20.2 ± 3.0	20.3 ± 2.8^{l3}
Body fat (%bw)	19.6 ± 8.4	21.2 ± 8.0^{k1}	11.9 ± 6.6	13.4 ± 5.8^{k1}	24.1 ± 5.5^{l1}	25.9 ± 4.8^{k1,l1}
Fat mass (kg)	11.2 ± 7.8	11.9 ± 5.7^{k3}	7.8 ± 6.1	8.9 ± 5.8^{k1}	13.2 ± 8.1^{l1}	13.7 ± 4.8^{l1}
Fat free mass (kg)	43.9 ± 8.4	43.8 ± 8.8^{k5}	52.8 ± 6.6	53.3 ± 6.3^{k3}	38.7 ± 3.4^{l1}	38.1 ± 3.6^{k1,l1}
Muscle mass (kg)	41.5 ± 8.0	41.4 ± 8.4	50.0 ± 6.3	50.5 ± 5.9^{k3}	36.4 ± 3.2^{l1}	35.9 ± 3.3^{k1,l1}
TBW (kg)	32.0 ± 6.2	31.1 ± 6.4^{k1}	38.5 ± 4.8	37.9 ± 4.9^{k3}	28.1 ± 2.5^{l1}	27.1 ± 2.7^{k1,l1}
TBW (%bw)	58.6 ± 6.3	56.1 ± 6.0^{k1}	64.3 ± 4.9	61.6 ± 4.8^{k1}	55.2 ± 4.2^{l1}	52.8 ± 3.7^{k1,l1}

Significant different from week 0, ^{k1} $p < 0.0005$, ^{k3} $p < 0.005$, and ^{k5} $p < 0.05$
Significant different from sex, ^{l1} $p < 0.0005$ and ^{l3} $p < 0.005$

Table 4.9 shows nutritional status of 813 subjects classified by BMI-for age as an indicator, based on WHO criteria (41) during the study. At the baseline, the subjects had normal weight (80.1%), at risk of overweight (8.2%), overweight (6.8%), and underweight (4.9%). At the end of this study, after receiving the nutritional therapy, percentage of normal weight and underweight subjects were increased to 82.2% and 5.0%, respectively from baseline, percentage of at risk of overweight and overweight subjects were decreased to 7.4% and 5.5% from baseline.

Three hundred and ninety-nine M.1-M.3 subjects at baseline, the subjects had normal weight (76.2%), at risk of overweight (10.8%), overweight (8.5%), and underweight (4.5%). At the end of this study, after receiving the nutritional therapy, percentage of normal weight subjects was increased to 79.7%, percentage of at risk of

overweight, and overweight students were decreased to 9.3%, 6.5%, respectively from baseline, and no change of the percentages of underweight subjects amount **(Table 4.9)**.

All the above mentioned body weight status improvement were also observed in male and female M.1-M.3 students, except the percentage of underweight male M.1-M.3 subjects at the end of this study were increased from 3.6% to 5.5%.

Four hundred and fourteen M.4-M.6 subjects at baseline, the subjects had normal weight (83.8%), at risk of overweight (5.8%), underweight (5.3%), and overweight (5.1%). At the end of this study, after receiving the nutritional therapy, the percentage of normal weight and underweight subjects were increased to 84.3% and 5.6%, whereas, at risk of overweight and overweight subjects were decreased to 5.6% and 4.6% **(Table 4.9)**.

All the above mentioned body weight status improvement were also observed in 154 male M.4-M.6 subjects, except no change of overweight subjects amount. At the baseline of 260 female M.4-M.6 subjects had normal weight (88.1%), at risk of overweight (5.0%), underweight (3.8%), and overweight (3.1%). At the end of this study, after receiving the nutritional therapy, no change of the percentage of normal weight and at risk of overweight subjects amount, however the percentage of overweight subjects was decreased to 2.3%, whereas the percentage of underweight was increased to 4.6% **(Table 4.9)**.

Percentage of body fat is the best parameter to classify obesity (42). At baseline, the subjects had normal body fat (77.5%), low body fat (15.9%), over body fat (3.4%), and excess body fat (3.2%). At the end of this study, after receiving the nutritional therapy, the percentages of normal body fat and over body fat subjects were increased to 82.5%, 4.1%, respectively. The percentages of low body fat and excess body fat subjects were decreased to 11.4% and 2.0%, respectively from baseline **(Table 4.10)**.

All the above mentioned body fat status improvement were also observed in M.1-M.3 and M.4-M.6 subjects, except in the percentages of low body fat and over body fat in M.1-M.3 subjects at the end of this study were increased from 10.3% to 11.8% and 3.2% to 4.8%, respectively.

At baseline of 163 male M.1-M.3 subjects had normal body fat (73.6%), low body fat (12.9%), excess body fat (8.0%), and over body fat (5.5%). At the end of this study, after receiving the nutritional therapy, the percentages of normal body fat, over body fat, and excess body fat subjects were decreased to 73.0%, 3.0%, 4.9%, respectively from baseline. The percentage of low body fat subjects was increased to 19.0% from baseline. All the above mentioned body fat status improvement were also observed in 236 female M.1-M.3 subjects **(Table 4.10)**.

At baseline, 154 male M.4-M.6 subjects had normal body fat (54.5%), low body fat (36.4%), over body fat (6.5%), and excess body fat (2.6%). At the end of this study, after receiving the nutritional therapy, the percentage of normal body fat subjects was increased to 71.4%. The percentages of low body fat and excess body fat subjects were decreased to 20.1% and 1.9%, respectively, and no change of the percentage of over body fat subjects **(Table 4.10)**.

At baseline, 260 M.4-M.6 female subjects had normal body fat (85.0%), low body fat (12.3%), over body fat (1.9%), and excess body fat (0.8%). At the end of this study, after receiving the nutritional therapy, the percentage of normal body fat subjects was increased to 91.5%. The percentages of low body fat and over body fat subjects were decreased to 5.8% and 1.5%, respectively from baseline, and no change of the percentage of excess body fat subjects **(Table 4.10)**.

When we use two criteria together for classifying body weight status, BMI-for age and body fat, at the baseline the study showed that 91.0% of at risk of overweight subjects had normal body fat, 7.5% of them had over body fat and 1.5% had excess body fat, thus 9.0% of at risk of overweight subjects were obese. 12.7% of overweight subjects had normal body fat, 41.8% of them had over body fat and 45.5% had excess body fat, thus 87.3% of overweight subjects were obese (**Table 4.11**).

Table 4.9 Body weight status classified by BMI-for age

BMI for age	Total n (% [a])	Total *n* (% [a])	M1-M3						M4-M6					
			Total *n* (% [a])		Males *n* (% [b])		Females *n* (% [b])		Total *n* (% [a])		Males *n* (% [b])		Females *n* (% [b])	
	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32
Underweight	40(4.9)	41(5.0)	18(4.5)	18(4.5)	6(3.6)	9(5.5)	12(5.0)	9(3.8)	22(5.3)	23(5.6)	12(7.8)	11(7.1)	10(3.8)	12(4.6)
Normal weight	651(80.1)	667(82.1)	304(76.2)	318(79.7)	119(73.0)	123(75.5)	185(78.4)	195(82.6)	347(83.8)	349(84.2)	118(76.7)	120(80.0)	229(88.1)	229(88.1)
At risk of overweight	67(8.2)	60(7.4)	43(10.8)	37(9.3)	19(11.7)	17(10.4)	24(10.2)	20(8.5)	24(5.8)	23(5.6)	11(7.1)	10(6.5)	13(5.0)	13(5.0)
Overweight	55(6.8)	45(5.5)	34(8.5)	26(6.5)	19(11.7)	14(8.6)	15(6.4)	12(5.1)	21(5.1)	19(4.6)	13(8.4)	13(8.4)	8(3.1)	6(2.3)
Total	813(100)	813(100)	399(100)	399(100)	163(100)	163(100)	236(100)	236(100)	414(100)	414(100)	154(100)	154(100)	260(100)	260(100)

[a]% of total subjects, [b]% within sex

Table 4.10 Body fat status classified by body fat (%bw)

Body fat for age	Total n (% [a])	Total *n* (% [a])	M1-M3						M4-M6					
			Total *n* (% [a])		Males *n* (% [b])		Females *n* (% [b])		Total *n* (% [a])		Males *n* (% [b])		Females *n* (% [b])	
	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32
Low	129 (15.9)	93(11.4)	41(10.3)	47(11.8)	21(12.9)	31(19.0)	20(8.5)	16(6.8)	88(21.3)	46(11.1)	56(36.4)	31(20.1)	32(12.3)	15(5.8)
Normal	630(77.5)	671(82.5)	325(81.5)	322(80.7)	120(73.6)	119(73.0)	205(86.9)	203(86.0)	305(73.7)	349(84.3)	84(54.5)	110(71.4)	221(85.0)	239(91.5)
Over	28(3.4)	33(4.1)	13(3.2)	19(4.8)	9(5.5)	5(3.1)	4(1.6)	14(5.9)	15(3.6)	14(3.4)	10(6.5)	10(6.5)	5(1.9)	4(1.5)
Excess	26(3.2)	16(2.0)	20(5.0)	11(2.7)	13(8.0)	8(4.9)	7(3.0)	3(1.3)	6(1.4)	5(1.2)	4(2.6)	3(1.9)	2(0.8)	2(0.8)
Total	813(100)	813(100)	399(100)	399(100)	163(100)	163(100)	236(100)	236(100)	414(100)	414(100)	154(100)	154(100)	260(100)	260(100)

[a]% of total subjects, [b]% within sex

Table 4.11 Body weight and body fat status

BMI for age	Body fat for age									
	Total *n* (% [a])	Total *n* (% [a])	Low *n* (% [b])		Normal *n* (% [b])		Over *n* (% [b])		Excess *n* (% [b])	
	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32	Week 0	Week 32
Underweight	40(4.9)	41(5.0)	39 (97.5)	28(70.0)	1(2.5)	12(30.0)	-	-	-	-
Normal weight	651(80.1)	667(82.1)	90(13.8)	64(9.6)	561(86.2)	601(90.1)	-	2(0.3)	-	-
At risk of overweight	67(8.2)	60(7.4)	-	-	61(91.0)	51(85.0)	5(7.5)	9(15.0)	1(1.5)	-
Overweight	55(6.8)	45(5.5)	-	-	7(12.7)	7(15.6)	23(41.8)	22(48.9)	25(45.5)	16(35.5)
Total	813(100.0)	813(100.0)	129(15.9)	92(11.3)	630(77.5)	674(82.9)	28(3.4)	31(3.8)	26(3.2)	16(2.0)

[a]% of total subjects, b% of total subjects in each BMI status

4.4.2 Blood chemistry

Table 4.12 shows mean (±SD) of serum blood chemistry parameters of 813 subjects at the baseline. The study showed that 13.5% of 813 subjects were anemia, 6.5% of M.1-M.3 and 20.3% of M.4-M.6 subjects were anemia. Most of anemia subjects were females, 100% of anemic M.1-M.3 and 98.8% of anemic M.4-M.6 subjects. One of M.1 male subjects had blood sugar 134 mg/dL, it may be due to his obese status, BMI =39.1kg/m^2, body fat (%bw) =69.3%. 46.1% of 813 subjects were hyperuricemia (33.9% borderline, 10.2% high, 2.0% very high), 44.9% of M.1-M.3 and 47.3% of M.4-M.6 subjects were hyperuricemia. The prevalences of hyperuricemia in male subjects were higher than those in female subjects **(Table 4.13)**.

The prevalences of hypertriglyceridemia in 813 subjects, M.1-M.3 and M.4-M.6 subjects were 1.4% (0.9% borderline, 0.5% high), 1.5% and 1.2%, respectively. All of high hypertriglyceridemia (TG =200-499 mg/dL) of M.4-M.6 subjects were males. Most of subjects had normal HDL-cholesterol levels. 50.2% of 813 subjects were hypercholesterolemia (34.8% borderline, 15.4% high), 52.9% of M.1-M.3 and 47.6% of M.4-M.6 subjects were hypercholesterolemia. The prevalences of hypercholesterolemia in M.1-M.3 males (10.4%) subjects were lower than those in female (16.0%) subjects. The prevalence of borderline hypercholesterolemia (LDL =110-130 mg/dL) in M.4-M.6 females subjects were higher than those in males (females =67.7%, males =32.3%), whereas the prevalence of high hypercholesterolemia (LDL >130 mg/dL) in M.4-M.6 females subjects were lower than those in males (females =48.4%, males =51.6%) **(Table 4.14).**

Table 4.12 Means (±SD) of blood chemistry parameters classified by sex

Parameters	M1-M3			M4-M6		
	Total (n=399)	Males (n=163)	Females (n=236)	Total (n=414)	Males (n=154)	Females (n=260)
Hb	13.6 ± 1	14.3 ± 0.7	13 ± 0.8 *l1*	13.4 ± 12 *k4*	14.4 ± 1	12.8 ± 0.9 *k1,l1*
FBS	93 ± 8	93 ± 9	92 ± 8	87 ± 8 *k1*	88 ± 8 *k1*	87 ± 8 *k1*
Uric	5.6 ± 1.5	6.6 ± 1.5	4.9 ± 1.0 *l1*	5.6 ± 1.4	6.6 ± 1.4	5 ± 1.0 *l1*
TG	64 ± 26	60 ± 28	67 ± 24 *l3*	63 ± 29	64 ± 39	63 ± 21 *k5*
HDL	51 ± 8	46 ± 6	55 ± 8 *l1*	50 ± 8	45 ± 6	54 ± 7 *k4,l1*
LDL	113 ± 25	112 ± 24	113 ± 26	112 ± 25	112 ± 27	111 ± 23

Significant different from class, *k1* $p < 0.0005$, *k4* $p < 0.02$, *k5* $p < 0.05$

Significant different from sex, *l1* $p < 0.0005$, *l3* $p < 0.005$

Table 4.13 Hemoglobin, blood glucose and uric status classified by sex

Parameters		Total (n=813) *n (% [a])*	M1-M3 Total (n=399) *n (% [a])*	M1-M3 Males (n=163) *n (% [b])*	M1-M3 Females (n=236) *n (% [b])*	M4-M6 Total (n=414) *n (% [a])*	M4-M6 Males (n=154) *n (% [b])*	M4-M6 Females (n=260) *n (% [b])*
Hb (g/dL)								
Normal	(>12g/dL)	703(86.5)	373(93.5)	163(43.7)	210(56.3)	330(79.7)	153(46.4)	177(53.6)
Anemia	(<12 g/dL)	110(13.5)	26(6.5)	-	26(100.0)	84(20.3)	1(1.2)	83(98.8)
FBS (mg/dL)								
Normal	(<110 mg/dL)	812(99.9)	398(99.7)	162(40.7)	236(59.3)	414(100.0)	154(37.2)	260(62.8)
IFPG	(110-125 mg/dL)	-	-	-	-	-	-	-
DM	(>126 mg/dL)	1(0.1)	1(0.3)	1(100.0)	-	-	-	-
Uric (mg/dL)								
Normal	(≤5.5 mg/dL)	438(53.9)	220(55.1)	40(18.2)	180(81.8)	218(52.7)	28(12.8)	190(87.2)
Borderline	(5.6-7.0 mg/dL)	276(33.9)	130(32.6)	80(61.5)	50(38.5)	146(35.3)	80(54.8)	66(45.2)
High	(7.1-9.0 mg/dL)	83(10.2)	40(10.0)	34(85.0)	6(15.0)	43(10.4)	39(90.7)	4(9.3)
Very high	(>9.0 mg/dL)	16(2.0)	9(2.3)	9(100.0)	-	7(1.7)	7(100.0)	-

[a]% of total subjects, [b]% of total subjects in each class

Table 4.14 Serum lipid profile status classified by sex

Parameters		Total (n=813)	M1-M3			M4-M6		
			Total (n=399)	Males (n=163)	Females (n=236)	Total (n=414)	Males (n=154)	Females (n=260)
		n (% [a])	*n (% [a])*	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
TG (mg/dL)								
Normal	(<150 mg/dL)	802(98.6)	393(98.5)	159(40.5)	234(59.5)	409(98.8)	151(36.9)	258(63.1)
Borderline	(150-199 mg/dL)	7(0.9)	4(1.0)	3(75.0)	1(25.0)	3(0.7)	1(33.3)	2(66.7)
High	(200-499 mg/dL)	4(0.5)	2(0.5)	1(50.0)	1(50.0)	2(0.5)	2(100.0)	-
HDL (mg/dL)								
Normal	(>40 mg/dL)	726(89.3)	360(90.2)	141(39.2)	219(60.8)	366(88.4)	117(32.0)	249(68.0)
Low	(0-40 mg/dL)	87(10.7)	39(9.8)	22(56.4)	17(43.6)	48(11.6)	37(77.1)	11(22.9)
LDL (mg/dL)								
Normal	(<110 mg/dL)	405(49.8)	188(47.1)	82(43.6)	106(56.4)	217(52.4)	78(35.9)	139(64.1)
Borderline	(110-130mg/dL)	283(34.8)	150(37.6)	58(38.7)	92(61.3)	133(32.1)	43(32.3)	90(67.7)
High	(>130 mg/dL)	125(15.4)	61(15.3)	23(37.7)	38(62.3)	64(15.5)	33(51.6)	31(48.4)

a% of total subjects, b% of total subjects in each class

4.5 Effect of nutritional therapy on nutritional status of sodium

Sodium questionnaires

Sodium questionnaires consists of 39 items including 3 areas; sodium knowledge 10 items, sodium and health 10 items, sodium and food behavior 15 items, total 3 areas 35 items and sodium questionnaires had 4 items of questionnaires for screening unintentional subjects. Answers had 4 choices. If the subjects incorrectly answered $\geq$2 items from 4 items of questionnaires for screening unintentional subjects, they will be excluded from the study because from the previous study have shown that they were inattentive to answer the questionnaires, thus we got the valid questionnaires from 784 subjects throughout the study.

In 784 subjects answered the questionnaires intentionally consisted of 299 males and 485 females: 100% of M.4, 97.8% of M.1, 97.4% of M.6, 96.2% of M.2, 95.9% of M.5, and 92.6% of M.3 **(Table 4.15)**.

4.5.1 Sodium knowledge (SN)

This part in sodium knowledge contained 10 questions which each question was the multiple choice questions had 4 options (**Tables 4.16- 4.18)**.

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SN questions was significant increase from the pretest at the beginning of study ($p<0.005$). Both males and females, number and percentage of subjects correctly answered the SN questions was significant increase (males: $p<0.005$ and female: $p<0.02$) from the pretest at the beginning of study **(Table 4.16)**.

After receiving the nutritional education, it was found that number and percentage of 379 M.1-M.3 and 405 M.4-M.6 subjects correctly answered the SN questions was significant increase from the pretest at the beginning of study ($p<0.002$). Both males and females, number and percentage of subjects correctly answered the SN questions was significant increase from at the beginning of study **(Tables 4.17-4.18)**.

4.5.2 Sodium and health (SH)

This part in sodium and health contained 10 questions which each question was the multiple choices questions had 4 options (**Tables 4.19- 4.21)**.

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SH questions was significant increase from the pretest at the beginning of study ($p<0.05$). In males, number and percentage of subjects correctly answered the SH questions was significant increase ($p<0.05$) from the pretest at the beginning of study, whereas in females, number and percentage of subjects correctly answered the SH questions did not change from the pretest at the beginning of study **(Table 4.19)**.

After receiving the nutritional education, number and percentage of 379 M.1-M.3 subjects correctly answered the SH questions was significant increase from the pretest at the beginning of study ($p<0.05$). Both males and females, number and percentage of subjects correctly answered the SH questions was significant increase from at the beginning of study **(Table 4.20)**.

After receiving the nutritional education, number and percentage of 405 M.4-M.6 subjects, 149 males, and 256 females correctly answered the SH questions did not change from the pretest at the beginning of study. **(Table 4.21)**.

4.5.3 Sodium and food behavior (SFB)

This part in sodium and food behavior contained 15 questions, 2 questions fill answers in the blanks, 7 questions were multiple choices questions had 3 options, and 5 questions were multiple choices questions had 4 options **(Tables 4.22- 4.24)**.

After receiving the nutritional therapy and nutritional education about sodium reduction.

This study showed that number and percentage of 784, 379 M.1-M.3, and 405 M.4-M.6 subjects always dipped salt and chili when ate sour fruits at the end of study decreased 23.8%, 55.5%, and 19.6%, respectively from baseline, number of female subjects always dipped salt and chili when ate sour fruits was higher than male subjects **(Tables 4.22 I-4.24 I)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects always added fish sauce when ate noodle decreased 10.2%, 15.1%, and 6.9%, respectively from baseline, number of female subjects always added fish sauce when ate noodle was higher than male subjects **(Tables 4.22 I-4.24 I)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects added fish sauce when subjects ate noodle >2.5 teaspoon decreased 16.4%, 17.6%, and 15.2%, respectively from baseline, number of female subjects always added fish sauce when subjects ate noodle >2.5 teaspoon was higher than male subjects at baseline, whereas at the end of study number of female subjects was lower than male subjects **(Tables 4.22 I-4.24 I)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects ate whole noodle soup when subjects ate noodle decreased 20.2%, 40.0%, and 4.1%, respectively from baseline, number of female subjects ate whole noodle soup when subjects ate noodle was higher than male subjects at baseline, whereas at the end of study number of female subjects was lower than male subjects **(Tables 4.22 I-4.24 I)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects always dipped sauce when subjects ate meat ball, sausage decreased 30.7%, 37.0%, and 25.0%, respectively from baseline, number of female subjects always dipped sauce when subjects ate meat ball, and sausage was higher than male subjects at baseline **(Tables 4.22 I-4.24 I)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects added ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken >2 teaspoons decreased 23.8%, 22.0%, and 25.2%, respectively from baseline, number of female subjects added ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken >2 teaspoons was higher than male subjects at baseline **(Tables 4.22 II-4.24 II)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects liked salty meal decreased 19.7%, 30.9% and 7.8%, respectively from baseline, number of female subjects like salty meal was higher than male subjects at baseline **(Tables 4.22 II-4.24 II)**.

Number and percentage of 784 subjects and 379 M.1-M.3 subjects liked crispy snack increased 3.9% and 8.6% from baseline, whereas 405 M.4-M.6 subjects did not change from baseline, number of female subjects liked crispy snack was higher than male subjects at baseline **(Tables 4.22 II-4.24 II)**.

Number and percentage of 784 subjects and M.1-M.3 subjects drank carbonated beverage after exercise decreased 21.0% and 75.0%, from baseline, whereas 405 M.4-M.6 subjects increased 18.2% from baseline, number of male subjects drank carbonated beverage after exercise was higher than female subjects at baseline. However, at the end of study we observed that number and percentage of 784 subject, M.1-M.3, and M.4-M.6 drank sport drink after exercise were increased to 89.5%, 122.2%, and 60.0%, respectively **(Tables 4.22 II-4.24 II)**.

Number and percentage of 784 subjects, 379 M.1-M.3 and 405 M.4-M.6 subjects preferred pickled mango decreased 7.0%, 13.3% and 3.6%, respectively from baseline, number of male subjects preferred pickled mango was higher than female subjects at baseline, whereas at the end of study number of female subjects preferred pickled mango was higher than male subjects **(Tables 4.22 II-4.24II)**.

Number and percentage of 784 subjects and 379 M.1-M.3 subjects ate dried fruits $\geq$4 times a week decreased 33.3% and 100.0% from baseline, whereas 405 M.4-M.6 subjects did not change from baseline**,** number of male subjects ate dried fruits $\geq$4 times a week was higher than female subjects at baseline **(Tables 4.22 III-4.24 III)**.

Number and percentage of 784 subjects, 379 M.1-M.3, and 405 M.4-M.6 subjects ate snacks (potato chip, fish snack, and crispy rice) $\geq$4 times a week decreased 12.6%, 16.7% and 8.5%, respectively from baseline, number of female subjects ate snack (potato chip, fish snack, and crisp rice) $\geq$4 times a week was higher than male subjects at baseline **(Tables 4.22 III-4.24 III)**.

Number and percentage of 784 subjects, 379 M.1-M.3 and 405 M.4-M.6 subjects ate bakery (cake, pancake, and bread) $\geq$4 times a week decreased 14.6%, 10.8% and 18.6%, respectively from baseline, number of female subjects ate bakery (cake, pancake, and bread) $\geq$4 times a week was higher than male subjects at baseline **(Tables 4.22 III-4.24 III)**.

Number and percentage of 784 subjects and 379 M.1-M.3 subjects ate meat products (meat ball and sausage) ≥4 times a week increased 1.1% and 5.4% from baseline, whereas 405 M.4-M.6 subjects decreased 5.9% from baseline, number of female subjects ate meat products (meat ball and sausage) ≥4 times a week was higher than male subjects at baseline **(Tables 4.22 III-4.24 III)**.

Number of 784 subjects and 405 M.4-M.6 subjects ate salted peanuts 2-3 times a week decreased 10.5% and 29.1% from baseline, whereas 379 M.1-M.3 subjects increased 15.0% from baseline, number of female subjects ate salted peanuts 2-3 times a week was higher than male subjects at baseline **(Tables 4.22 III-4.24 III)**.

Table 4.15 Percentage of subjects answered sodium questionnaires classified by sex and class level

Levels	All subjects (n=813)			Intentional subjects Q[c] (n=784)			Unintentional subjects Q[c] (n=29)		
	Total (n=813) *n (% [a])*	Males (n=317) *n (% [b])*	Females (n=496) *n (% [b])*	Total (n=784) *n (% [a])*	Males (n=299) *n (% [b])*	Females (n=485) *n (% [b])*	Total (n=29) *n (% [a])*	Males (n=18) *n (% [b])*	Females (n=11) *n (% [b])*
M1	93(11.4)	38(40.9)	55(59.1)	91(97.8)	37(40.7)	54(59.3)	2(2.2)	1(50.0)	1(50.0)
M2	131(16.1)	52(39.7)	79(60.3)	126(96.2)	48(38.1)	78(61.9)	5(3.8)	4(80.0)	1(20.0)
M3	175(21.5)	73(41.7)	102(58.3)	162(92.6)	65(40.1)	97(59.9)	13(7.4)	8(61.5)	5(38.5)
M4	152(18.8)	55(36.2)	97(63.8)	152(100.0)	55(36.2)	97(63.8)	-	-	-
M5	147(18.1)	56(38.1)	91(61.9)	141(95.9)	53(37.6)	88(62.4)	6(4.1)	3(50.0)	3(50.0)
M6	115(14.1)	43(37.4)	72(62.6)	112(97.4)	41(36.6)	71(63.4)	3(2.6)	2(66.7)	1(33.3)
Total	813(100.0)	317(39.0)	496(61.0)	784(96.4)	299(38.1)	485(61.9)	29(3.6)	18(62.1)	11(37.9)

[a] % of total subjects, [b] % of subjects in each level and [c] questionnaires

Table 4.16 Sodium knowledge of total subjects

Questions	Pre-Total (n=784)			Post-Total (n=784)		
	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])	correct answer n^{k3}(% [a])	males n^{k3} (% [b])	females n^{k4} (% [b])
1.What is atomic number of sodium?	431(55.0)	163(37.8)	268 (62.2)	593(75.6)	230(38.8)	363(61.2)
2.What is atomic weight of sodium?	312(39.8)	97(31.1)	215(68.9)	455(58.0)	165(36.3)	290(63.7)
3. What group is sodium in the periodic table?	530(67.6)	185(34.9)	345(65.1)	716(91.3)	268(37.4)	448(62.6)
4. What is chemical formula of table salt?	604(77.0)	229(37.9)	375(62.1)	746(95.2)	285(38.2)	461(61.8)
5. How much does a teaspoon of salt weigh?	289(36.9)	119(41.2)	170(58.8)	566(72.2)	207(36.6)	359(63.4)
6. How much does sodium of a teaspoon salt weigh?	376(48.0)	142(37.8)	234(62.2)	568(72.4)	201(35.4)	367(64.6)
7. Which item is all high sodium foods?	649(82.8)	248(38.2)	401(61.8)	755(96.3)	287(38.0)	468(62.0)
8. Which item is all low sodium foods?	681(86.9)	256(37.6)	425(62.4)	756(96.4)	287(38.0)	469(62.0)
9. Which plant do have the highest sodium content?	119(15.2)	56(47.1)	63(52.9)	583(74.4)	228(39.1)	355(60.9)
10.Which item of 100 gram seasoning do have the highest sodium content?	448(57.1)	154(34.4)	294(65.6)	449(57.3)	166(37.0)	283(63.0)

[a] % of total subjects, [b] % of subjects with the correctly answer
Significant different from pre-test [k3] $p < 0.005$ and [k4] $p < 0.02$

Table 4.17 Sodium knowledge of 379 M.1-M.3 subjects

Questions	Pre-M1-M 3 (n= 379)			Post-M1-M 3 (n= 379)		
	correct answer	males	females	correct answer	males	females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n [k2] (% [a])*	*n [k3] (% [b])*	*n [k2] (% [b])*
1.What is atomic number of sodium?	98(25.9)	46(46.9)	52(53.1)	231(60.9)	95(41.1)	136(58.9)
2.What is atomic weight of sodium?	95(25.1)	35(36.8)	60(63.2)	127(33.5)	47(37.0)	80(63.0)
3. What group is sodium in the periodic table?	160(42.2)	59(36.9)	101(63.1)	331(87.3)	131(39.6)	200(60.4)
4. What is chemical formula of table salt?	244(64.4)	96(39.3)	148(60.7)	347(91.6)	138(39.8)	209(60.2)
5. How much does a teaspoon of salt weigh?	135(35.6)	57(42.2)	78(57.8)	284(74.9)	112(39.4)	172(60.6)
6. How much does sodium of a teaspoon salt weigh?	181(47.8)	65(35.9)	116(64.1)	273(72.0)	96(35.2)	177(64.8)
7. Which item is all high sodium foods?	307(81.0)	122(39.7)	185(60.3)	365(96.3)	146(40.0)	219(60.0)
8. Which item is all low sodium foods?	315(83.1)	118(37.5)	197(62.5)	366(96.6)	145(39.6)	221(60.4)
9. Which plant do have the highest sodium content?	68(17.9)	32(47.1)	36(52.9)	296(78.1)	125(42.2)	171(57.8)
10.Which item of 100 gram seasoning do have the highest sodium content?	209(55.1)	78(37.3)	131(62.7)	216(57.0)	85(39.4)	131(60.6)

[a] % of total subjects, [b] % of subjects with the correctly answer
Significant different from pre-test [k2] $p < 0.002$ and [k3] $p < 0.005$

Table 4.18 Sodium knowledge of 405 M.4-M.6 subjects

Questions	Pre-M4-M 6 (n= 405)			Post-M4-M 6 (n= 405)		
	correct answer	males	females	correct answer	males	females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* [k4] (% [a])	*n* [k4] (% [b])	*n* [k4] (% [b])
1.What is atomic number of sodium?	333(82.2)	117(35.1)	216(64.9)	362(89.4)	135(37.3)	227(62.7)
2.What is atomic weight of sodium?	217(53.6)	62(28.6)	155(71.4)	328(81.0)	118(36.0)	210(64.0)
3. What group is sodium in the periodic table?	370(91.4)	126(34.1)	244(65.9)	385(95.1)	137(35.6)	248(64.4)
4. What is chemical formula of table salt?	360(88.9)	133(36.9)	227(63.1)	399(98.5)	147(36.8)	252(63.2)
5. How much does a teaspoon of salt weigh?	154(38.0)	62(40.3)	92(59.7)	282(69.6)	95(33.7)	187(66.3)
6. How much does sodium of a teaspoon salt weigh?	195(48.1)	77(39.5)	118(60.5)	295(72.8)	105(35.6)	190(64.4)
7. Which item is all high sodium foods?	342(84.4)	126(36.8)	216(63.2)	390(96.3)	141(36.2)	249(63.8)
8. Which item is all low sodium foods?	366(90.4)	138(37.7)	228(62.3)	390(96.3)	142(36.4)	248(63.6)
9. Which plant do have the highest sodium content?	51(12.6)	24(47.1)	27(52.9)	287(70.9)	103(35.9)	184(64.1)
10.Which item of 100 gram seasoning do have the highest sodium content?	239(59.0)	76(31.8)	163(68.2)	233(57.5)	81(34.8)	152(65.2)

[a] % of total subjects, [b] % of subjects with the correctly answer
Significant different from pre-test, [k4] $p < 0.02$

Table 4.19 Sodium and health of total subjects

Questions	Pre-Total (n=784)			Post-Total (n=784)		
	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])	correct answer *n* [k5] (% [a])	males *n* [k5] (% [b])	females *n* (% [b])
1.Which one is not the sodium function in the body?	243(31.0)	89(36.6)	154(63.4)	453(57.8)	176(38.9)	277(61.1)
2. How much sodium recommended per day?	491(62.6)	180(36.7)	311(63.3)	724(92.3)	274(37.8)	450(62.2)
3. Sodium excretion through many organs, except?	713(90.9)	275(38.6)	438(61.4)	754(96.2)	284(37.7)	470(62.3)
4. Which substance is used to replace for salty taste?	656(83.7)	239(36.4)	417(63.6)	392(50.0)	155(39.5)	237(60.5)
5. What to drink when you have severe diarrhea?	743(94.8)	275(37.0)	468(63.0)	764(97.4)	284(37.2)	480(62.8)
6. Which sign or symptom caused by high sodium?	151(19.3)	52(34.4)	99(65.6)	414(52.8)	141(34.1)	273(65.9)
7. Which sign or symptom caused by low sodium?	365(46.6)	137(37.5)	228(62.5)	492(62.8)	186(37.8)	306(62.2)
8. Which disease caused by high sodium intake?	677(86.4)	252(37.2)	425(62.8)	726(92.6)	274(37.7)	452(62.3)
9. Which kind of meats can cause high blood pressure?	267(34.1)	103(38.6)	164(61.4)	542(69.1)	211(38.9)	331(61.1)
10. We can assess sodium intake by several methods, except?	100(12.8)	36(36.0)	64(64.0)	345(44.0)	127(36.8)	218(63.2)

[a] % of total subjects, [b] % of subjects with the correctly answer
Significant different from pre-test, [k5] $p < 0.05$

Table 4.20 Sodium and health of 379 M.1-M.3 subjects

Questions	Pre-M1-M 3 (n= 379)			Post-M1-M 3 (n= 379)		
	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])	correct answer n^{k5} (% [a])	males n^{k5} (% [b])	females n^{k5} (% [b])
1.Which one is not the sodium function in the body?	99(26.1)	37(37.4)	62(62.6)	210(55.4)	78(37.1)	132(62.9)
2. How much sodium recommended per day?	241(63.6)	99(41.1)	142(58.9)	357(94.2)	144(40.3)	213(59.7)
3. Sodium excretion through many organs, except?	340(89.7)	137(40.3)	203(59.7)	369(97.4)	145(39.3)	224(60.7)
4. Which substance is used to replace for salty taste?	328(86.5)	126(38.4)	202(61.6)	199(52.5)	82(41.2)	117(58.8)
5. What to drink when you have severe diarrhea?	351(92.6)	134(38.2)	217(61.8)	365(96.3)	138(37.8)	227(62.2)
6. Which sign or symptom caused by high sodium?	61(16.1)	21(34.4)	40(65.6)	200(52.8)	76(38.0)	124(62.0)
7. Which sign or symptom caused by low sodium?	170(44.9)	60(35.3)	110(64.7)	269(71.0)	98(36.4)	171(63.6)
8. Which disease caused by high sodium intake?	323(85.2)	129(39.9)	194(60.1)	343(90.5)	131(38.2)	212(61.8)
9. Which kind of meats can cause high blood pressure?	118(31.1)	40(33.9)	78(66.1)	289(76.3)	114(39.4)	175(60.6)
10. We can assess sodium intake by several methods, except?	46(12.1)	16(34.8)	30(65.2)	199(52.5)	79(39.7)	120(60.3)

[a] % of total subjects, [b] % of subjects with the correctly answer
Significant different from pre-test, [k5] $p < 0.05$

Table 4.21 Sodium and health of 405 M.4-M.6 subjects

Questions	Pre-M4-M 6 (n= 405)			Post-M4-M 6 (n= 405)		
	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])
1.Which one is not the sodium function in the body?	144(35.6)	52(36.1)	92(63.9)	243(60.0)	98(40.3)	145(59.7)
2. How much sodium recommended per day?	250(61.7)	81(32.4)	169(67.6)	367(90.6)	130(35.4)	237(64.6)
3. Sodium excretion through many organs, except?	373(92.1)	138(37.0)	235(63.0)	385(95.1)	139(36.1)	246(63.9)
4. Which substance is used to replace for salty taste?	328(81.0)	113(34.5)	215(65.5)	193(47.7)	73(37.8)	120(62.2)
5. What to drink when you have severe diarrhea?	392(96.8)	141(36.0)	251(64.0)	399(98.5)	146(36.6)	253(63.4)
6. Which sign or symptom caused by high sodium?	90(22.2)	31(34.4)	59(65.6)	214(52.8)	65(30.4)	149(69.6)
7. Which sign or symptom caused by low sodium?	195(48.1)	77(39.5)	118(60.5)	223(55.1)	88(39.5)	135(60.5)
8. Which disease caused by high sodium intake?	354(87.4)	123(34.7)	231(65.3)	383(94.6)	143(37.3)	240(62.7)
9. Which kind of meats can cause high blood pressure?	149(36.8)	63(42.3)	86(57.7)	253(62.5)	97(38.3)	156(61.7)
10. We can assess sodium intake by several methods, except?	54(13.3)	20(37.0)	34(63.0)	146(36.0)	48(32.9)	98(67.1)

[a] % of total subjects, [b] % of subjects with the correctly answer

Table 4.22 Sodium and food behavior of total subjects I

Questions	Pre-Total (n=784)			Post-Total (n=784)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
1. Do you dip salt and chili when you eat sour fruits?						
- Never	116(14.8)	53(45.7)	63(54.3)	162(20.7)	75(46.3)	87(53.7)
- Sometime	581(74.1)	217(37.3)	364(62.7)	565(72.1)	208(36.8)	357(63.2)
- Always	87(11.1)	29(33.3)	58(66.7)	57(7.2)	16(28.1)	41(71.9)
2. Do you add fish sauce when you eat noodle?						
- Never	176(22.4)	70(39.8)	106(60.2)	203(25.9)	75(36.9)	128(63.1)
- Sometime	343(43.8)	118(34.4)	225(65.6)	343(43.8)	136(39.7)	207(60.3)
- Always	265(33.8)	111(41.9)	154(58.1)	238(30.3)	88(37.0)	150(63.0)
3. How much fish sauce do you add to your noodles?						
- Never	172(21.9)	68(39.5)	104(60.5)	193(24.6)	72(37.3)	121(62.7)
- <1 teaspoon	121(15.4)	35(28.9)	86(71.1)	133(17.0)	48(36.1)	85(63.9)
- ≤1.5 teaspoons	254(32.4)	91(35.8)	163(64.2)	245(31.3)	87(35.5)	158(64.5)
- ≤2.5 teaspoons	170(21.7)	78(45.9)	92(54.1)	157(20.0)	61(38.9)	96(61.1)
- >2.5 teaspoons	67(8.6)	27(40.3)	40(59.7)	56(7.1)	31(55.4)	25(44.6)
4. How do you eat your noodle soup?						
- Never	28(3.6)	12(42.9)	16(57.1)	44(5.6)	19(43.2)	25(56.8)
- some soup	667(85.1)	244(36.6)	423(63.4)	669(85.3)	241(36.0)	428(64.0)
- whole noodle soup	89(11.3)	43(48.3)	46(51.7)	71(9.1)	39(54.9)	32(45.1)
5. Do you dip sauce when you eat meat ball, sausage?						
- Never	33(4.2)	12(36.4)	21(63.6)	57(7.3)	21(36.8)	36(63.2)
- Small dip	468(59.7)	175(37.4)	293(62.6)	531(67.7)	210(39.5)	321(60.5)
- Big dip	283(36.1)	112(39.6)	171(60.4)	196(25.0)	68(34.7)	128(65.3)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.22 Sodium and food behavior of total subjects II (cont.)

Questions	Pre-Total (n=784)			Post-Total (n=784)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?						
- Never	74(9.4)	27(36.5)	47(63.5)	129(16.5)	60(46.5)	69(53.5)
- ≤1 teaspoons	155(19.8)	59(38.1)	96(61.9)	195(24.9)	76(39.0)	119(61.0)
- ≤2 teaspoons	324(41.3)	122(37.7)	202(62.3)	284(36.2)	89(31.3)	195(68.7)
- >2 teaspoons	231(29.5)	91(39.4)	140(60.6)	176(22.4)	74(42.0)	102(58.0)
7. Which taste would you like ?						
- Sweet	246(31.4)	95(38.6)	151(61.4)	260(33.2)	98(37.7)	162(62.3)
- Salty	213(27.2)	95(44.6)	118(55.4)	171(21.8)	79(46.2)	92(53.8)
- Sour	325(41.4)	109(33.5)	216(66.5)	353(45.0)	122(34.6)	231(65.4)
8. Which snack would you like ?						
- Crispy snack	335(42.7)	112(33.4)	223(66.6)	348(44.4)	116(33.3)	232(66.7)
- Dessert	138(17.6)	62(44.9)	76(55.1)	128(16.3)	51(39.8)	77(60.2)
- Bread	311(39.7)	125(40.2)	186(59.8)	308(39.3)	132(42.9)	176(57.1)
9. After exercise, which beverage would you drink?						
- Water	746(95.2)	278(37.3)	468(62.7)	733(93.5)	272(37.1)	461(62.9)
- carbonated beverage	19(2.4)	10(52.6)	9(47.4)	15(1.9)	9(60.0)	6(40.0)
-sport drink	19(2.4)	11(57.9)	8(42.1)	36(4.6)	18(50.0)	18(50.0)
10. Which mango do you flavor?						
- Fresh mango	741(94.5)	275(37.1)	466(62.9)	744(94.9)	282(37.9)	462(62.1)
- Pickled mango	43(5.5)	24(55.8)	19(44.2)	40(5.1)	17(42.5)	23(57.5)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.22 Sodium and food behavior of total subjects III (cont.)

Questions	Pre-Total (n=784)			Post-Total (n=784)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
11. How often did you eat dried fruits?						
-Never	266(33.9)	126(47.4)	140(52.6)	290(37.0)	130(44.8)	160(55.2)
- 1 time/week	477(60.8)	161(33.8)	316(66.2)	448(57.1)	153(34.2)	295(65.8)
- 2-3 times /week	38(4.9)	10(26.3)	28(73.7)	44(5.6)	15(34.1)	29(65.9)
- ≥ 4 times /week	3(0.4)	2(66.7)	1(33.3)	2(0.3)	1(50.0)	1(50.0)
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?						
- Never	10(1.3)	6(60.0)	4(40.0)	20(2.6)	13(65.0)	7(35.0)
- 1 time/week	254(32.4)	102(40.2)	152(59.8)	299(38.1)	130(43.5)	169(56.5)
- 2-3 times /week	425(54.2)	161(37.9)	264(62.1)	382(48.7)	131(34.3)	251(65.7)
- ≥ 4 times /week	95(12.1)	30(31.6)	65(68.4)	83(10.6)	25(30.1)	58(69.9)
13. How often did you eat the following bakery (cake, pancake, and bread) ?						
- Never	9(1.1)	6(66.7)	3(33.3)	24(3.1)	14(58.3)	10(41.7)
- 1 time/week	210(26.8)	81(38.6)	129(61.4)	268(34.2)	102(38.1)	166(61.9)
- 2-3 times /week	421(53.7)	153(36.3)	268(63.7)	369(47.0)	129(35.0)	240(65.0)
- ≥ 4 times /week	144(18.4)	59(41.0)	85(59.0)	123(15.7)	54(43.9)	69(56.1)
14. How often did you eat the following meat products (meat ball, sausage) ?						
- Never	15(1.9)	9(60.0)	6(40.0)	27(3.4)	18(66.7)	9(33.3)
- 1 time/week	273(34.8)	111(40.7)	162(59.3)	289(36.9)	106(36.7)	183(63.3)
- 2-3 times /week	406(51.8)	153(37.7)	253(62.3)	377(48.1)	151(40.1)	226(59.9)
- ≥ 4 times /week	90(11.5)	26(28.9)	64(71.1)	91(11.6)	24(26.4)	67(73.6)
15. How often did you eat salted peanuts.						
- Never	179(22.9)	70(39.1)	109(60.9)	209(26.7)	89(42.6)	120(57.4)
- 1 time/week	505(64.4)	188(37.2)	317(62.8)	484(61.7)	178(36.8)	306(63.2)
- 2-3 times /week	95(12.1)	38(40.0)	57(60.0)	85(10.8)	29(34.1)	56(65.9)
- ≥ 4 times /week	5(0.6)	3(60.0)	2(40.0)	6(0.8)	3(50.0)	3(50.0)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.23 Sodium and food behavior of 379 M.1-M.3 subjects I

Questions	Pre-M1-M3 (n=379)			Post-M1-M3 (n=379)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
1. Do you dip salt and chili when you eat sour fruits?						
- Never	51(13.5)	25(49.0)	26(51.0)	80(21.1)	33(41.3)	47(58.8)
- Sometime	292(77.0)	111(38.0)	181(62.0)	283(74.7)	112(39.6)	171(60.4)
- Always	36(9.5)	14(38.9)	22(61.1)	16(4.2)	5(31.3)	11(68.8)
2. Do you add fish sauce when you eat noodle?						
- Never	90(23.7)	37(41.1)	53(58.9)	118(31.1)	43(36.4)	75(63.6)
- Sometime	183(48.3)	65(35.5)	118(64.5)	171(45.1)	69(40.4)	102(59.6)
- Always	106(28.0)	48(45.3)	58(54.7)	90(23.8)	38(42.2)	52(57.8)
3. How much fish sauce do you add to your noodles?						
- Never	88(23.2)	35(39.8)	53(60.2)	113(29.8)	42(37.2)	71(62.8)
- <1 teaspoon	59(15.6)	18(30.5)	41(69.5)	52(13.7)	21(40.4)	31(59.6)
- ≤1.5 teaspoons	120(31.6)	44(36.7)	76(63.3)	120(31.7)	39(32.5)	81(67.5)
- ≤2.5 teaspoons	78(20.6)	39(50.0)	39(50.0)	66(17.4)	30(45.5)	36(54.5)
- >2.5 teaspoons	34(9.0)	14(41.2)	20(58.8)	28(7.4)	18(64.3)	10(35.7)
4. How do you eat your noodle soup?						
- Never	10(2.6)	4(40.0)	6(60.0)	17(4.5)	7(41.2)	10(58.8)
- some soup	329(86.8)	121(36.8)	208(63.2)	338(89.2)	125(37.0)	213(63.0)
- whole noodle soup	40(10.6)	25(62.5)	15(37.5)	24(6.3)	18(75.0)	6(25.0)
5. Do you dip sauce when you eat meat ball, sausage?						
- Never	16(4.2)	6(37.5)	10(62.5)	27(7.2)	12(44.4)	15(55.6)
- Small dip	228(60.2)	92(40.4)	136(59.6)	267(70.4)	108(40.4)	159(59.6)
- Big dip	135(35.6)	52(38.5)	83(61.5)	85(22.4)	30(35.3)	55(64.7)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.23 Sodium and food behavior of 379 M.1-M.3 subjects II (cont.)

Questions	Pre-M1-M3 (n=379)			Post-M1-M3 (n=379)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?						
- Never	36(9.5)	15(41.7)	21(58.3)	66(17.4)	36(54.5)	30(45.5)
- ≤1 teaspoons	91(24.0)	37(40.7)	54(59.3)	104(27.4)	40(38.5)	64(61.5)
- ≤2 teaspoons	152(40.1)	57(37.5)	95(62.5)	131(34.6)	42(32.1)	89(67.9)
- >2 teaspoons	100(26.4)	41(41.0)	59(59.0)	78(20.6)	32(41.0)	46(59.0)
7. Which taste would you like ?						
- Sweet	119(31.4)	44(37.0)	75(63.0)	120(31.7)	47(39.2)	73(60.8)
- Salty	110(29.0)	51(46.4)	59(53.6)	76(20.0)	39(51.3)	37(48.7)
- Sour	150(39.6)	55(36.7)	95(63.3)	183(48.3)	64(35.0)	119(65.0)
8. Which snack would you like ?						
- Crispy snack	151(39.8)	50(33.1)	101(66.9)	164(43.3)	57(34.8)	107(65.2)
- Dessert	61(16.1)	28(45.9)	33(54.1)	58(15.3)	26(44.8)	32(55.2)
- Bread	167(44.1)	72(43.1)	95(56.9)	157(41.4)	67(42.7)	90(57.3)
9. After exercise, which beverage would you drink?						
- Water	362(95.5)	142(39.2)	220(60.8)	357(94.2)	141(39.5)	216(60.5)
- carbonated beverage	8(2.1)	5(62.5)	3(37.5)	2(0.5)	-	2(100.0)
- sport drink	9(2.4)	3(33.3)	6(66.7)	20(5.3)	9(45.0)	11(55.0)
10. Which mango do you flavor?						
- Fresh mango	364(96.0)	140(38.5)	224(61.5)	366(96.6)	146(39.9)	220(60.1)
- Pickled mango	15(4.0)	10(66.7)	5(33.3)	13(3.4)	4(30.8)	9(69.2)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.23 Sodium and food behavior of 379 M.1-M.3 subjects III (cont.)

Questions	Pre-M1-M3 (n=379)			Post-M1-M3 (n=379)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
11. How often did you eat dried fruits?						
-Never	142(37.5)	69(48.6)	73(51.4)	159(42.0)	81(50.9)	78(49.1)
- 1 time/week	213(56.2)	75(35.2)	138(64.8)	195(51.5)	60(30.8)	135(69.2)
- 2-3 times /week	23(6.1)	6(26.1)	17(73.9)	25(6.6)	9(36.0)	16(64.0)
- ≥ 4 times /week	1(0.2)	-	1(100.0)	-	-	-
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?						
- Never	2(0.5)	1(50.0)	1(50.0)	10(2.6)	8(80.0)	2(20.0)
- 1 time/week	123(32.5)	50(40.7)	73(59.3)	136(35.9)	54(39.7)	82(60.3)
- 2-3 times /week	206(54.4)	87(42.2)	119(57.8)	193(50.9)	75(38.9)	118(61.1)
- ≥ 4 times /week	48(12.6)	12(25.0)	36(75.0)	40(10.6)	13(32.5)	27(67.5)
13. How often did you eat the following bakery (cake, pancake, and bread) ?						
- Never	3(0.8)	2(66.7)	1(33.3)	11(2.9)	5(45.5)	6(54.5)
- 1 time/week	87(23.0)	32(36.8)	55(63.2)	120(31.7)	54(45..0)	66(55.0)
- 2-3 times /week	215(56.7)	86(40.0)	129(60.0)	182(48.0)	63(34.6)	119(65.4)
- ≥ 4 times /week	74(19.5)	30(40.5)	44(59.5)	66(17.4)	28(42.4)	38(57.6)
14. How often did you eat the following meat products (meat ball, sausage) ?						
- Never	5(1.3)	3(60.0)	2(40.0)	16(4.2)	12(75.0)	4(25.0)
- 1 time/week	113(29.8)	53(46.9)	60(53.1)	112(29.6)	48(42.9)	64(57.1)
- 2-3 times /week	205(54.1)	78(38.0)	127(62.0)	192(50.7)	76(39.6)	116(60.4)
- ≥ 4 times /week	56(114.8)	16(28.6)	40(71.4)	59(15.5)	14(23.7)	45(76.3)
15. How often did you eat salted peanuts.						
- Never	89(23.5)	37(41.6)	52(58.4)	110(29.0)	63(57.3)	47(42.7)
- 1 time/week	249(65.7)	96(38.6)	153(61.4)	221(58.4)	68(30.8)	153(69.2)
- 2-3 times /week	40(10.6)	17(42.5)	23(57.5)	46(12.1)	19(41.3)	27(58.7)
- ≥ 4 times /week	1(0.2)	-	1(100.0)	2(0.5)	-	2(100.0)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.24 Sodium and food behavior of 405 M.4-M.6 subjects I

Questions	Pre-M4-M6 (n=405)			Post-M4-M6 (n=405)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
1. Do you dip salt and chili when you eat sour fruits?						
- Never	65(16.0)	28(43.1)	37(56.9)	82(20.3)	42(51.2)	40(48.8)
- Sometime	289(71.4)	106(36.7)	183(63.3)	282(69.6)	96(34.0)	186(66.0)
- Always	51(12.6)	15(29.4)	36(70.6)	41(10.1)	11(26.8)	30(73.2)
2. Do you add fish sauce when you eat noodle?						
- Never	86(21.2)	33(38.4)	53(61.6)	85(21.0)	32(37.6)	53(62.4)
- Sometime	160(39.5)	53(33.1)	107(66.9)	172(42.5)	67(39.0)	105(61.0)
- Always	159(39.3)	63(39.6)	96(60.4)	148(36.5)	50(33.8)	98(66.2)
3. How much fish sauce do you add to your noodles?						
- Never	84(20.8)	33(39.3)	51(60.7)	80(19.8)	30(37.5)	50(62.5)
- <1 teaspoon	62(15.3)	17(27.4)	45(72.6)	81(20.0)	27(33.3)	54(66.7)
- ≤1.5 teaspoons	134(33.1)	47(35.1)	87(64.9)	125(30.9)	48(38.4)	77(61.6)
- ≤2.5 teaspoons	92(22.7)	39(42.4)	53(57.6)	91(22.5)	31(34.1)	60(65.9)
- >2.5 teaspoons	33(8.1)	13(39.4)	20(60.6)	28(6.8)	13(46.4)	15(53.6)
4. How do you eat your noodle soup?						
- Never	18(4.4)	8(44.4)	10(55.6)	27(6.7)	12(44.4)	15(55.6)
- some soup	338(83.5)	123(36.4)	215(63.6)	331(81.7)	116(35.0)	215(65.0)
- whole noodle soup	49(12.1)	18(36.7)	31(63.3)	47(11.6)	21(44.7)	26(55.3)
5. Do you dip sauce when you eat meat ball, sausage?						
- Never	17(4.2)	6(35.3)	11(64.7)	30(7.4)	9(30.0)	21(70.0)
- Small dip	240(59.3)	83(34.6)	157(65.4)	264(65.2)	102(38.6)	162(61.4)
- Big dip	148(36.5)	60(40.5)	88(59.5)	111(27.4)	38(34.2)	73(65.8)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.24 Sodium and food behavior of 405 M.4-M.6 subjects II (cont.)

Questions	Pre-M4-M 6 (n= 405)			Post-M4-M 6 (n= 405)		
	Total *n* (% [a])	Males *n* (% [b])	Females *n* (% [b])	Total *n* (% [a])	Males *n* (% [b])	Females *n* (% [b])
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?						
- Never	38(9.4)	12(31.6)	26(68.4)	63(15.6)	24(38.1)	39(61.9)
- ≤1 teaspoons	64(15.8)	22(34.4)	42(65.6)	91(22.5)	36(39.6)	55(60.4)
- ≤2 teaspoons	172(42.5)	65(37.8)	107(62.2)	153(37.8)	47(30.7)	106(69.3)
- >2 teaspoons	131(32.3)	50(38.2)	81(61.8)	98(24.1)	42(42.9)	56(57.1)
7. Which taste would you like ?						
- Sweet	127(31.4)	51(40.2)	76(59.8)	140(34.5)	51(36.4)	89(63.6)
- Salty	103(25.4)	44(42.7)	59(57.3)	95(23.5)	40(42.1)	55(57.9)
- Sour	175(43.2)	54(30.9)	121(69.1)	170(42.0)	58(34.1)	112(65.9)
8. Which snack would you like ?						
- Crispy snack	184(45.4)	62(33.7)	122(66.3)	184(45.4)	59(32.1)	125(67.9)
- Dessert	77(19.0)	34(44.2)	43(55.8)	70(17.3)	25(35.7)	45(64.3)
- Bread	144(35.6)	53(36.8)	91(63.2)	151(37.3)	65(43.0)	86(57.0)
9. After exercise, which beverage would you drink?						
- Water	384(94.8)	136(35.4)	248(64.6)	376(92.8)	131(34.8)	245(65.2)
- carbonated beverage	11(2.7)	5(45.5)	6(54.5)	13(3.2)	9(69.2)	4(30.8)
- sport drink	10(2.5)	8(80.0)	2(20.0)	16(4.0)	9(56.2)	7(43.8)
10. Which mango do you flavor?						
- Fresh mango	377(93.1)	135(35.8)	242(64.2)	378(93.3)	136(36.0)	242(64.0)
- Pickled mango	28(6.9)	14(50.0)	14(50.0)	27(6.7)	13(48.1)	14(51.9)

[a] % of total subjects, [b] % of total subjects in each question

Table 4.24 Sodium and food behavior of 405 M.4-M.6 subjects III (cont.)

Questions	Pre-M4-M 6 (n= 405)			Post-M4-M 6 (n= 405)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
11. How often did you eat dried fruits?						
-Never	124(30.6)	57(46.0)	67(54.0)	131(32.3)	49(37.4)	82(62.6)
- 1 time/week	264(65.2)	86(32.6)	178(67.4)	253(62.5)	93(36.8)	160(63.2)
- 2-3 times /week	15(3.7)	4(26.7)	11(73.3)	19(4.7)	6(31.6)	13(68.4)
- ≥ 4 times /week	2(0.5)	2(100.0)	-	2(0.5)	1(50.0)	1(50.0)
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?						
- Never	8(2.0)	5(62.5)	3(37.5)	10(2.5)	5(50.0)	5(50.0)
- 1 time/week	131(32.3)	52(39.7)	79(60.3)	163(40.2)	76(46.6)	87(53.4)
- 2-3 times /week	219(54.1)	74(33.8)	145(66.2)	189(46.7)	56(29.6)	133(70.4)
- ≥ 4 times /week	47(11.6)	18(38.3)	29(61.7)	43(10.6)	12(27.9)	31(72.1)
13. How often did you eat the following bakery (cake, pancake, and bread) ?						
- Never	6(1.5)	4(66.7)	2(33.3)	13(3.2)	9(69.2)	4(30.8)
- 1 time/week	123(30.4)	49(39.8)	74(60.2)	148(36.5)	48(32.4)	100(67.6)
- 2-3 times /week	206(50.9)	67(32.5)	139(67.5)	187(46.2)	66(35.3)	121(64.7)
- ≥ 4 times /week	70(17.2)	29(41.4)	41(58.6)	57(14.1)	26(45.6)	31(54.4)
14. How often did you eat the following meat products (meat ball, sausage) ?						
- Never	10(2.5)	6(60.0)	4(40.0)	11(2.7)	6(54.5)	5(45.5)
- 1 time/week	160(39.5)	58(36.2)	102(63.8)	177(43.7)	58(32.8)	119(67.2)
- 2-3 times /week	201(49.6)	75(37.3)	126(62.7)	185(45.7)	75(40.5)	110(59.5)
- ≥ 4 times /week	34(8.4)	10(29.4)	24(70.6)	32(7.9)	10(31.2)	22(68.8)
15. How often did you eat salted peanuts.						
- Never	90(22.2)	33(36.7)	57(63.3)	99(24.5)	26(26.3)	73(73.7)
- 1 time/week	256(63.2)	92(35.9)	164(64.1)	263(64.9)	110(41.8)	153(58.2)
- 2-3 times /week	55(13.6)	21(38.2)	34(61.8)	39(9.6)	10(25.6)	29(74.4)
- ≥ 4 times /week	4(1.0)	3(75.0)	1(25.0)	4(1.0)	3(75.0)	1(25.0)

[a] % of total subjects, [b] % of total subjects in each question

21 obese subjects

Obese subjects were 15 males and 6 females with age range of 12-18 years, mean BMI of 27.6 $\pm$ 4.3 kg/m^2, and mean body fat of 35.3 $\pm$ 10.6 (% bw).

4.6 Nutritional therapy on nutritional status

4.6.1 Body composition

Mean (±SD) of age and body composition parameters of 21 obese subjects during the study are shown in **Table 4.25**. The mean height at the end of study was significantly higher than those at the week 0.

Their means BMI at weeks 16, 24, and 32 decreased significantly after receiving the nutritional therapy. At week 16 their means BMI was significantly lower than those at weeks 24 and 32. Range of weight reduction during 32 weeks of study was -0.3 to -12.6 kg (0.4% to 17.0% of mean body weight at week 0). In 15 obese male subjects, range of weight reduction was -0.3 to -12.6 kg (0.4% to 17.0% of mean body weight at week 0) and in 6 obese female subjects, range of weight reduction was -2.6 to -7.9kg (3.5% to 10.6% of mean body weight at week 0) **(Table 4.25 I)**.

Their mean body fat (%bw) at week 24 decreased significantly after receiving the nutritional therapy from that at week 16, whereas at week 32 decreased significantly from that at weeks 0, 16, and 24. At the end of study at week 32 their mean body fat (%bw) was lowest during the study. Range of body fat (%bw) reduction during 32 weeks of study was -1.8% to -15.1%bw (5.1% to 42.5% of their percentage body fat at week 0). In 15 obese male subjects, range of body fat (%bw) reduction was -2.3% to -15.1%bw (7.0% to 45.9% of their percentage body fat at week 0) and in 6 obese female subjects, range of body fat (%bw) reduction was -1.8% to -5.7%bw (4.4% to 13.8% of their percentage body fat at week 0) **(Table 4.25 II)**.

Their mean muscle mass at week 24 increased significantly after receiving the nutritional therapy from that at week 16, whereas at week 32 increased significantly from that at weeks 0, 16, and 24. At the end of study at week 32 their mean muscle mass was highest during the study. Range of increased muscle mass

during 32 weeks of study was 0.1 to 11.2 kg (0.2% to 25.3% of mean muscle mass at week 0). In 15 obese male subjects, range of increased muscle mass was 1.2 to 11.2 kg (2.6% to 24.5% of mean muscle mass at week 0) and in 6 obese female subjects, range of increased muscle mass was 0.1 to 1.7kg (0.2% to 4.2% of mean muscle mass at week 0) **(Table 4.25 III).**

Table 4.26 shows BMI and body fat status of 21 obese subjects during the study. At the baseline, the subjects had at risk of overweight (19.0%) and overweight (81.0%). Percentage of body fat at the baseline, the subjects had over body fat (47.6%) and excess body fat (52.4%). In this study we classified 21 obese subjects from body fat (%bw) (42), therefore 21 obese subjects had over body fat and excess body fat were 100%, whereas subjects had only overweight were 81.0%.

During the study, percentage of normal body fat subjects at weeks 0, 16, 24, and 32 were 0%, 14.3%, 19.1%, and 42.8%, respectively. Percentage of over body fat subjects at weeks 0, 16, 24, and 32 were 47.6%, 19.0%, 33.3%, and 33.3%, respectively. Percentage of excess body fat subjects at weeks 0, 16, 24, and 32 were 52.4%, 66.7%, 47.6%, and 23.8%, respectively.

After receiving the nutritional therapy, at week 32, 9 of 21 (42.8%) obese subjects had become normal body fat, percentage of over body fat subjects had decreased from 47.6% to 33.3%, and percentage of excess body fat subjects had decreased from 52.4% to 23.8%.

Table 4.25 Means (±SD) of age and body composition parameters of 21 obese subjects classified by sex I

Parameters		Obesity (n=21)		
		Total (n=21)	Males (n=15)	Females (n=6)
Age (y) range	(wk0)	12 – 18	12 – 16	12 – 18
	(wk32)	13 – 19	13 – 16	13 – 19
Height (cm)	(wk0)	163.4 ± 8.3	165.1 ± 8.9	159.2 ± 4.6
	(wk32)	165.1 ± 7.8^{k2}	167.5 ± 7.7^{k2}	159.3 ± 4.3^{l5}
Weight (kg)	(wk0)	74.2 ± 15.1	74.1 ± 16.5	74.5 ± 12.0
	(wk16)	70.4 ± 12.9^{k2}	70.2 ± 13.2^{k4}	71.0 ± 13.3^{k5}
	(wk24)	71.9 ± 12.5^{k5,m4}	72.0 ± 13.1 ^{m1}	71.6 ± 12.0
	(wk32)	72.2 ± 13.4 ^{m4}	72.4 ± 13.8 ^{m5}	71.8 ± 13.7
BMI (kg/m^2)	(wk0)	27.6 ± 4.3	27.0 ± 4.3	29.4 ± 4.1
	(wk16)	26.3 ± 3.7^{k1}	25.6 ± 3.1^{k4}	28.0 ± 4.8^{k5}
	(wk24)	26.8 ± 3.5$^{k5, m3}$	26.2 ± 3.1 ^{m4}	28.2 ± 4.4
	(wk32)	26.4 ± 4.2^{k4}	25.7 ± 3.7^{k5}	28.2 ± 5.0

Significant difference from week 0, ^{k1} $p < 0.0005$, ^{k2} $p < 0.002$, ^{k3} $p < 0.005$, ^{k4} $p < 0.02$, ^{k5} $p < 0.05$
Significant difference from week 16, ^{m1} $p < 0.0005$, ^{m3} $p < 0.005$, ^{m4} $p < 0.02$, ^{m5} $p < 0.05$
Significant difference from sex, ^{l5} $p < 0.05$

Table 4.25 Means (±SD) of age and body composition parameters of 21 obese subjects classified by sex II (cont.)

Parameters		Obesity (n=21)		
		Total (n=21)	Males (n=15)	Females (n=6)
Body fat (% bw)	(wk0)	35.3 ± 10.6	32.9 ± 11.6	41.3 ± 3.9
	(wk16)	34.5 ± 8.4	31.4 ± 7.8	42.2 ± 3.5^{l3}
	(wk24)	33.3 ± 8.5 ^{m5}	30.5 ± 8.3	40.3 ± 4.1$^{l4, m5}$
	(wk32)	30.2 ± 10.8^{k1,m1,n1}	26.4 ± 10.2^{k2,m1,n1}	39.6 ± 5.3^{l4}
Fat mass (kg)	(wk0)	27.3 ± 14.2	25.8 ± 16.0	31.1 ± 7.8
	(wk16)	24.9 ± 9.9	22.8 ± 9.9	30.3 ± 8.3
	(wk24)	24.5 ± 10.0	22.7 ± 10.4	29.2 ± 7.7
	(wk32)	22.6 ± 11.7^{k3,m2,n3}	20.1 ± 11.8^{k4,m4,n3}	29.0 ± 9.6
Fat free mass (kg)	(wk0)	46.9 ± 7.6	48.3 ± 8.2	43.4 ± 5.1
	(wk16)	45.5 ± 6.9	47.5 ± 6.6	40.6 ± 5.4^{k5,l5}
	(wk24)	47.4 ± 6.9 ^{m1}	49.3 ± 6.7 ^{m3}	42.4 ± 5.1$^{l5, m5}$
	(wk32)	49.6 ± 8.1^{k3,m1,n1}	52.3 ± 7.6^{k1,m1,n1}	42.8 ± 5.1^{l4,m5}

Significant difference from week 0, ^{k1} $p < 0.0005$, ^{k2} $p < 0.002$, ^{k3} $p < 0.005$, ^{k4} $p < 0.02$, ^{k5} $p < 0.05$

Significant difference from week 16, ^{m1} $p < 0.0005$, ^{m2} $p < 0.002$, ^{m3} $p < 0.005$, ^{m4} $p < 0.02$, ^{m5} $p < 0.05$

Significant difference from sex week 24, ^{n1} $p < 0.0005$, ^{n3} $p < 0.005$

Significant difference from sex, ^{l3} $p < 0.005$, ^{l4} $p < 0.02$, ^{l5} $p < 0.05$

Table 4.25 Means (±SD) of age and body composition parameters of 21 obese subjects classified by sex III (cont.)

Parameters		Obesity (n=21)		
		Total (n=21)	Males (n=15)	Females (n=6)
Muscle mass (kg)	(wk0)	44.3 ± 7.2	45.7 ± 7.7	40.7 ± 4.7
	(wk16)	43.0 ± 6.6	45.0 ± 6.2	38.1 ± 5.0^{k5,l5}
	(wk24)	44.7 ± 6.6 ^{m1}	46.7 ± 6.3	39.8 ± 4.7^{l5}
	(wk32)	46.9 ± 7.8^{k3,m1,n1}	49.5 ± 7.2^{k1}	40.2 ± 4.7^{l4}
TBW (kg)	(wk0)	34.3 ± 5.6	35.3 ± 6.0	31.8 ± 3.7
	(wk16)	33.3 ± 5.1	34.8 ± 4.8	29.7 ± 3.9^{k5,l5}
	(wk24)	34.8 ± 5.2 ^{m1}	36.1 ± 4.9	31.6 ± 4.7
	(wk32)	36.2 ± 6.0^{k4,m1,n5}	38.3 ± 5.5^{k1}	30.8 ± 3.3^{l4}
TBW (%bw)	(wk0)	47.3 ± 7.8	49.1 ± 8.5	43.0 ± 2.9
	(wk16)	48.0 ± 6.2	50.2 ± 5.7	42.3 ± 2.6^{l3}
	(wk24)	49.0 ± 6.0 ^{m5}	50.9 ± 6.0	44.3 ± 1.9^{l4}
	(wk32)	51.0 ± 8.2^{k2,m1,n5}	53.9 ± 7.4^{k2}	43.7 ± 5.1^{l4}

Significant difference from week 0, ^{k1} $p < 0.0005$, ^{k2} $p < 0.002$, ^{k3} $p < 0.005$, ^{k4} $p < 0.02$, ^{k5} $p < 0.05$

Significant difference from week 16, ^{m1} $p < 0.0005$, ^{m5} $p < 0.05$

Significant difference from sex week 24, ^{n1} $p < 0.0005$, ^{n5} $p < 0.05$

Significant difference from sex, ^{l3} $p < 0.005$, ^{l4} $p < 0.02$, ^{l5} $p < 0.05$

Table 4.26 Body weight and body fat status of 21 obese subjects

Parameters	Weeks			
	0	16	24	32
	n (% [a])	*n (% [a])*	*n (% [a])*	*n (% [a])*
Normal weight	-	-	-	3(14.3)
At risk of overweight	4(19.0)	6(28.6)	5(23.8)	6(28.6)
Overweight	17(81.0)	15(71.4)	16(76.2)	12(57.1)
Normal body fat	-	3(14.3)	4(19.1)	9(42.8)
Over body fat	10(47.6)	4(19.0)	7(33.3)	7(33.3)
Excess body fat	11(52.4)	14(66.7)	10(47.6)	5(23.8)

[a] % of total 21 obese subject

4.6.2 Blood chemistry

Table 4.27 shows means (±SD) of blood chemistry parameters of 21 obese subjects during the study. Only mean serum uric acid level was significantly decreased from week 0.

At the baseline, 1 case of 21 (4.8%) of obese subjects was anemia, after receiving the nutritional therapy at week 32 she had normal serum hemoglobin level **(Tables 4.28 and 4.30).**

At the baseline, 1 case of 21 (4.8%) of obese subjects had blood sugar 134 mg/dL, it may be due to his obese status, BMI= 39.1kg/m^2, body fat (%bw) = 69.3%, after receiving the nutritional therapy at week 32 he had normal FBS level **(Tables 4.28 and 4.30).**

At the baseline, 19 of 21 (90.5%) of obese subjects were hyperuricemia (38.1% (8/21) borderline, 42.9% (9/21) high, 9.5% (2/21) very high), after receiving the nutritional therapy at week 32, percentage of hyperuricemia decreased from 90.5% (19/21) to 76.2% (16/21), (66.6% (14/21) borderline, 4.8% (1/21) high, 4.8% (1/21) very high) **(Tables 4.28 and 4.30).**

At the baseline, 1 of 21 (4.8%) obese subjects was borderline hypertriglyceridemia (TG=150-199 mg/dL), after receiving the nutritional therapy at week 32 he had normal serum triglyceride level **(Tables 4.29-4.30).**

At the baseline, 23.8% (5/21) of obese subjects had low HDL-cholesterol levels, receiving the nutritional therapy at week 32, percentage of low HDL-cholesterol subjects decreased from 23.8% (5/21) to 19.0% (4/21) **(Tables 4.29-4.30).**

At the baseline, 19.0% (4/21) of obese subjects were borderline hypercholesterolemia, receiving the nutritional therapy at week 32, percentage of borderline and high hypercholesterolemia increased from 19.0% (4/21) to 23.8% (5/21) and 0% to 9.5% (2/21), respectively **(Tables 4.29-4.30).**

Table 4.27 Means (±SD) of blood chemistry parameters of 21 obese subjects classified by sex

Parameters	Week 0			Week 32		
	Total (n=21)	Males (n=15)	Females (n=6)	Total (n=21)	Males (n=15)	Females (n=6)
Hb	13.7 ± 7	14.1 ± 0.7	12.8 ± 0.6 [l2]	14.1 ± 1.1	14.5 ± 1	13.2 ± 0.4 [l4]
FBS	96 ± 11	96 ± 13	97 ± 6	98 ± 7	97 ± 7	99 ± 7
Uric	7.4 ± 1.4	7.4 ± 1.5	7.4 ± 1.2	6.4 ± 1.2[k4]	6.7 ± 1.4	5.8 ± 0.4[k5]
TG	71 ± 34	66 ± 34	84 ± 31	66 ± 23	62 ± 23	74 ± 22
HDL	45 ± 8	42 ± 7	51 ± 8 [l5]	46 ± 8	45 ± 8	48 ± 9
LDL	97 ± 19	94 ± 10	104 ± 18	100 ± 23	96 ± 23	110 ± 19

Significant difference from week 0, [k4] $p < 0.02$, [k5] $p < 0.05$

Significant difference from sex, [l2] $p < 0.002$, [l4] $p < 0.02$, [l5] $p < 0.05$

Table 4.28 Hemoglobin, blood glucose and uric status of the 21 obese subjects classified by sex

Parameters	Week 0			Week 32		
	Total (n=21)	Males (n=15)	Females (n=6)	Total (n=21)	Males (n=15)	Females (n=6)
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
Hb (g/dL)						
Normal (>12g/dL)	20(95.2)	15(75.0)	5(25.0)	21(100.0)	15(71.4)	6(28.6)
Anemia (<12 g/dL)	1(4.8)	-	1(100.0)	-	-	-
FBS (mg/dL)						
Normal (<110 mg/dL)	20(95.2)	14(70.0)	6(30.0)	21(100.0)	15(71.4)	6(28.6)
IFPG (110-125 mg/dL)	-	-	-	-	-	-
DM (>126 mg/dL)	1(4.8)	1(100.0)	-	-	-	-
Uric (mg/dL)						
Normal (≤5.5 mg/dL)	2(9.5)	2(100.0)	-	5(23.8)	3(60.0)	2(40.0)
Borderline (5.6-7.0 mg/dL)	8(38.1)	6(75.0)	2(25.0)	14(66.6)	10(71.4)	4(28.6)
High (7.1-9.0 mg/dL)	9(42.9)	5(55.6)	4(44.4)	1(4.8)	1(100.0)	-
Very high (>9.0 mg/dL)	2(9.5)	2(100.0)	-	1(4.8)	1(100.0)	-

[a] % of total 21 obese subject, [b] % of total subjects in each parameter

Table 4.29 Serum lipid profile status of the 21 obese subjects classified by sex

Parameters		Week 0			Week 32		
		Total (n=21)	Males (n=15)	Females (n=6)	Total (n=21)	Males (n=15)	Females (n=6)
		n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
TG (mg/dL)							
Normal	(<150 mg/dL)	20(95.2)	14(70.0)	6(30.0)	21(100.0)	15(71.4)	6(28.6)
Borderline	(150-199 mg/dL)	1(4.8)	1(100.0)	-	-	-	-
High	(200-499 mg/dL)	-	-	-	-	-	-
HDL (mg/dL)							
Normal	(>40 mg/dL)	16(76.2)	11(68.8)	5(31.2)	17(81.0)	12(70.6)	5(29.4)
Low	(0-40 mg/dL)	5(23.8)	4(80.0)	1(20.0)	4(19.0)	3(75.0)	1(25.0)
LDL (mg/dL)							
Normal	(≤110 mg/dL)	17(81.0)	13(76.5)	4(23.5)	14(66.7)	11(78.6)	3(21.4)
Borderline	(111-130 mg/dL)	4(19.0)	2(50.0)	2(50.0)	5(23.8)	3(60.0)	2(40.0)
High	(> 130 mg/dL)	-	-	-	2(9.5)	1(50.0)	1(50.0)

a % of total 21 obese subjects, b % of total subjects in each parameter

Table 4.30 Percentage of anemia, hyperuricemia, hypertriglyceridemia, and hypercholesterolemia of 21 obese subjects

Parameter	Week 0			Week 32		
	Total (n=21)	Males (n=15)	Females (n=6)	Total (n=21)	Males (n=15)	Females (n=6)
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
Anemia (<12 g/dL)	1(4.8)	-	1(100.0)	-	-	-
High uric (>5.5 mg/dL)	19(90.5)	13(68.4)	6(31.6)	16(76.2)	12(75.0)	4(25.0)
High TG (>150 mg/dL)	1(4.8)	1(100.0)	-	-	-	-
Low HDL (<40 mg/dL)	5(23.8)	4(80.0)	1(20.0)	4(19.0)	3(75.0)	1(25.0)
High LDL (> 130 mg/dL)	-	-	-	2(9.5)	1(50.0)	1(50.0)

a % of total 21 obese subjects, b % of total subjects in each parameter

4.7 Effect of nutritional therapy on nutritional status of sodium

Sodium questionnaires

We got the valid questionnaires from 21 obese subjects throughout the study.

4.7.1 Sodium knowledge (SN)

This part in sodium knowledge contained 10 questions which each question was the multiple choice questions had 4 options.

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SN questions increased significantly from the pretest at the beginning of study ($p<0.005$). Both males and females, number and percentage of subjects correctly answered the SN questions increased significantly (males: $p<0.005$ and female: $p<0.02$) from the pretest at the beginning of study **(Table 4.31)**.

4.7.2 Sodium and health (SH)

This part in sodium and health contained 10 questions which each question was the multiple choice questions had 4 options

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SH questions did not change from the pretest at the beginning of study. Both males and females, number and percentage of subjects correctly answered the SH questions did not change from the pretest at the beginning of study **(Table 4.32)**

4.7.3 Sodium and food behavior (SFB)

This part in sodium and food behavior contained 15 questions, 2 questions fill answers in the blanks, 7 questions were multiple choice questions had 3 options, and 5 questions were multiple choice questions had 4 options **(Tables 4.33)**.

After receiving the nutritional therapy and nutritional education about sodium reduction.

No obese subjects always dipped salt and chili when ate sour fruits at the beginning and at the end of study. Most of obese subjects at pretest (71.4%) and posttest (66.7%) sometime dipped salt and chili when ate sour fruits **(Tables 4.33 I)**.

Most of obese subjects at pretest (61.9%) and posttest (66.7%) sometime added fish sauce when subjects ate noodle **(Tables 4.33 I)**.

Most of obese subjects at pretest (49.2%) and posttest (38.1%) added $\leq$ 1.5 teaspoons of fish sauce when subjects ate noodle **(Tables 4.33 I)**.

Most of obese subjects at pretest (95.2%) and posttest (90.5%) ate some soup when subjects ate noodle **(Tables 4.33 I)**.

Most of obese subjects at pretest (52.4%) and posttest (66.7%) small dipped sauce when subjects ate meat ball **(Tables 4.33 I)**.

Most of obese subjects at pretest (52.4%) added $\leq$ 2 teaspoons of ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken and posttest (28.6% and 28.6%) never added of ketchup and chili and added $\leq$ 2 teaspoons of ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken **(Tables 4.33 II)**.

Most of obese subjects at pretest (42.9%) and posttest (47.6%) liked sour taste **(Tables 4.33 II)**.

Most of obese subjects at pretest (61.9%) and posttest (61.9%) liked bread snack **(Tables 4.33 II)**.

Most of obese subjects at pretest (95.2%) and posttest (95.2%) drank water after exercise **(Tables 4.33 II)**.

Most of obese subjects at pretest (81.0%) and posttest (90.5%) preferred fresh mango to pickled mango **(Tables 4.33 II)**.

Most of obese subjects at pretest (42.9% and 42.9%) and posttest (42.9% and 57.1%) never ate dried fruit and ate 1 time/week **(Tables 4.33 III)**.

No obese subjects ate snacks (potato chip, fish snack, and crispy rice) $\geq$ 4 time a week at the beginning and at the end of study. Most of obese subjects at pretest (76.2%) ate snacks (potato chip, fish snack, and crispy rice) 2-3 times/week and

posttest (61.9%) ate snacks (potato chip, fish snack, and crispy rice) 1 time/week **(Tables 4.33 III)**.

Most of obese subjects at pretest (57.1%) ate bakery (cake, pancake, and bread) 2-3 times/week and posttest (38.1% and 38.1%) ate those bakery 1 time/week and 2-3 times/week **(Tables 4.33 III)**.

Most of obese subjects at pretest (61.9%) and posttest (61.9%) ate meat products (meat ball and sausage) 2-3 times/week **(Tables 4.33 III)**.

Most of obese subjects at pretest (71.4%) and posttest (66.7%) ate salted peanuts 1 time/week **(Tables 4.33 III)**.

Table 4.31 Sodium knowledge of 21 obese subjects

Questions	Pre-Total (n=21)			Post-Total (n=21)		
	correct answer	males	females	correct answer	males	females
	n (% [a])	*n* (% [b])	*n* (% [b])	n^{k3}(% [a])	n^{k3} (% [b])	n^{k4} (% [b])
1.What is atomic number of sodium?	7(33.3)	5(71.4)	2(28.6)	12(57.1)	9(75.0)	3(25.0)
2.What is atomic weight of sodium?	5(23.8)	4(80.0)	1(20.0)	6(28.6)	5(83.3)	1(16.7)
3. What group is sodium in the periodic table?	5(23.8)	4(80.0)	1(20.0)	18(85.7)	14(77.8)	4(22.2)
4. What is chemical formula of table salt?	13(61.9)	10(76.9)	3(23.1)	17(81.0)	13(76.5)	4(23.5)
5. How much does a teaspoon of salt weigh?	6(28.6)	4(66.7)	2(33.3)	13(61.9)	10(76.9)	3(23.1)
6. How much does sodium of a teaspoon salt weigh?	13(61.9)	9(69.2)	4(30.8)	13(61.9)	10(76.9)	3(23.1)
7. Which item is all high sodium foods?	20(95.2)	15(75.0)	5(25.0)	21(100.0)	15(71.4)	6(28.6)
8. Which item is all low sodium foods?	19(90.5)	13(68.4)	6(31.6)	20(95.2)	14(70.0)	6(30.0)
9. Which plant do have the highest sodium content?	6(28.6)	4(66.7)	2(33.3)	19(90.5)	15(78.9)	4(21.1)
10.Which item of 100 gram seasoning do have the highest sodium content?	10(47.6)	8(80.0)	2(20.0)	12(57.1)	8(66.7)	4(33.3)

[a]% of total 21 obese subjects, [b]% of total subjects correctly answer
Significant difference from week0, ^{k3} $p < 0.005$ and ^{k4} $p < 0.02$

Table 4.32 Sodium and health of 21 obese subjects

Questions	Pre-Total (n=21)			Post-Total (n=21)		
	correct answer	males	females	correct answer	males	females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
1.Which one is not the sodium function in the body?	7(33.3)	5(71.4)	2(28.6)	11(52.4)	8(72.7)	3(27.3)
2. How much sodium recommended per day?	12(57.1)	9(75.0)	3(25.0)	21(100.0)	15(71.4)	6(28.6)
3. Sodium excretion through many organs, except?	17(81.0)	13(76.5)	4(23.5)	21(100.0)	15(71.4)	6(28.6)
4. Which substance is used to replace for salty taste?	18(85.7)	12(66.7)	6(33.3)	9(42.9)	5(55.6)	4(44.4)
5. What to drink when you have severe diarrhea?	20(95.2)	14(70.0)	6(30.0)	21(100.0)	15(71.4)	6(28.6)
6. Which sign or symptom caused by high sodium?	2(9.5)	2(100.0)	-	14(66.7)	9(64.3)	5(35.7)
7. Which sign or symptom caused by low sodium?	12(57.1)	9(75.0)	3(25.0)	15(71.4)	9(60.0)	6(40.0)
8. Which disease caused by high sodium intake?	19(90.5)	13(68.4)	6(31.6)	18(85.7)	13(72.2)	5(27.8)
9. Which kind of meats can cause high blood pressure?	5(23.8)	4(80.0)	1(20.0)	12(57.1)	9(75.0)	3(25.0)
10. We can assess sodium intake by several methods, except?	2(9.5)	1(50.0)	1(50.0)	7(33.3)	5(71.4)	2(28.6)

[a]% of total 21 obese subjects, [b]% of total subjects correctly answer

Table 4.33 Sodium and food behavior of 21 obese subjects I

Questions	Pre-Total (n=21)			Post-Total (n=21)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
1. Do you dip salt and chili when you eat sour fruits?						
- Never	6(28.6)	4(66.7)	2(33.3)	7(33.3)	5(71.4)	2(28.6)
- Sometime	15(71.4)	11(73.3)	4(26.7)	14(66.7)	10(71.4)	4(28.6)
- Always	-	-	-	-	-	-
2. Do you add fish sauce when you eat noodle?						
- Never	5(23.8)	2(40.0)	3(60.0)	4(19.0)	1(25.0)	3(75.0)
- Sometime	13(61.9)	11(84.6)	2(15.4)	14(66.7)	12(85.7)	2(14.3)
- Always	3(14.3)	2(66.7)	1(33.3)	3(14.3)	2(66.7)	1(33.3)
3. How much fish sauce do you add to your noodles?						
- Never	4(19.0)	1(25.0)	3(75.0)	4(19.0)	1(25.0)	3(75.0)
- <1 teaspoon	2(9.5)	1(50.0)	1(50.0)	3(14.3)	2(66.7)	1(33.3)
- ≤1.5 teaspoons	9(43.0)	8(88.9)	1(11.1)	8(38.1)	8(100.0)	-
- ≤2.5 teaspoons	4(19.0)	4(100.0)	-	5(23.8)	3(60.0)	2(40.0)
- >2.5 teaspoons	2(9.5)	1(50.0)	1(50.0)	1(4.8)	1(100.0)	-
4. How do you eat your noodle soup?						
- Never	-	-	-	2(9.5)	2(100.0)	-
- some soup	20(95.2)	14(70.0)	6(30.0)	19(90.5)	13(68.4)	6(31.6)
- whole noodle soup	1(4.8)	1(100.0)	-	-	-	-
5. Do you dip sauce when you eat meat ball, sausage?						
- Never	3(14.3)	1(33.3)	2(66.7)	5(23.8)	3(60.0)	2(40.0)
- Small dip	11(52.4)	8(72.7)	3(27.3)	14(66.7)	11(78.6)	3(21.4)
- Big dip	7(33.3)	6(85.7)	1(14.3)	2(9.5)	1(50.0)	1(50.0)

[a]% of total 21 obese subjects, [b]% of total subjects each item

Table 4.33 Sodium and food behavior of 21 obese subjects II (cont.)

Questions	Pre-Total (n=21)			Post-Total (n=21)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?						
- Never	2(9.5)	1(50.0)	1(50.0)	6(28.6)	4(66.7)	2(33.3)
- ≤1 teaspoons	6(28.6)	4(66.7)	2(33.3)	4(19.0)	2(50.0)	2(50.0)
- ≤2 teaspoons	11(52.4)	8(72.7)	3(27.3)	6(28.6)	4(66.7)	2(33.3)
- >2 teaspoons	2(9.5)	2(100.0)	-	5(23.8)	5(100.0)	-
7. Which taste would you like ?						
- Sweet	5(23.8)	4(80.0)	1(20.0)	6(28.6)	5(83.3)	1(16.7)
- Salty	7(33.3)	5(71.4)	2(28.6)	5(23.8)	3(60.0)	2(40.0)
- Sour	9(42.9)	6(66.7)	3(33.3)	10(47.6)	7(70.0)	3(30.0)
8. Which snack would you like ?						
- Crispy snack	6(28.6)	4(66.7)	2(33.3)	5(23.8)	4(80.0)	1(20.0)
- Dessert	2(9.5)	1(50.0)	1(50.0)	3(14.3)	1(33.3)	2(66.7)
- Bread	13(61.9)	10(76.9)	3(23.1)	13(61.9)	10(76.9)	3(23.1)
9. After exercise, which beverage would you drink?						
- Water	20(95.2)	14(70.0)	6(30.0)	20(95.2)	14(70.0)	6(30.0)
- carbonated beverage	1(4.8)	1(100.0)	-	-	-	-
-sport drink	-	-	-	1(4.8)	1(100.0)	-
10. Which mango do you flavor?						
- Fresh mango	17(81.0)	12(70.6)	5(29.4)	19(90.5)	14(73.7)	5(26.3)
- Pickled mango	4(19.0)	3(75.0)	1(25.0)	2(9.5)	1(50.0)	1(50.0)

[a]% of total 21 obese subjects, [b]% of total subjects each item

Table 4.33 Sodium and food behavior of 21 obese subjects III (cont.)

Questions	Pre-Total (n=21)			Post-Total (n=21)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
11. How often did you eat dried fruits?						
-Never	9(42.9)	4(44.4)	5(55.6)	9(42.9)	6(66.7)	3(33.3)
- 1 time/week	9(42.9)	8(88.9)	1(11.1)	12(57.1)	9(75.0)	3(25.0)
- 2-3 times /week	2(9.5)	2(100.0)	-	-	-	-
- ≥ 4 times /week	1(4.7)	1(100.0)	-	-	-	-
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?						
- Never	-	-	-	-	-	-
- 1 time/week	5(23.8)	3(60.0)	2(40.0)	13(61.9)	9(69.2)	4(30.8)
- 2-3 times /week	16(76.2)	12(75.0)	4(25.0)	8(38.1)	6(75.0)	2(25.0)
- ≥ 4 times /week	-	-	-	-	-	-
13. How often did you eat the following bakery (cake, pancake, and bread) ?						
- Never	-	-	-	-	-	-
- 1 time/week	8(38.1)	5(62.5)	3(37.5)	8(38.1)	7(87.5)	1(12.5)
- 2-3 times /week	12(57.1)	9(75.0)	3(25.0)	8(38.1)	3(37.5)	5(62.5)
- ≥ 4 times /week	1(4.8)	1(100.0)	-	5(23.8)	5(100.0)	-
14. How often did you eat the following meat products (meat ball, sausage) ?						
- Never	-	-	-	1(4.8)	-	1(100.0)
- 1 time/week	7(33.3)	4(57.1)	3(42.9)	6(28.5)	4(66.7)	2(33.3)
- 2-3 times /week	13(61.9)	10(76.9)	3(23.1)	13(61.9)	10(76.9)	3(23.1)
- ≥ 4 times /week	1(4.8)	1(100.0)	-	1(4.8)	1(100.0)	-
15. How often did you eat salted peanuts.						
- Never	4(19.1)	3(75.0)	1(25.0)	7(33.3)	7(100.0)	-
- 1 time/week	15(71.4)	11(73.3)	4(26.7)	14(66.7)	8(57.1)	6(42.9)
- 2-3 times /week	2(9.5)	1(50.0)	1(50.0)	-	-	-
- ≥ 4 times /week	-	-	-	-	-	-

[a]% of total 21 obese subjects, [b]% of total subjects each item

4.8 Nutritional therapy on urinary sodium excretion

Urinary sodium excretion

24-hour urinary sodium excretions of 21 obese subjects were collected 1-day at week 0 and 1-day at week 32.

Table 4.34 shows means ±SEM and range of urinary sodium excretion of 21 obese subjects during the study.

Mean of 24-hour urinary sodium excretions at week 0 was 122.6 $\pm$ 11.4 mmol/day (50.4 – 235.5 mmol/day) and at week 32, mean of 24-hour urinary sodium excretions was 145.7 $\pm$ 17.2 mmol/day (32.5–300.2 mmol/day). Mean of 24-hour urinary sodium excretions at week 32 was higher than that from week 0 but did not reach significant difference. Mean of 24-hour urinary sodium excretions of 15 obese male and 6 obese female subjects at week 32 was higher than that from week 0 but did not reach significant difference.

Mean of urinary sodium excretion of 15 obese male subjects at week 0 was 138.4 $\pm$ 12.2 (58.8 – 235.5 mmol/day) and mean of urinary sodium excretion of 6 obese female subjects at week 0 was 83.0 $\pm$ 18.5 mmol/day (50.4 – 171.5 mmol/day). Mean of urinary sodium excretion of 15 obese male subjects at week 0 was significantly higher than that of 6 obese female subjects ($p<0.05$).

Mean of urinary sodium excretion of 15 obese male subjects at week 32 was 159.5 $\pm$ 21.8 (32.5 – 300.2 mmol/day) and mean of urinary sodium excretion of 6 obese female subjects at week 32 was 111.2 $\pm$ 21.8 mmol/day (57.4 – 190.8 mmol/day). Mean of urinary sodium excretion of 15 obese male subjects at week 32 was higher than that of 6 obese female subjects but did not reach significant difference.

Table 4.34 Means ±SEM and range of urinary sodium excretion of 21 obese subjects

Parameter	Week 0			Week 32		
	Total (n=21)	Males (n=15)	Females (n=6)	Total (n=21)	Males (n=15)	Females (n=6)
Urinary sodium excretion (mmol/day)	122.6 ± 11.4	138.4 ± 12.2	83 ± 18.5 [15]	145.7 ± 17.2	159.5 ± 21.8	111.2 ± 21.8
	(50.4 – 235.5)	(58.8 – 235.5)	(50.4 – 171.5)	(32.5 – 300.2)	(32.5 – 300.2)	(57.4 – 190.8)

Significant difference from sex, [15] $p < 0.05$

50 LDL (hypercholesterolemia) subjects

LDL subjects were 20 males and 30 females with age range of 12-18 years, mean BMI of 19.6 $\pm$ 2.6 kg/m^2, and mean body fat of 18.9 $\pm$ 7.8 (% bw).

4.9 Nutritional therapy on nutritional status

4.9.1 Body composition

Mean (±SD) of age and body composition parameters of 50 LDL subjects during the study are shown in **Table 4.35**. The mean height at the end of study was significantly higher than those at the week 0.

Their means BMI at weeks 24 and 32 increased significantly after receiving the nutritional therapy. At week 16 their means BMI was significantly lower than those at week 24. Range of weight reduction during 32 weeks of study was -0.1 to -3.6 kg (0.2% to 7.2% of mean body weight at week 0). In 20 LDL male subjects, range of weight reduction was -0.2 to -3.5 kg (0.4% to 6.6% of mean body weight at week 0) and in 30 LDL female subjects, range of weight reduction was -0.1 to -3.6 kg (0.2% to 7.5% of mean body weight at week 0) **(Table 4.35 I)**.

Their mean body fat (%bw) at weeks 16, 24, and 32 decreased significantly after receiving the nutritional therapy, whereas at week 32 decreased significantly from that at weeks 16 and 24. Range of body fat (%bw) reduction during 32 weeks of study was -0.2% to -7.0%bw (1.1% to 37.0% of their percentage body fat at week 0). In 20 LDL male subjects, range of body fat (%bw) reduction was -0.2% to -7.0%bw (1.6% to 56.0% of their percentage body fat at week 0) and in 30 LDL female subjects, range of body fat (%bw) reduction was -0.7% to -2.3%bw (3.0% to 10.0% of their percentage body fat at week 0) **(Table 4.35 II)**.

Their mean muscle mass at week 16 decreased significantly after receiving the nutritional therapy from that at week 0, however at week 24 increased significantly from that at week 16, whereas at week 32 increased significantly from that at weeks 16 and 24. Range of increased muscle mass during 32 weeks of study was 0.1 to 3.8 kg (0.3% to 10.0% of mean muscle mass at week 0). In 20 LDL male subjects, range of increased muscle mass was 0.2 to 3.8 kg (0.4% to 8.7% of mean muscle mass at week

0) and in 30 LDL female subjects, range of increased muscle mass was 0.1 to 2.5kg (0.3% to 7.3% of mean muscle mass at week 0) **(Table 4.35 III)**.

Table 4.36 shows BMI and body fat status of 50 LDL subjects during the study. At the baseline, the subjects had underweight (12.0%), normal weight (76.0%), and at risk of overweight (12.0%). Percentage of body fat at the baseline, the subjects had low body fat (18.0%) and normal body fat (82.0%). In this study we classified 50 LDL subjects by serum LDL-cholesterol level more than 130 mg/dL (43) and subjects had normal body fat, therefore 50 LDL subjects had not obesity from body fat (%bw).

During the study, percentage of underweight subjects at weeks 0, 16, 24, and 32 were 12.0%, 2.0%, 4.0%, and 4.0%, respectively. Percentage of normal weight subjects at weeks 0, 16, 24, and 32 were 76.0%, 86.0%, 84.0%, and 88.0%, respectively. Percentage of at risk of overweight subjects at weeks 0, 16, 24, and 32 were 12.0%, 12.0%, 12.0%, and 8.0%, respectively.

During the study, percentage of low body fat subjects at weeks 0, 16, 24, and 32 were 18.0%, 6.0%, 8.0%, and 14.0%, respectively. Percentage of normal body fat subjects at weeks 0, 16, 24, and 32 were 82.0%, 86.0%, 92.0%, and 84.0%, respectively. Percentage of over body fat subjects at weeks 0, 16, 24, and 32 were 0%, 8.0%, 0%, and 2.0%, respectively.

Table 4.35 Means (±SD) of age and body composition parameters of 50 LDL subjects classified by sex I

Parameters		LDL (n=50)		
		Total (n=50)	Males (n=20)	Females (n=30)
Age (y) range	(wk0)	12 – 18	12 – 17	12 – 18
	(wk32)	13 – 18	13 – 17	13 – 18
Height (cm)	(wk0)	159.5 ± 7.0	164.2 ± 7.7	156.3 ± 4.1 ^{l1}
	(wk32)	160.4 ± 7.3 ^{k3}	165.8 ± 7.2	156.8 ± 4.6 ^{l1}
Weight (kg)	(wk0)	49.9 ± 8.9	53.1 ± 9.5	47.8 ± 8.0 ^{l5}
	(wk16)	49.7 ± 8.2	52.3 ± 9.2	48.1 ± 7.2
	(wk24)	50.7 ± 8.3 ^{k3,m1}	53.7 ± 9.2 ^{m1}	48.8 ± 7.2 $^{l5, m1}$
	(wk32)	50.4 ± 7.8 $^{k4, m1}$	53.8 ± 8.4 ^{m2}	48.2 ± 6.6 ^{l4}
BMI (kg/m^2)	(wk0)	19.6 ± 2.6	19.6 ± 2.4	19.5 ± 2.8
	(wk16)	19.5 ± 2.4	19.3 ± 2.2	19.6 ± 2.6
	(wk24)	19.9 ± 2.4 $^{k3, m1}$	19.8 ± 2.2 ^{m1}	19.9 ± 2.6 $^{k3, m1}$
	(wk32)	19.6 ± 2.2 ^{n1}	19.5 ± 2.0	19.6 ± 2.3 ^{n5}

Significant difference from week 0, $^{k1}p < 0.0005$, $^{k3}p < 0.005$, $^{k4}p < 0.02$

Significant difference from week 16, $^{m1}p < 0.0005$, $^{m2}p < 0.002$

Significant difference from week 24, $^{n4}p < 0.02$, $^{n5}p < 0.05$

Significant difference from sex, $^{l4}p < 0.02$ and $^{l5}p < 0.05$

Table 4.35 Means (±SD) of age and body composition parameters of 50 LDL subjects classified by sex II (cont.)

Parameters		LDL (n=50)		
		Total (n=50)	Males (n=20)	Females (n=30)
Body fat (% bw)	(wk0)	18.9 ± 7.8	12.5 ± 5.5	23.1 ± 6.1 ^{l1}
	(wk16)	21.6 ± 8.0 ^{k1}	14.5 ± 5.6 ^{k2}	26.3 ± 5.4 ^{l1}
	(wk24)	20.8 ± 7.8 $^{k1, m4}$	13.9 ± 5.2 ^{k5}	25.4 ± 5.4 ^{l1}
	(wk32)	19.5 ± 7.8 $^{k5, m1,n4}$	11.8 ± 4.0 $^{m1, n4}$	24.7 ± 5.0 ^{l1}
Fat mass (kg)	(wk0)	9.6 ± 4.8	6.9 ± 3.8	11.5 ± 4.6 ^{l2}
	(wk16)	10.9 ± 4.8 ^{k1}	7.8 ± 3.9	12.9 ± 4.3 ^{l1}
	(wk24)	10.7 ± 4.8 ^{k1}	7.7 ± 3.8	12.7 ± 4.3 ^{l1}
	(wk32)	9.9 ± 4.5	6.5 ± 2.9	12.2 ± 3.9 ^{l1}
Fat free mass (kg)	(wk0)	40.3 ± 7.2	46.2 ± 7.2	36.4 ± 3.8 ^{l1}
	(wk16)	38.9 ± 6.9 ^{k1}	44.5 ± 7.0	35.2 ± 3.6 ^{l1}
	(wk24)	40.1 ± 6.9	46.0 ± 6.6	36.1 ± 3.5 ^{l1}
	(wk32)	40.6 ± 7.3	47.3 ± 6.4	36.1 ± 3.2 ^{l1}

Significant difference from week 0, $^{k1}p < 0.0005$, $^{k5}p < 0.05$

Significant difference from week 16, $^{m1}p < 0.0005$, $^{m2}p < 0.002$, $^{m3}p < 0.005$, $^{m4}p < 0.02$, $^{m5}p < 0.05$

Significant difference from week 24, $^{n3}p < 0.005$, $^{n4}p < 0.02$

Significant difference from sex, $^{l1}p < 0.0005$, $^{l2}p < 0.002$

Table 4.35 Means (±SD) of age and body composition parameters of 50 LDL subjects classified by sex III (cont.)

Parameters		LDL (n=50)		
		Total (n=50)	Males (n=20)	Females (n=30)
Muscle mass (kg)	(wk0)	38.1 ± 6.9	43.8 ± 6.8	34.2 ± 3.5 ^{l1}
	(wk16)	36.8 ± 6.6 ^{k1}	42.2 ± 6.7	33.2 ± 3.4 ^{l1}
	(wk24)	37.8 ± 6.6	43.5 ± 6.3	34.0 ± 3.2 ^{l1}
	(wk32)	38.3 ± 6.9	44.8 ± 6.1	34.0 ± 2.9 ^{l1}
TBW (kg)	(wk0)	29.4 ± 5.3	33.8 ± 5.3	26.5 ± 2. 8 ^{l1}
	(wk16)	28.4 ± 5.1 ^{k1}	32.6 ± 5.2	25.6 ± 2.6 ^{l1}
	(wk24)	29.2 ± 5.1	33.6 ± 4.9	26.3 ± 2.5 ^{l1}
	(wk32)	29.5 ± 5.4	34.6 ± 4.7	26.1 ± 2.2 ^{l1}
TBW (%bw)	(wk0)	59.3 ± 5.8	64.1 ± 4.0	56.0 ± 4.5 ^{l1}
	(wk16)	57.3 ± 5.9 ^{k1}	62.6 ± 4.1	53.7 ± 3.9 ^{l1}
	(wk24)	57.8 ± 5.7 ^{k1}	63.0 ± 3.8	54.3 ± 3.8 ^{l1}
	(wk32)	58.6 ± 6.0 ^{k5}	64.6 ± 2.9	54.5 ± 3.8 ^{l1}

Significant difference from week 0, $^{k1}p < 0.0005$and ^{k5} $p < 0.05$

Significant difference from week 16, $^{m1}p < 0.0005$, $^{m2}p < 0.002$, $^{m3}p < 0.005$,

Significant difference from week 24, ^{n3} $p < 0.005$, $^{n4}p < 0.02$

Significant difference from sex, $^{l1}p < 0.0005$

Table 4.36 Body weight and body fat status of 50 LDL subjects

Parameters	Weeks			
	0	16	24	32
	n (% [a])	*n (% [a])*	*n (% [a])*	*n (% [a])*
Underweight	6(12.0)	1(2.0)	2(4.0)	2(4.0)
Normal weight	38(76.0)	43(86.0)	42(84.0)	44(88.0)
At risk of overweight	6(12.0)	6(12.0)	6(12.0)	4(8.0)
Low body fat	9(18.0)	3(6.0)	4(8.0)	7(14.0)
Normal body fat	41(82.0)	43(86.0)	46(92.0)	42(84.0)
Over body fat	-	4(8.0)	-	1(2.0)

[a] % of total 50 LDL subjects

4.9.2 Blood chemistry

Table 4.37 shows means (±SD) of blood chemistry parameters of 50 LDL subjects during the study. At week 32, the end of study the mean serum uric acid, triglyceride, and LDL-cholesterol level was significantly decreased from week 0. Only in males and females, mean serum LDL-cholesterol levels were significantly decreased from week 0.

At the baseline, 2 case of 50 (4.0%) of LDL subjects were anemia, after receiving the nutritional therapy at week 32, percentage of anemia increased from 4.0% (2/50) to 6.0% (3/50) **(Tables 4.38-4.39).**

In 50 LDL subjects had normal FBS level throughout the study **(Tables 4.38-4.39).**

At the baseline, 24 of 50 (48.0%) of LDL subjects were hyperuricemia (42.0% (21/50) borderline, 4.0% (2/50) high, 2.0% (1/50) very high), after receiving the nutritional therapy at week 32, percentage of hyperuricemia decreased from 48.0% (24/50) to 40.0% (20/50), (36.0% (18/50) borderline, 4.0% (2/50) high, 0% very high) **(Tables 4.38-4.39).**

At the baseline, 1 case of 50 (2.0%) LDL subjects was borderline hypertriglyceridemia (TG=150-199 mg/dL), after receiving the nutritional therapy at week 32 she had serum triglyceride level increased from week 0, but still in borderline high triglyceride level **(Tables 4.38 and 4.40).**

In 50 LDL subjects had normal HDL-cholesterol level throughout the study **(Tables 4.38 and 4.40).**

After receiving the nutritional therapy at week 32, percentage of high hypercholesterolemia decreased from 100.0% (50/50) to 52.0% (26/50), and 50 LDL subjects had become borderline and normal LDL-cholesterol level were 44.0% (22/50) and 4.0% (2/50), respective **(Tables 4.38 and 4.40).**

Table 4.37 Means (±SD) of blood chemistry parameters of 50 LDL subjects classified by sex

Parameters	Week 0			Week 32		
	Total (n=50)	Males (n=20)	Females (n=30)	Total (n=50)	Males (n=20)	Females (n=30)
Hb	13.8 ± 1	14.6 ± 0.7	13.3 ± 0.8 ^{l1}	13.7 ± 1.2	14.4 ± 0.7	13.2 ± 1.0 ^{l1}
FBS	95 ± 20	97 ± 30	94 ± 8	91 ± 8	88 ± 7	93 ± 8
Uric	5.6 ± 1.3	6.4 ± 1.4	5 ± 1.0 ^{l1}	5.3 ± 1.2 ^{k5}	6 ± 1.2	4.8 ± 1.0 ^{l1}
TG	68 ± 24	55 ± 9	77 ± 27 ^{l2}	60 ± 25 ^{k4}	56 ± 15	62 ± 30 ^{l2}
HDL	59 ± 8	53 ± 5	63 ± 7 ^{l1}	61 ± 14	50 ± 87	68 ± 13 ^{l1}
LDL	153 ± 20	151 ± 18	154 ± 22	139 ± 23 ^{k1}	134 ± 22 ^{k2}	142 ± 23 ^{k3}

Significant difference from week0, $^{k1}p < 0.0005$, $^{k2}p < 0.002$, $^{k3}p < 0.005$, $^{k4}p < 0.02$, $^{k5}p < 0.05$

Significant difference from sex, $^{l1}p < 0.0005$ and $^{l2}p < 0.002$

Table 4.39 Hemoglobin, blood glucose and uric status of the 50 LDL subjects classified by sex

Parameters	Week 0			Week 32		
	Total (n=50)	Males (n=20)	Females (n=30)	Total (n=50)	Males (n=20)	Females (n=30)
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
Hb (g/dL)						
Normal (>12g/dL)	48(96.0)	20(41.7)	28(58.3)	47(94.0)	20(42.6)	27(57.4)
Anemia (<12 g/dL)	2(4.0)	-	2(100.0)	3(6.0)	-	3(100.0)
FBS (mg/dL)						
Normal (<110 mg/dL)	50(100.0)	20(40.0)	30(60.0)	50(100.0)	20(40.0)	30(60.0)
IFPG (110-125 mg/dL)	-	-	-	-	-	-
DM (>126 mg/dL)			-	-	-	-
Uric (mg/dL)						
Normal (≤5.5 mg/dL)	26(52.0)	4(15.4)	22(84.6)	30(60.0)	5(16.7)	25(83.3)
Borderline (5.6-7.0 mg/dL)	21(42.0)	13(61.9)	8(38.1)	18(36.0)	13(72.2)	5(27.8)
High (7.1-9.0 mg/dL)	2(4.0)	2(100.0)	-	2(4.0)	2(100.0)	-
Very high (>9.0 mg/dL)	1(2.0)	1(100.0)	-	-	-	-

[a] % of total 50 LDL subject, [b] % of total subjects in each parameter

Table 4.39 Serum lipid profile status of the 50 LDL subjects classified by sex

Parameters		Week 0			Week 32		
		Total (n=50)	Males (n=20)	Females (n=30)	Total (n=50)	Males (n=20)	Females (n=30)
		n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
TG (mg/dL)							
Normal	(<150 mg/dL)	49(98.0)	20(40.8)	29(59.2)	49(98.0)	20(40.8)	29(59.2)
Borderline	(150-199 mg/dL)	1(2.0)	-	1(100.0)	1(2.0)	-	1(100.0)
High	(200-499 mg/dL)	-	-	-	-	-	-
HDL (mg/dL)							
Normal	(>40 mg/dL)	50(100.0)	20(40.0)	30(60.0)	50(100.0)	20(40.0)	30(60.0)
Low	(0-40 mg/dL)	-	-	-	-	-	-
LDL (mg/dL)							
Normal	(≤110 mg/dL)	-	-	-	2(4.0)	2(100.0)	-
Borderline	(111-130mg/dL)	-	-	-	22(44.0)	9(40.9)	13(59.1)
High	(> 130 mg/dL)	50(100.0)	20(40.0)	30(60.0)	26(52.0)	9(34.6)	17(65.4)

% of total 50 LDL subjects, [b] % of total subjects in each parameter

Table 4.40 Percentage of anemia, hyperuicemia, hytriglyceridemia, and hycholesterolemia 50 LDL subjects

Parameters	Week 0			Week 32		
	Total (n=50)	Males (n=20)	Females (n=30)	Total (n=50)	Males (n=20)	Females (n=30)
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
Anemia (<12 g/dL)	2(4.0)	-	2(100.0)	3(6.0)	-	3(100.0)
High uric (>5.5 mg/dL)	24(48.0)	16(66.7)	8(33.3)	20(40.0)	15(75.0)	5(25.0)
High TG (>150 mg/dL)	1(2.0)	-	1(100.0)	1(2.0)	-	1(100.0)
Low HDL (≤40 mg/dL)	-	-	-	-	-	-
High LDL (>130 mg/dL)	50(100.0)	20(40.0)	30(60.0)	26(52.0)	9(34.6)	17(65.4)

% of total 50 LDL subjects, [b] % of total subjects in each parameter

4.10 Effect of nutritional therapy on nutritional status of sodium

Sodium questionnaires

We got the valid questionnaires from 50 LDL subjects throughout the study.

4.10.1 Sodium knowledge (SN)

This part in sodium knowledge contained 10 questions which each question was the multiple choice questions had 4 options.

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SN questions increased significantly from the pretest at the beginning of study ($p<0.002$). Both males and females, number and percentage of subjects correctly answered the SN questions increased significantly (males: $p<0.005$ and female: $p<0.0005$) from the pretest at the beginning of study **(Table 4.41)**.

4.10.2 Sodium and health (SH)

This part in sodium and health part contained 10 questions which each question was the multiple choice questions had 4 options

In overview after receiving the nutritional education about sodium reduction, it was found that number and percentage of subjects correctly answered the SH questions did not change from the pretest at the beginning of study. Both males and females, number and percentage of subjects correctly answered the SH questions did not change from the pretest at the beginning of study **(Table 4.42)**

4.10.3 Sodium and food behavior (SFB)

This part in sodium and food behavior contained 15 questions, 2 questions fill answers in the blanks, 7 questions were multiple choice questions had 3 options, and 5 questions were multiple choice questions had 4 options **(Table 4.43)**.

After receiving the nutritional therapy and nutritional education about sodium reduction.

Most of LDL subjects at pretest (70.0%) and posttest (78.0%) sometime dipped salt and chili when ate sour fruits, however the percentage of LDL subjects at pretest (16.0%) and posttest (2.0%) always dipped salt and chili when ate sour fruits **(Tables 4.43 I)**.

Most of LDL subjects at pretest (60.0%) and posttest (60.0%) sometime added fish sauce when subjects ate noodle **(Tables 4.43 I)**.

Most of LDL subjects at pretest (34.0%) and posttest (36.0%) added $\leq$ 1.5 teaspoons of fish sauce when subjects ate noodle **(Tables 4.43 I)**.

Most of LDL subjects at pretest (88.0%) and posttest (92.0%) ate some soup when subjects ate noodle **(Tables 4.43 I)**.

Most of LDL subjects at pretest (56.0%) and posttest (64.0%) small dipped sauce when subjects ate meat ball **(Tables 4.43 I)**.

Most of LDL subjects at pretest (46.0%) and posttest (42.0%) added $\leq$ 2 teaspoons of ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken **(Tables 4.43 II)**.

Most of LDL subjects at pretest (40.0%) and posttest (42.0%) liked sour taste **(Tables 4.43 II)**.

Most of LDL subjects at pretest (48.0%) and posttest (50.0%) liked crispy snack **(Tables 4.43 II)**.

Most of LDL subjects at pretest (98.0%) and posttest (90.0%) drank water after exercise **(Tables 4.43 II)**.

Most of LDL subjects at pretest (96.0%) and posttest (98.0%) preferred fresh mango to pickled mango **(Tables 4.43 II)**.

Most of LDL subjects at pretest (52.0%) and posttest (58.0%) ate dried fruit 1 time/week **(Tables 4.43 III)**.

Most of LDL subjects at pretest (46.0%) and posttest (54.0%) ate snacks (potato chip, fish snack, and crispy rice) 2-3 times/week **(Tables 4.43 III)**.

Most of LDL subjects at pretest (46.0%) and posttest (60.0%) ate bakery (cake, pancake, and bread) 2-3 times/week **(Tables 4.43 III)**.

Most of LDL subjects at pretest (50.0%) ate meat products (meat ball and sausage) 1 time/week and posttest (46.0%) ate meat products (meat ball and sausage) 2-3 times/week **(Tables 4.43 III)**.

Most of LDL subjects at pretest (66.0%) and posttest (72.0%) ate salted peanuts 1 time/week **(Tables 4.43 III)**.

Table 4.41 Sodium knowledge of 50 LDL subjects

Questions	Pre-Total (n=50)			Post-Total (n=50)		
	correct answer	males	females	correct answer	males	females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* [k2] (% [a])	*n* [k3] (% [b])	*n* [k1] (% [b])
1.What is atomic number of sodium?	23(46.0)	11(47.8)	12(52.2)	35(70.0)	13(37.1)	22(62.9)
2.What is atomic weight of sodium?	17(34.0)	7(41.2)	10(58.8)	27(54.0)	8(29.6)	19(70.4)
3. What group is sodium in the periodic table?	29(58.0)	11(37.9)	18(62.1)	44(88.0)	16(36.4)	28(63.6)
4. What is chemical formula of table salt?	30(60.0)	11(36.7)	19(63.3)	47(94.0)	18(38.3)	29(61.7)
5. How much does a teaspoon of salt weigh?	19(38.0)	8(42.1)	11(57.9)	36(72.0)	11(30.6)	25(69.4)
6. How much does sodium of a teaspoon salt weigh?	25(50.0)	9(36.0)	16(64.0)	38(76.0)	15(39.5)	23(60.5)
7. Which item is all high sodium foods?	40(80.0)	15(37.5)	25(62.5)	49(98.0)	20(40.8)	29(59.2)
8. Which item is all low sodium foods?	41(82.0)	17(41.5)	24(58.5)	48(96.0)	20(41.7)	28(58.3)
9. Which plant do have the highest sodium content?	6(12.0)	3(50.0)	3(50.0)	41(82.0)	17(41.5)	24(58.5)
10.Which item of 100 gram seasoning do have the highest sodium content?	25(50.0)	10(40.0)	15(60.0)	30(60.0)	11(36.7)	19(63.3)

[a]% of total 50 LDL subjects, [b]% of total subjects correctly answer
Significant difference from week0, [k1] $p < 0.0005$, [k2] $p < 0.002$ and [k3] $p < 0.005$

Table 4.42 Sodium and health of 50 LDL subjects

Questions	Pre-Total (n=50)			Post-Total (n=50)		
	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])	correct answer *n* (% [a])	males *n* (% [b])	females *n* (% [b])
1.Which one is not the sodium function in the body?	14(28.0)	6(42.9)	8(57.1)	30(60.0)	11(36.7)	19(63.3)
2. How much sodium recommended per day?	33(66.0)	14(42.4)	19(57.6)	48(96.0)	19(39.6)	29(60.4)
3. Sodium excretion through many organs, except?	44(88.0)	18(40.9)	26(59.1)	49(98.0)	19(38.8)	30(61.2)
4. Which substance is used to replace for salty taste?	45(90.0)	17(37.8)	28(62.2)	24(48.0)	10(41.7)	14(58.3)
5. What to drink when you have severe diarrhea?	48(96.0)	18(37.5)	30(62.5)	47(94.0)	18(38.3)	29(61.7)
6. Which sign or symptom caused by high sodium?	12(24.0)	5(41.7)	7(58.3)	26(52.0)	9(34.6)	17(65.4)
7. Which sign or symptom caused by low sodium?	20(40.0)	8(40.0)	12(60.0)	27(54.0)	13(48.1)	14(51.9)
8. Which disease caused by high sodium intake?	42(84.0)	17(40.5)	25(59.5)	48(96.0)	19(39.6)	29(60.4)
9. Which kind of meats can cause high blood pressure?	18(36.0)	9(50.0)	9(50.0)	38(76.0)	16(42.1)	22(57.9)
10. We can assess sodium intake by several methods, except?	5(10.0)	2(40.0)	3(60.0)	24(48.0)	11(45.8)	13(54.2)

[a]% of total 50 LDL subjects, [b]% of total subjects correctly answer

Table 4.43 Sodium and food behavior of 50 LDL subjects I

Questions	Pre-Total (n=50)			Post-Total (n=50)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n* (% [b])	*n* (% [b])	*n* (% [a])	*n* (% [b])	*n* (% [b])
1. Do you dip salt and chili when you eat sour fruits?						
- Never	7(14.0)	2(28.6)	5(71.4)	10(20.0)	6(60.0)	4(40.0)
- Sometime	35(70.0)	14(40.0)	21(60.0)	39(78.0)	14(35.9)	25(64.1)
- Always	8(16.0)	4(50.0)	4(50.0)	1(2.0)	-	1(100.0)
2. Do you add fish sauce when you eat noodle?						
- Never	6(12.0)	3(50.0)	3(50.0)	9(18.0)	5(55.6)	4(44.4)
- Sometime	30(60.0)	10(33.3)	20(66.7)	30(60.0)	9(30.0)	21(70.0)
- Always	14(28.0)	7(50.0)	7(50.0)	11(22.0)	6(54.5)	5(45.5)
3. How much fish sauce do you add to your noodles?						
- Never	6(12.0)	3(50.0)	3(50.0)	9(18.0)	5(55.6)	4(44.4)
- <1 teaspoon	12(24.0)	4(33.3)	8(66.7)	9(18.0)	5(55.6)	4(44.4)
- ≤1.5 teaspoons	17(34.0)	3(17.6)	14(82.4)	18(36.0)	5(27.8)	13(72.2)
- ≤2.5 teaspoons	11(22.0)	7(63.6)	4(36.4)	11(22.0)	2(18.2)	9(81.8)
- >2.5 teaspoons	4(8.0)	3(75.0)	1(25.0)	3(6.0)	3(100.0)	-
4. How do you eat your noodle soup?						
- Never	1(2.0)	1(100.0)	-	1(2.0)	1(100.0)	-
- some soup	44(88.0)	16(36.4)	28(63.6)	46(92.0)	18(39.1)	28(60.9)
- whole noodle soup	5(10.0)	3(60.0)	2(40.0)	3(6.0)	1(33.3)	2(66.7)
5. Do you dip sauce when you eat meat ball, sausage?						
- Never	4(8.0)	3(75.0)	1(25.0)	4(8.0)	3(75.0)	1(25.0)
- Small dip	28(56.0)	10(35.7)	18(64.3)	32(64.0)	12(37.5)	20(62.5)
- Big dip	18(36.0)	7(38.9)	11(61.1)	14(28.0)	5(35.7)	9(64.3)

[a]% of total 50 LDL subjects, [b]% of total subjects each item

Table 4.43 Sodium and food behavior of 50 LDL subjects II (cont.)

Questions	Pre-Total (n=50)			Post-Total (n=50)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?						
- Never	3(6.0)	2(66.7)	1(33.3)	4(8.0)	3(75.0)	1(25.0)
- ≤1 teaspoons	13(26.0)	3(23.1)	10(76.9)	16(32.0)	7(43.8)	9(56.2)
- ≤2 teaspoons	23(46.0)	8(34.8)	15(65.2)	21(42.0)	4(19.0)	17(81.0)
- >2 teaspoons	11(22.0)	7(63.6)	4(36.4)	9(18.0)	6(66.7)	3(33.3)
7. Which taste would you like ?						
- Sweet	16(32.0)	5(31.2)	11(68.8)	18(36.0)	5(27.8)	13(72.2)
- Salty	14(28.0)	9(64.3)	5(35.7)	11(22.0)	6(54.5)	5(45.5)
- Sour	20(40.0)	6(30.0)	14(70.0)	21(42.0)	9(42.9)	12(57.1)
8. Which snack would you like ?						
- Crispy snack	24(48.0)	13(54.2)	11(45.8)	25(50.0)	12(48.0)	13(52.0)
- Dessert	8(16.0)	2(25.0)	6(75.0)	7(14.0)	3(42.9)	4(57.1)
- Bread	18(36.0)	5(27.8)	13(72.2)	18(36.0)	5(27.8)	13(72.2)
9. After exercise, which beverage would you drink?						
- Water	49(98.0)	20(40.8)	29(59.2)	45(90.0)	20(44.4)	25(55.6)
- carbonated beverage	-	-	-	1(2.0)	-	1(100.0)
-sport drink	1(2.0)	-	1(100.0)	4(8.0)	-	4(100.0
10. Which mango do you flavor?						
- Fresh mango	48(96.0)	20(41.7)	28(58.3)	49(98.0)	20(40.8)	29(59.2)
- Pickled mango	2(4.0)	-	2(100.0)	1(2.0)	-	1(100.0)

[a]% of total 50 LDL subjects, [b]% of total subjects each item

Table 4.43 Sodium and food behavior of 50 LDL subjects III (cont.)

Questions	Pre-Total (n=50)			Post-Total (n=50)		
	Total	Males	Females	Total	Males	Females
	n (% [a])	*n (% [b])*	*n (% [b])*	*n (% [a])*	*n (% [b])*	*n (% [b])*
11. How often did you eat dried fruits?						
-Never	22(44.0)	11(50.0)	11(50.0)	17(34.0)	7(41.2)	10(58.8)
- 1 time/week	26(52.0)	8(30.8)	18(69.2)	29(58.0)	10(34.5)	19(65.5)
- 2-3 times /week	2(4.0)	1(50.0)	1(50.0)	4(8.0)	3(75.0)	1(25.0)
- ≥ 4 times /week	-	-	-	-	-	-
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?						
- Never	-	-	-	2(4.0)	1(50.0)	1(50.0)
- 1 time/week	21(42.0)	8(38.1)	13(61.9)	15(30.0)	5(33.3)	10(66.7)
- 2-3 times /week	23(46.0)	11(47.8)	12(52.2)	27(54.0)	12(44.4)	15(55.6)
- ≥ 4 times /week	6(12.0)	1(16.7)	5(83.3)	6(12.0)	2(33.3)	4(66.7)
13. How often did you eat the following bakery (cake, pancake, and bread) ?						
- Never	1(2.0)	1(100.0)	-	1(2.0)	-	1(100.0)
- 1 time/week	19(38.0)	9(47.4)	10(52.6)	14(28.0)	4(28.6)	10(71.4)
- 2-3 times /week	23(46.0)	9(39.1)	14(60.9)	30(60.0)	14(46.7)	16(53.3)
- ≥ 4 times /week	7(14.0)	1(14.3)	6(85.7)	5(10.0)	2(40.0)	3(60.0)
14. How often did you eat the following meat products (meat ball, sausage) ?						
- Never	1(2.0)	1(100.0)	-	3(6.0)	1(33.3)	2(66.7)
- 1 time/week	25(50.0)	11(44.0)	14(56.0)	19(38.0)	6(31.6)	13(68.4)
- 2-3 times /week	23(46.0)	8(34.8)	15(65.2)	23(46.0)	12(52.2)	11(47.8)
- ≥ 4 times /week	1(2.0)	-	1(100.0)	5(10.0)	1(20.0)	4(80.0)
15. How often did you eat salted peanuts.						
- Never	13(26.0)	8(61.5)	5(38.5)	9(18.0)	4(44.4)	5(55.6)
- 1 time/week	33(66.0)	11(33.3)	22(66.7)	36(72.0)	13(36.1)	23(63.9)
- 2-3 times /week	4(8.0)	1(25.0)	3(75.0)	5(10.0)	3(60.0)	2(40.0)
- ≥ 4 times /week	-	-	-	-	-	-

[a]% of total 50 LDL subjects, [b]% of total subjects each item

4.11 Nutritional therapy on urinary sodium excretion

Urinary sodium excretion

24-hour urinary sodium excretions of 50 LDL subjects were collected 1-day at week 0 and 1-day at week 32.

Table 4.44 shows means ±SEM and range of urinary sodium excretion of 50 LDL subjects during the study.

Mean of 24-hour urinary sodium excretions at week 0 was 89.0 $\pm$ 5.1 mmol/day (25.0 – 179.8 mmol/day) and at week 32, mean of 24-hour urinary sodium excretions was 108.6 $\pm$ 8.7 mmol/day (31.5 – 279.0 mmol/day). Mean of 24-hour urinary sodium excretions at week 32 was significantly higher than that from week 0 ($p<0.05$). Mean of 24-hour urinary sodium excretions of 20 LDL male and 30 LDL female subjects at week 32 was higher than that from week 0 but did not reach significant difference.

Mean of urinary sodium excretion of 20 LDL male subjects at week 0 was 100.4 $\pm$ 9.2 (36.3 – 179.8 mmol/day) and mean of urinary sodium excretion of 30 LDL female subjects at week 0 was 81.4 $\pm$ 5.6 mmol/day (25.0 – 148.8 mmol/day). Mean of urinary sodium excretion of 20 LDL male subjects at week 0 was higher than that of 30 LDL female subjects but did not reach significant difference.

Mean of urinary sodium excretion of 20 LDL male subjects at week 32 was 131.5 $\pm$ 17.5 (49.4 – 279.0 mmol/day) and mean of urinary sodium excretion of 30 LDL female subjects at week 32 was 93.4 $\pm$ 7.5 mmol/day (31.5 – 195.2 mmol/day). Mean of urinary sodium excretion of 20 LDL male subjects at week 32 was significantly higher than that of 30 LDL female subjects ($p<0.05$).

Table 4.44 Means ± SEM and range of urinary sodium excretion of 50 LDL subjects

Parameter	Week 0			Week 32		
	Total (n=50)	Males (n=20)	Females	Total (n=50)	Males (n=20)	Females (n=30)
Urinary sodium excretion (mmol/day)	89 ± 5.1	100.4 ± 9.2	81.4 ± 5.6	108.6 ± 8.7 [k5]	131.5 ± 17.5	93.4 ± 7.5 [l5]
	(25.0 – 179.8)	(36.3 – 179.8)	(25.0 – 148.8)	(31.5 – 279.0)	(49.4 – 279.0)	(31.5 – 195.2)

Significant difference from week 0, [k5] $p < 0.05$
Significant difference from sex, [l5] $p < 0.05$

4 Obese + LDL (hypercholesterolemia) subjects

Obese + LDL subjects were 4 males with range age of 15-16 years, mean BMI of 31.1 $\pm$ 3.4 kg/m^2 and mean body fat of 31.8 $\pm$ 3.9 (% bw).

4.12 Nutritional therapy on nutritional status

4.12.1 Body composition

Mean (±SD) of age and body composition parameters of 4 obese + LDL subjects during the study are shown in **Table 4.45**.

Table 4.46 shows BMI and body fat status of 4 obese + LDL subjects during the study. At the baseline, all 4 subjects had overweight. After receiving nutritional therapy at week 16, body weight of all 4 subjects decreased from week 0, -1.2 to -1.6 kg, but at week 24, their body weight increased from week 16, 1.2 to 4.2 kg. As well as at week 32, their body weight still increased from week 24, 0.4 to 1.6 kg. At the end of study, all 4 subjects were still in overweight status, however 2 of 4 subjects had weight lost -0.5 to -1.8 kg and 2 of 4 subjects had weight gain 0.8 to 2.8 kg.

At the baseline, all 4 subjects had excess body fat. After receiving nutritional therapy at week 16, body fat of 3/4 subjects increased from week 0, 1.0% to 4.5%bw, whereas their body fat of 1/4 subjects decreased from week 0, 1.4%, but at week 24 their body fat of 3/4 subjects decreased from week 16, -2.2% to -9.2%bw, whereas their body fat of 1/4 subjects increased from week 16, 1.0%. At week 32, their body fat of 2/4 subjects decreased from week 24, -4.4% to -7.6%bw and their body fat of 2/4 subjects increased from week 24, 0.2% to 0.4%bw. However, at the end of study, body fat all 4 subjects had decreased from week 0, -0.2% to -6.6%bw.

After receiving the nutritional therapy, at week 32, 1 of 4 obese + LDL subjects had become normal body fat, 1 of 4 obese + LDL subjects had become over body fat, and 2 of 4 obese + LDL subjects had decreased from week 0 but still in excess body fat.

Table 4.45 Means (±SD) of age and body composition parameters of 4 obese + LDL subjects classified by sex I

Parameters		Obese + LDL (n=4)	
		Total (n=4)	Males (n=4)
Age (y) range	(wk0)	15 – 16	15 – 16
	(wk32)	16 – 17	16 – 17
Height (cm)	(wk0)	172.8 ± 7.2	172.8 ± 7.2
	(wk32)	173.0 ± 6.7	173.0 ± 6.7
Weight (kg)	(wk0)	93.3 ± 15.6	93.3 ± 15.6
	(wk16)	90.2 ± 14.4	90.2 ± 14.4
	(wk24)	92.4 ± 15.6 ^{m5}	92.4 ± 15.6
	(wk32)	93.6 ± 15.8 $^{m5, n5}$	93.6 ± 15.8
BMI (kg/m^2)	(wk0)	31.1 ± 3.4	31.1 ± 3.4
	(wk16)	30.0 ± 3.1	30.0 ± 3.1
	(wk24)	30.8 ± 3.5 ^{m5}	30.8 ± 3.5
	(wk32)	31.1 ± 3.7 $^{m5, n5}$	31.1 ± 3.7

Significant difference from week 16, $^{m5}p < 0.05$

Significant difference from week 24, $^{n5}p < 0.05$

Table 4.45 Means (±SD) of age and body composition parameters of 4 obese + LDL subjects classified by sex (cont.) II

Parameters		Obese + LDL (n=4)	
		Total (n=4)	Males (n=4)
Body fat (% bw)	(wk0)	31.8 ± 3.9	31.8 ± 3.9
	(wk16)	33.6 ± 4.6	33.6 ± 4.6
	(wk24)	30.4 ± 6.1	30.4 ± 6.1
	(wk32)	27.5 ± 4.5	27.5 ± 4.5
Fat mass (kg)	(wk0)	29.9 ± 7.8	29.9 ± 7.8
	(wk16)	30.5 ± 7.7	30.5 ± 7.7
	(wk24)	28.5 ± 9.5	28.5 ± 9.5
	(wk32)	26.2 ± 8.4	26.2 ± 8.4
Fat free mass (kg)	(wk0)	63.4 ± 8.9	63.4 ± 8.9
	(wk16)	59.6 ± 8.7 ^{k5}	59.6 ± 8.7 ^{k5}
	(wk24)	63.9 ± 8.5	63.9 ± 8.5
	(wk32)	67.4 ± 7.6 ^{m5}	67.4 ± 7.6

Significant difference from week 0, $^{k5}p < 0.05$

Significant difference from week 16, $^{m5}p < 0.05$

Table 4.45 Means (±SD) of age and body composition parameters of 4 obese + LDL subjects classified by sex (cont.) III

Parameters		Obese + LDL (n=4)	
		Total (n=4)	Males (n=4)
Muscle mass (kg)	(wk0)	60.0 ± 8.5	60.0 ± 8.5
	(wk16)	56.5 ± 8.3 ^{k5}	56.5 ± 8.3 ^{k5}
	(wk24)	60.6 ± 8.1	60.6 ± 8.1
	(wk32)	63.9 ± 7.2 ^{m5}	63.9 ± 7.2
TBW (kg)	(wk0)	46.4 ± 6.6	46.4 ± 6.6
	(wk16)	43.6 ± 6.6 ^{k5}	43.6 ± 6.6 ^{k5}
	(wk24)	46.8 ± 6.2	46.8 ± 6.2
	(wk32)	49.3 ± 5.6 ^{m5}	49.3 ± 5.6
TBW (%bw)	(wk0)	50.0 ± 2.9	50.0 ± 2.9
	(wk16)	48.6 ± 3.3	48.6 ± 3.3
	(wk24)	51.0 ± 4.5	51.0 ± 4.5
	(wk32)	53.1 ± 3.3	53.1 ± 3.3

Significant difference from week 0, $^{k5}p < 0.05$

Significant difference from week 16, $^{m5}p < 0.05$

Table 4.46 Body weight and body fat status of 4 obese + LDL subjects

Parameters	Weeks			
	0	16	24	32
	n (% [a])	*n (% [a])*	*n (% [a])*	*n (% [a])*
Overweight	4(100.0)	4(100.0)	4(100.0)	4(100.0)
Normal body fat	-	-	1(25.0)	1(25.0)
Over body fat	-	-	1(25.0)	1(25.0)
Excess body fat	4(100.0)	4(100.0)	2(50.0)	2(50.0)

[a] % of total 4 obese + LDL subjects

4.12.2 Blood Chemistry

Table 4.47 shows means (±SD) of blood chemistry parameters of 4 obese + LDL subjects during the study. All mean of blood chemistry parameters did not change from week 0.

In 4 obese + LDL subjects had normal serum hemoglobin, normal FBS, and normal HDL-cholesterol levels throughout the study **(Tables 4.48-4.50).**

At the baseline, 4 of 4 of obese + LDL subjects were hyperuricemia (1 of 4 borderline, 3 of 4 high) after receiving the nutritional therapy at week 32, 1 obese + LDL subjects had serum uric acid level decreased from week 0 but still in borderline serum uric acid levels, whereas 3 obese + LDL subjects had high serum uric acid level at week 0, 2/3 subjects had high serum uric acid level decreased from week 0 but still in high serum uric acid level, 1/3 subjects had high serum uric acid level increased from week 0 but still in high serum uric acid level **(Tables 4.48- 4.49).**

At the baseline, 4 obese + LDL subjects had normal serum triglyceride level, after receiving the nutritional therapy at week 32, 2 obese + LDL subjects had hypertriglyceridemia level increased from week 0 into borderline hypertriglyceridemia level **(Tables 4.48 and 4.50).**

After receiving the nutritional therapy at week 32, 2 obese + LDL subjects had become normal LDL-cholesterol level, 1 obese + LDL subjects had LDL-cholesterol level decreased from week 0 but still in high LDL-cholesterol level, whereas 1 obese + LDL subjects had LDL-cholesterol level increased from week 0 **(Tables 4.48 and 4.50).**

Table 4.47 Means (±SD) of blood chemistry parameters of 4 obese + LDL subjects classified by sex

Parameters	Week 0		Week 32	
	Total (n=4)	Males (n=4)	Total (n=4)	Males (n=4)
Hb	14.2 ± 0.8	14.2 ± 0.8	14.6 ± 0.5	14.6 ± 0.5
FBS	97 ± 14	97 ± 14	100 ± 7	100 ± 7
Uric	7.8 ± 0.7	7.8 ± 0.7	7.5 ± 1.3	7.5 ± 1.3
TG	90 ± 41	90 ± 41	136 ± 65	136 ± 65
HDL	56 ± 6	56 ± 6	58 ± 11	58 ± 11
LDL	166 ± 32	166 ± 32	144 ± 46	144 ± 46

Table 4.48 Hemoglobin, blood glucose and uric status of 4 obese + LDL subjects classified by sex

Parameters	Week 0		Week 32	
	Total (n=4)	Males (n=4)	Total (n=4)	Males (n=4)
	n (% [a])	*n (% [b])*	*n (% [a])*	*n (% [b])*
Hb (g/dL)				
Normal (>12g/dL)	4(100.0)	4(100.0)	4(100.0)	4(100.0)
Anemia (<12 g/dL)	-	-	-	-
FBS (mg/dL)				
Normal (<110 mg/dL)	4(100.0)	4(100.0)	4(100.0)	4(100.0)
IFPG (110-125 mg/dL)	-	-	-	-
DM (>126 mg/dL)	-	-	-	-
Uric (mg/dL)				
Normal (≤5.5 mg/dL)	-	-	-	-
Borderline (5.6-7.0 mg/dL)	1(25.0)	1(100.0)	1(25.0)	1(100.0)
High (7.1-9.0 mg/dL)	3(75.0)	3(100.0)	3(75.0)	3(100.0)
Very high (>9.0 mg/dL)	-	-	-	-

[a] % of total 4 obese + LDL subject, [b] % of total subjects in each parameter

Table 4.49 Serum lipid profile status of the 4 obese + LDL subjects classified by sex

Parameters		Week 0		Week 32	
		Total (n=4)	Males (n=4)	Total (n=4)	Males (n=4)
		n (% [a])	*n* (% [b])	*n* (% [a])	*n* (% [b])
TG (mg/dL)					
Normal	(<150 mg/dL)	4(100.0)	4(100.0)	2(50.0)	2(100.0)
Borderline	(150-199 mg/dL)	-	-	2(50.0)	2(100.0)
High	(200-499 mg/dL)	-	-	-	-
HDL (mg/dL)					
Normal	(>40 mg/dL)	4(100.0)	4(100.0)	4(100.0)	4(100.0)
Low	(0-40 mg/dL)	-	-	-	-
LDL (mg/dL)					
Normal	(≤110 mg/dL)	-	-	2(50.0)	2(100.0)
Borderline	(111-130mg/dL)	-	-	-	-
High	(> 130 mg/dL)	4(100.0)	4(100.0)	2(50.0)	2(100.0)

[a] % of total 4 obese + LDL subject, [b] % of total subjects in each parameter

Table 4.50 Percentage of anemia, hyperuricemia, hypertriglyceridemia, and hypercholesterolemia of 4 obese + LDL subjects

Parameters	Week 0		Week 32	
	Total (n=4)	Males (n=4)	Total (n=4)	Males (n=4)
	n (% [a])	*n* (% [b])	*n* (% [a])	*n* (% [b])
Anemia (<12 g/dL)	-	-	-	-
High uric (>5.5 mg/dL)	4(100.0)	4(100.0)	4(100.0)	4(100.0)
High TG (>150 mg/dL)	-	-	2(50.0)	2(100.0)
Low HDL (≤40 mg/dL)	-	-	-	-
High LDL (> 130 mg/dL)	4(100.0)	4(100.0)	2(50.0)	2(100.0)

[a] % of total 4 obese + LDL subject, [b] % of total subjects in each parameter

4.13 Effect of nutritional therapy on nutritional status of sodium

Sodium questionnaires

We got the valid questionnaires from 4 obese + LDL subjects throughout the study.

4.13.1 Sodium knowledge (SN)

This part in sodium knowledge contained 10 questions which each question was the multiple choice questions had 4 options.

In overview after receiving the nutritional education about sodium reduction, it was found that number of item correctly answered the SN questions of all of 4 subjects increased from pretest **(Table 4.51).**

4.13.2 Sodium and health (SH)

This part in sodium and health contained 10 questions which each question was the multiple choice questions had 4 options

In overview after receiving the nutritional education about sodium reduction, the study showed that number of item correctly answered the SN questions of 2/4 subjects increased from pretest and 2/4 subjects did not change from pretest **(Table 4.52).**

4.13.3 Sodium and food behavior (SFB)

This part in sodium and food behavior contained 15 questions, 2 questions fill answers in the blanks, 7 questions were multiple choice questions had 3 options, and 5 questions were multiple choice questions had 4 options **(Table 4.53)**.

After receiving the nutritional therapy and nutritional education about sodium reduction.

Three obese + LDL subjects at pretest and 4 subjects at posttest sometime dipped salt and chili when ate sour fruits. One obese + LDL subjects at pretest always

dipped salt and chili when ate sour fruits, however they did not dipped salt and chili at posttest **(Table 4.53 I)**.

Two obese + LDL subjects at pretest and 2 subjects at posttest always added fish sauce when subjects ate noodle **(Table 4.53 I).**

Two obese + LDL subjects at pretest and 2 subjects at posttest added >2.5 teaspoons of fish sauce when subjects ate noodle **(Table 4.53 I).**

Three obese + LDL subjects at pretest and 3 subjects at posttest ate some soup when subjects ate noodle **(Table 4.53 I).**

Two obese + LDL subjects at pretest and 4 subjects at posttest small dipped sauce when subjects ate meat ball. Two obese + LDL subjects at pretest big dipped sauce when subjects ate meat ball, however they did not big dipped sauce when subjects ate meat ball at posttest **(Table 4.53 I).**

Three obese + LDL subjects at pretest and 3 subjects at posttest added $\leq$ 2 teaspoons of ketchup and chili sauce when subjects ate omelet, French fries, pizza or fried chicken **(Table 4.53 II).**

Two obese + LDL subjects at pretest and 1 subject at posttest liked sweet taste. Two obese + LDL subjects at pretest and 3 subjects at posttest liked salty taste **(Table 4.53 II)**.

Two obese + LDL subjects at pretest and 4 subjects at posttest liked crispy snack. Two obese + LDL subjects at pretest liked dessert snack, however they did not liked dessert snack at posttest **(Table 4.53 II)**.

Four obese + LDL subjects at pretest and 4 subjects at posttest drank water after exercise **(Table 4.53 II)**.

Three obese + LDL subjects at pretest and 4 subjects at posttest preferred fresh mango to pickled mango **(Table 4.53 II)**.

Four obese + LDL subjects at pretest and 4 subjects at posttest ate dried fruit 1 time/week **(Table 4.53 III)**.

Two obese + LDL subjects at pretest and 3 subjects at posttest ate snacks (potato chip, fish snack, and crispy rice) 2-3 times/week. Two obese + LDL subjects at pretest ate snacks (potato chip, fish snack, and crispy rice) $\geq$4 times/week, however they did not ate snacks (potato chip, fish snack, and crispy rice) $\geq$4 times/week at posttest **(Table 4.53 III)**.

Three obese + LDL subjects at pretest and 4 subjects at posttest ate bakery (cake, pancake, and bread) 2-3 times/week **(Table 4.53 III)**.

Two obese + LDL subjects at pretest and 3 subjects at posttest ate meat products (meat ball and sausage) 2-3 times/week. Two obese + LDL subjects at pretest ate meat products (meat ball and sausage) ≥4 times/week and posttest, however they did not ate meat products (meat ball and sausage) ≥4 times/week at posttest **(Table 4.53 III)**.

Three obese + LDL subjects at pretest and 1 subject at posttest ate salted peanuts 1 time/week **(Table 4.53 III)**.

In overview after receiving the nutritional therapy and nutritional education about sodium reduction, food behavior about sodium of 2 of 4 subjects had positive behavior, whereas 2 of 4 subjects had negative behavior.

Table 4.51 Sodium knowledge of 4 obese + LDL subjects

Questions	Pre-Total (n=4)		Post-Total (n=4)	
	correct answer	males	correct answer	males
	n (% [a])	*n (% [b])*	*n [k5](% [a])*	*n [k5](% [b])*
1.What is atomic number of sodium?	2(50.0)	2(100.0)	3(75.0)	3(100.0)
2.What is atomic weight of sodium?	-	-	3(75.0)	3(100.0)
3. What group is sodium in the periodic table?	2(50.0)	2(100.0)	4(100.0)	4(100.0)
4. What is chemical formula of table salt?	3(75.0)	3(100.0)	4(100.0)	4(100.0)
5. How much does a teaspoon of salt weigh?	1(25.0)	1(100.0)	4(100.0)	4(100.0)
6. How much does sodium of a teaspoon salt weigh?	3(75.0)	3(100.0)	3(75.0)	3(100.0)
7. Which item is all high sodium foods?	4(100.0)	4(100.0)	3(75.0)	3(100.0)
8. Which item is all low sodium foods?	4(100.0)	4(100.0)	3(75.0)	3(100.0)
9. Which plant do have the highest sodium content?	-	-	3(75.0)	3(100.0)
10.Which item of 100 gram seasoning do have the highest sodium content?	2(50.0)	2(100.0)	4(100.0)	4(100.0)

[a]% of total 4 obese + LDL subjects, [b]% of total subjects correctly answer
Significant difference from week0, [k5] $p < 0.05$

Table 4.52 Sodium and health of 4 obese + LDL subjects

Questions	Pre-Total (n=4)		Post-Total (n=4)	
	correct answer	males	correct answer	males
	n (% [a])	*n (% [b])*	*n (% [a])*	*n (% [b])*
1.Which one is not the sodium function in the body?	3(75.0)	3(100.0)	2(50.0)	2(100.0)
2. How much sodium recommended per day?	3(75.0)	3(100.0)	4(100.0)	4(100.0)
3. Sodium excretion through many organs, except?	4(100.0)	4(100.0)	4(100.0)	4(100.0)
4. Which substance is used to replace for salty taste?	4(100.0)	4(100.0)	1(25.0)	1(100.0)
5. What to drink when you have severe diarrhea?	4(100.0)	4(100.0)	4(100.0)	4(100.0)
6. Which sign or symptom caused by high sodium?	-	-	-	-
7. Which sign or symptom caused by low sodium?	2(50.0)	2(100.0)	3(75.0)	3(100.0)
8. Which disease caused by high sodium intake?	4(100.0)	4(100.0)	4(100.0)	4(100.0)
9. Which kind of meats can cause high blood pressure?	-	-	4(100.0)	4(100.0)
10. We can assess sodium intake by several methods, except?	1(25.0)	1(100.0)	1(25.0)	1(100.0)

[a]% of total 4 obese + LDL subjects, [b]% of total subjects correctly answer

Table 4.53 sodium and food behavior of 4obese + LDL subjects I

Questions	Pre-Total (n=4)		Post-Total (n=4)	
	Total	Males	Total	Males
	n (% [a])	*n (% [b])*	*n (% [a])*	*n (% [b])*
1. Do you dip salt and chili when you eat sour fruits?				
- Never	-	-	-	-
- Sometime	3(75.0)	3(100.0)	4(100.0)	4(100.0)
- Always	1(25.0)	1(100.0)	-	-
2. Do you add fish sauce when you eat noodle?				
- Never	1(25.0)	1(100.0)	-	-
- Sometime	1(25.0)	1(100.0)	2(50.0)	2(100.0)
- Always	2(50.0)	2(100.0)	2(50.0)	2(100.0)
3. How much fish sauce do you add to your noodles?				
- Never	1(25.0)	1(100.0)	-	-
- <1 teaspoon	-	-	-	-
- ≤1.5 teaspoons	-	-	2(50.0)	2(100.0)
- ≤2.5 teaspoons	1(25.0)	1(100.0)	-	-
- >2.5 teaspoons	2(50.0)	2(100.0)	2(50.0)	2(100.0)
4. How do you eat your noodle soup?				
- Never	-	-	-	-
- some soup	3(75.0)	3(100.0)	3(75.0)	3(100.0)
- whole noodle soup	1(25.0)	1(100.0)	1(25.0)	1(100.0)
5. Do you dip sauce when you eat meat ball, sausage?				
- Never	-	-	-	-
- Small dip	2(50.0)	2(100.0)	4(100.0)	4(100.0)
- Big dip	2(50.0)	2(100.0)	-	-

[a]% of total 4 obese + LDL subjects, [b]% of total subjects each item

Table 4.53 Sodium and food behavior of 4obese + LDL subjects II (cont.)

Questions	Pre-Total (n=4)		Post-Total (n=4)	
	Total	Males	Total	Males
	n (% [a])	*n (% [a])*	*n (% [a])*	*n (% [a])*
6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken?				
- Never	-	-	-	-
- ≤1 teaspoons	-	-	-	-
- ≤2 teaspoons	3(75.0)	3(100.0)	3(75.0)	3(100.0)
- >2 teaspoons	1(25.0)	1(100.0)	1(25.0)	1(100.0)
7. Which taste would you like ?				
- Sweet	2(50.0)	2(100.0)	1(25.0)	1(100.0)
- Salty	2(50.0)	2(100.0)	3(75.0)	3(100.0)
- Sour	-	-	-	-
8. Which snack would you like ?				
- Crispy snack	2(50.0)	2(100.0)	4(100.0)	4(100.0)
- Dessert	2(50.0)	2(100.0)	-	-
- Bread	-	-	-	-
9. After exercise, which beverage would you drink?				
- Water	4(100.0)	4(100.0)	4(100.0)	4(100.0)
- carbonated beverage	-	-	-	-
-sport drink	-	-	-	-
10. Which mango do you flavor?				
- Fresh mango	3(75.0)	3(100.0)	4(100.0)	4(100.0)
- Pickled mango	1(25.0)	1(100.0)	-	-

[a]% of total 4 obese + LDL subjects, [b]% of total subjects each item

Table 4.53 Sodium and food behavior of 4obese + LDL subjects III (cont.)

Questions	Pre-Total (n=4)		Post-Total (n=4)	
	Total	Males	Total	Males
	n (% [a])	*n (% [b])*	*n (% [a])*	*n (% [b])*
11. How often did you eat dried fruits?				
-Never	-	-	-	-
- 1 time/week	4(100.0)	4(100.0)	4(100.0)	4(100.0)
- 2-3 times /week	-	-	-	-
- ≥ 4 times /week	-	-	-	-
12. How often did you eat the following snacks (potato chip, fish snack, and crispy rice) ?				
- Never	-	-	-	-
- 1 time/week	-	-	-	-
- 2-3 times /week	2(50.0)	2(100.0)	3(75.0)	3(100.0)
- ≥ 4 times /week	2(50.0)	2(100.0)	1(25.0)	1(100.0)
13. How often did you eat the following bakery (cake, pancake, and bread) ?				
- Never	-	-	-	-
- 1 time/week	-	-	-	-
- 2-3 times /week	3(75.0)	3(100.0)	4(100.0)	4(100.0)
- ≥ 4 times /week	1(25.0)	1(100.0)	-	-
14. How often did you eat the following meat products (meat ball, sausage) ?				
- Never	-	-	-	-
- 1 time/week	-	-	-	-
- 2-3 times /week	2(50.0)	2(100.0)	3(75.0)	3(100.0)
- ≥ 4 times /week	2(50.0)	2(100.0)	1(25.0)	1(100.0)
15. How often did you eat salted peanuts.				
- Never	-	-	1(25.0)	1(100.0)
- 1 time/week	3(75.0)	3(100.0)	1(25.0)	1(100.0)
- 2-3 times /week	1(25.0)	1(100.0)	2(50.0)	2(100.0)
- ≥ 4 times /week	-	-	-	-

[a]% of total 4 obese + LDL subjects, [b]% of total subjects each item

4.14 Nutritional therapy on urinary sodium excretion

Urinary sodium excretion

24-hour urinary sodium excretions of 4 obese + LDL subjects were collected 1-day at week 0 and 1-day at week 32.

Table 4.54 shows means ±SEM and range of urinary sodium excretion of 4 obese + LDL subjects during the study.

Mean of 24-hour urinary sodium excretions at week 0 was 154.9 $\pm$ 29.6 mmol/day (102.0 – 239.4 mmol/day) and at week 32, mean of 24-hour urinary sodium excretions was 282.4 $\pm$ 60.5 mmol/day (141.0 – 432.0 mmol/day). Mean of 24-hour urinary sodium excretions at week 32 was higher than that from week 0 but did not reach significant difference. However, after receiving the nutritional therapy and nutritional education, the study showed that number of 24-hour urinary sodium excretions of all of 4 subjects increased from week 0.

Table 4.54 Means ±SEM and range of urinary sodium excretion of 4 obese + LDL subjects

Parameter	Week 0		Week 32	
	Total (n=4)	Males (n=4)	Total (n=4)	Males (n=4)
Urinary sodium excretion (mmol/day)	154.9 $\pm$ 29.6 (102.0 – 239.4)	154.9 $\pm$ 29.6 (102.0 – 239.4)	282.4 $\pm$ 60.5 (141.0 – 432.0)	282.4 $\pm$ 60.5 (141.0 – 432.0)

CHAPTER V
DISCUSSION

Princess Chulabhorn's College Chiang Rai (Regional Science School) (PCCCR), a school founded by the royal projects to honour Her Royal Highness Princess Chulabhorn Walailak on the occasion of her 36th anniversary, established 27th July 1993. PCCCR is one of the 12 Chulabhorn Science High Schools in 12 provinces, covered 6 regions of Thailand (Phitsanulok, Lopburi, Pathumthani, Chonburi, Phetchaburi, Loei, Buriram, Mukdahan, Nakhon Si Thammarat, Trang, Satun, and Chiang Rai) for nurturing students with exceptional ability (gifted) in mathematics and science both lower and upper high school in a kind of residential high school. The school has a 3-year program at the junior high school level (grade 7 to 9) and also a 3-year program at the senior high school level (grade 10 to 12). All programs are specialized and intensive in mathematics and science. It is a co-education and boarding school.

PCCCR is a boarding school where all students study and live during the school year with their fellow students and possibly teacher and administrators. The word "boarding" is used in the sense of "bed and board" that is, food and lodging. This research was prospective study aimed to assess the association of salt intakes and salt reduction in secondary school-age students of PCCCR and the researcher is intended to develop the methods in reducing dietary sodium intake in the risk group. Our subjects consisted of 813 total students including 317 males and 496 females, aged 12 to 18 years.

Most of 813 total subjects came from single family, most of them had 2 siblings. Most father and mother completed bachelor's degree, they were government official/state enterprise. The majority of family income was 20,001 - 30,000 Baht/month, most of total subjects allowances from their parents were 500 - 1,000 Baht/month, and most of their expenses were used for snack.

5.1 Nutritional status of 813 PCCCR subjects

5.1.1 Body composition

Nutritional status were assessed by body composition, classified by BMI-for age as an indicator, based on WHO criteria (41) in this study it was found that 6.8% of 813 subjects were overweight, and when using body fat (%bw) indicator (42) in this study it was found that 3.2% had excess body fat. In 2010 Rattanayosee et al. studied in Thailand at PCCCR they found 9.6% of 820 PCCCR students were overweight, 12.4% had excess body fat (11). Percentage of overweight and excess body fat in PCCCR students of our study declined from year 2010 due to PCCCR students receiving the nutritional therapy from Waisaihealth program since 2009.

Jitnarin N, et al., (51) studied in Thai population, a cross-sectional population survey, aged 12 to 18 years, and results of the National Thai Food Consumption Survey in 2011, overweight and obesity were defined based on the sex-specific BMI for age standard from the 2000 reference proposed by the International Obesity Task Force (IOTF), found that the prevalence of overweight and obesity of adolescent was 2.4% and 0.9%, respectively, lower than our study, 8.2% and 6.8% of overweight and obesity (WHO criteria) of PCCCR students, aged 12-18 years may be due to the different criteria.

When we compare these obese prevalences with other Asian countries: in 2012 Li P, et al., (52) studied in 7,194 Chengdu, Southwest Chinese, aged 9-15 years, used WHO criteria (BMI-for-age (Z-score >1SD and <2SD = overweight) and (BMI-for-age (Z-score >2SD = obesity), both of overweight and obesity were called excess body weight found the prevalence of excess body weight was 17.8% higher than our study, 15.0% of PCCCR students, aged 12-18 years may be due to the difference of the range ages, furthermore in Li P, et al., (52) studied found that a significant decreasing tendency with increasing age of excess body weight prevalence was shown in both boys and girls. The prevalence of excess body weight in boys was higher than in girls.

When using body fat (%bw) indicator (42) which is the best parameter to classify obesity during adolescence period, we found 55.7% of at risk of overweight and overweight subjects had normal body fat, this may be due to their large frame

size. When compare proportion of obesity under BMI percentile and body fat: in 2011, Etchison WC, et al., (53) studied in 33,595 student athletes, range aged 11-19 years, used BMI percentile found 13.31 % of adolescent athletes were obese but found only 5.95% were obese when used the skinfold method which the same as our study, 15.0% of PCCCR students were obese when used BMI-for-age as an indicator but found only 6.3% were obese when used body fat (%bw) indicator, main point of Etchison WC, et al., (53) studied found that 62% of those classified as obese by BMI were false positive when consider by the skinfold method. Therefore, assessment of nutrition status should considered both BMI and body fat, especially body fat reference can be useful for evaluation of overweight and obesity, furthermore Kurtoglu S, et al., (54) studied in 4,076 (2,276 girls, 1,800 boys) healthy Turkish children and adolescents aged 6-18 years found that the mean body fat % was measured by a segmental body composition analyzer, Tanita BC-418MA of girls significantly higher than boys which as same in our study, mean body fat (%bw) in female M.1-M.3 and M.4-M.6 subjects was found to significantly higher than males.

All the above mentioned, childhood obesity is a predictor of adult obesity and obesity-related disorders (metabolic syndrome, cardiovascular disease, type 2 diabetes, nonalcoholic fatty liver disease, obstructive sleep apnea, polycystic ovarian syndrome, infertility, asthma, and increased rates of cancer) among others (55). From prevalence of childhood and adult obesity defined as body mass index at or above the 95th percentile on the Centers for Disease Control and Prevention (CDC) sex-specific BMI for age growth charts in 9,120 participants of the United States, aged 12-19 years in Ogden CL, et al. (56) found that 17.4% and 20.5% of obesity prevalence in 2003-2004 and 2011-2012, respectively but no significant change in prevalence between 2003-2004 and 2011-2012, nevertheless when observed in aged $\geq$60 years, 31.0% and 35.4% of obesity prevalence in 2003-2004 and 2011-2012, respectively which an increased obesity prevalence between 2003-2004 and 2011-2012 which childhood obesity also results in the development of chronic co-morbid condition of obesity in adults. Therefore, the early intervention is important to prevent the effect of childhood obesity on the development of diet-related chronic diseases at adulthood (57).

Several strategies for weight loss from clinical guideline for treatment of overweight and obesity, (58) especially in adolescent overweight and obesity, these

strategies for weight loss are much more important because they are in the grow period (59). There are many strategies of prevention and treatment for childhood obesity such as diet and physical activity, behavior therapy, pharmacotherapy, and surgery (60).

Pharmacological treatment of obesity in children and adolescents, in Inghetti L, et al. (61) show guideline suggests pharmacotherapy in overweight in children and adolescents only if severe co-morbidities persist despite intensive lifestyle modification, particularly in children with a strong family history for type 2 diabetes or premature cardiovascular disease but patients should be aware of this potential for adverse effects such as nausea, dizziness, and diarrhea, moreover some medicine had interferences with absorption of fat-soluble vitamins (A, D, E, and K). As same in bariatric surgery (62), in children and adolescents, used for anyone who is severe obesity and co-morbidities because it is effect to a number of different procedures designed to restrict food intake and/or reduce nutrient absorption which risks typically vary depending on the type of surgery.

From adherence to nutritional therapy in obese adolescents; a review, in Franca SL, et al., (63) definition of adherence was "voluntary participation of the subject in solving their own problems and making decisions about changes in their diet". Furthermore, nutritional therapy is importance to prevention of weight gain in overweight and obese, which they can maintenance of an altered body weight (64). From design of the nutritional therapy in 2012, Marques M, ea al., (65) studied in 204 overweight and obese Spanish adolescents, range aged 13-16 years, used EVASYON program (Development, implementation and evaluation of the efficacy of a therapeutic programmed for overweight/obese adolescents) was dietary intervention to improve nutrition education in order to reach food behavior modification and helps adolescent to plan with free-choice menus were right decisions for every day meals. Therefore one of the best strategies to reduce childhood obesity is to improve the diet and exercise habits of your entire family. As same in our study, we used nutritional therapy for obesity, anemia, hyperuricemia, and hyperlipidemia because this therapy is cost saving and helps protect the health of your child now and in the future. Therefore each intervention may have minimal effects when assessed in isolation but it can significant corporate of overall strategy (66).

The nutritional therapy in this study was performed at weeks 0, 16, 24, and 32 for obesity, anemia, hyperuricemia, and hyperlipidemia. Our study provided group nutritional education for all students and individuals for students who had the above nutritional problems. Various medias were used for counseling and nutritional education eg. brochures, poster, power point, and video. Demonstration and explaining about the food groups such as low calorie food, low cholesterol food, processed food, preserved food, seasonings, beverages, and snacks. The present study suggested that reduction in energy intake from high sodium food and snacks is important for obese subjects.

After receiving the nutritional therapy for 32 weeks, the nutritional therapy was an effective to improve body weight status, which 31.1% (38 of 122) of at risk of overweight and overweight subjects and 21.3% (26 of 122) of at risk of overweight and overweight subjects had become normal body weight. When we follow-up by percentage of body fat 29.6% of over and excess body fat subjects had become normal body fat.

5.1.2 Anemia, hyperuricemia, and dyslipidemia

At the beginning of academic year, anemia, hyperuricemia, and dyslipidemia were assessed by blood examination.

Prevalences of anemia, hyperuricemia, hypertriglyceridemia, low HDL-cholseterol level, and hypercholesterolemia were 13.5%, 46.1%, 1.4%, 10.7%, and 15.4% of 813 PCCCR students close to the study in 713 SW.PY students (Srinagarindra the Princess Mother School, Phayao is boarding school in Northern Thailand) in 2012 by Satoh S, et al (Thesis, unpublished data) found that anemia (10.1%), hyperuricemia (61.4%), hypertriglyceridemia (2.1%), low HDL-cholseterol (8.4%), and hypercholesterolemia (10.8%).

Anemia

Prevalence of anemia in Singh P, et al., (67) studies in 2,027 adolescent (aged 10-19 years) males and females attending out-patients and in-patient from 2011-2012 in the far western part of Nepal, anemia was classified according to WHO's criteria, hemoglobin<12 g/dL, found that 52.0% of 2027 adolescent patients, 22.4% of

the males and 29.7% of the females were anemia. The highest prevalence were found in 18-19 year age group, 27.7% were anemia. However in our study, the highest prevalence were found in 16-17 year age group, 50.0% were anemia, most of anemic subjects were females (0.9% in males and 99.1% in females). In addition, in Bagni UV, et al. (68), studies in 707 adolescent, aged 11.0-19.9 years found overweight girls (BMI for age $\geq$ 95th percentile) presented significantly lower hemoglobin concentration than not overweight due to the relation between overweight and the impairment in iron status would be the increase of inflammatory activity in adipose tissue of obese individuals, induce to a higher production of hepcidin (hormone for the regulation of intestinal absorption and iron homeostasis). From, in Sanad M, et al., (69) studies in 70 children with iron deficiency anemia (IDA), (hemoglobin<11.5 for age 5-11 years, hemoglobin<12 for age above 12 years) (35 obese (mean age 7.11 year) with BMI $\geq$ 95th percentile for age and sex and 35 non-obese (mean age 6.96 year) with BMI < 85th percentile for age and sex). Healthy non-obese were 30 children (mean age 7.11 year) of comparable age and sex served as a control group. When compared to the control group, serum hepcidin was significantly lower in non-obese children with IDA ($p< 0.01$) and significantly higher in obese children with IDA ($p< 0.01$). In addition, in Zimmermann MB, et al., (70) studied in 92 Thai women (18-50 years), Moroccan (6-15 years) and Indian (6-13 years) children found a higher BMI Z-score was associated with decreased iron absorption.

Our study in 813 subjects we found the significantly negative correlation between percentage of body fat and hemoglobin level ($r=-0.3925$, $p<0.0005$) as well as fat mass and hemoglobin level ($r=-0.1918$, $p<0.0005$). We gave nutritional therapy for anemic subjects group throughout the study, which the results show in Teeratititum S, et al. (Thesis, unpublished data).

Hyperuricemia

The mean concentration of serum uric acid in Lin JD, et al., (71) studied in 941 Taiwan children and adolescent, aged 4-18 years (59.7% in boys and 40.3% in girls), found 6.33 $\pm$ 1.77 mg/dL (range 1.80-15.20) in the boys and 4.85 $\pm$ 1.39 mg/dL (range 1.50-10.40) in the girls. In our study, we found the mean concentration of serum uric acid were 6.59 $\pm$ 1.44 mg/dL (range 3.0-12.0) in males and 4.93 $\pm$ 0.98

mg/dL (range 3.0-9.0) in females. Moreover, in Lin JD, et al., (71) hyperuricemia was classified according to DOH, 2009 criteria (serum uric acid ≥7 mg/dL for men and serum uric acid ≥6 mg/dL for women) found prevalence of hyperuricemia was 27.4% in 623 Taiwan children and adolescent, aged 13-18 years, which prevalence of hyperuricemia (46.1%) in our study higher than studied in Taiwan children and adolescent because two different criteria to classified subjects, in our study, hyperuricemia was classified according to Feig ID and Johnson RJ, 2003 (46) (serum uric acid >5.5 mg/dL). In addition, in Lin JD, et al. (71), found that correlation between serum uric acid and BMI value among the 920 subjects ($r=0.477$, $P<0.001$) which prevalence of hyperuricemia in obese individuals (prevalence =57.6%) had significantly higher than overweight (prevalence =28.3%), normal weight (prevalence =17.1%) or underweight persons (prevalence =10.2%). As same in our study in 813 PCCCR subjects found correlation between serum uric acid and BMI value ($r=0.321$, $p<0.0005$) which prevalence of hyperuricemia in overweight had significantly higher than at risk of overweight, normal weight, or underweight subjects were 76.4%, 62.7%, 42.5%, and 35.0%, respectively. We gave nutritional therapy for hyperuricemic subjects group throughout the study, which the results show in Teeratititum S, et al. (Thesis, unpublished data).

Dyslipidemia

The mean concentration of serum triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) in Yang s, et al. (72), studied in 2,363 Korean children and adolescent, aged 10-18 years, found 90 mg/dL, 49 mg/dL, and 90 mg/dL, respectively. Our study, in 813 subjects, we found the mean concentration of serum TG, HDL-C and LDL-C were 64 mg/dL, 51 mg/dL, and 112 mg/dL, respectively. Moreover, in Yang s, et al. (72), dyslipidemia was classified according to the NECP (2007-2009) and AHA (2003) report (serum TG >150 mg/dL, HDL-C <35 mg/dL, and LDL-C >130 mg/dL) found prevalence of high TG, low HDL-C and high LDL-C were 10.1%, 7.1%, and 4.7%. In our study, dyslipidemia was classified according to the NECP (2002) and AHA (2003) criteria (serum TG >150 mg/dL, HDL-C <40 mg/dL, and LDL-C >130 mg/dL) found prevalence of high TG, low HDL-C and high LDL-C were 1.4%, 10.7%, and 15.4%.

From the above mentioned prevalences of dyslipidemia, prevalence of hypertriglyceridemia in our study was lower than in Yang s, et al. (72) studied (1.4% and 10.1%, respectively), despite the same hypertriglyceridemia criteria (serum TG >150 mg/dL), thus this evidence may be due to our study was carried out in PCCCR which is a boarding school, all meal were prepared by PCCCR school canteen and snacks sold in PCCCR school co-operatives shop were controlled by teachers who concerned the nutritional values. Whereas, Yang s, et al. (72) studied in non-institutionalized civilian population of Korea and prevalence of obese subjects in our study less than in Yang s, et al. (72) studied (6.8% (BMI for age, WHO criteria) and 14.4% (BMI for age $\geq 95^{th}$ percentile), respectively). The prevalence of low HDL in our study higher than in Yang s, et al. (72) (10.7% and 7.1%, respectively), because two different criteria to classified subjects. The prevalence of hypercholesterolemia in our study higher than in Yang s, et al. (72) studied (15.4% and 4.7%, respectively), despite the same hypercholesterolemia criteria (serum high LDL-C >130 mg/dL). However, we need further investigation to clarify this evidence.

The correlation between body composition and dyslipidemia were studied by Park J, et al. (73) in 734 United States and 664 Korea adolescents (12-19 years) found the prevalence of hypertriglyceridemia in obese groups (BMI for age $\geq 95^{th}$ percentile) was more than 2.7 and 1.4 times that of the normal weight group (BMI for age ≥ 5 to $<85^{th}$ percentile) and overweight group (BMI for age $\geq 85^{th}$ to<95 percentile), respectively in United States adolescents and the prevalence of hypertriglyceridemia in obese groups was more than about 5 and 2 times that of the normal weight group and overweight group, respectively in Korea adolescents. In our study, we found the significantly positive correlation between BMI and serum triglyceride levels ($r=0.1370$, $p<0.0005$) as well as fat mass and serum triglyceride levels ($r=0.1430$, $p<0.0005$) and percentage of body fat and serum triglyceride levels ($r=0.1295$, $p<0.0005$). In addition, in Yang s, et al. (72) studied found the peak of TG concentration in aged 15-16 years group in boys and aged 11-12 years group in girls. In our study found the peak of TG concentration in aged 17-18 years group in males and aged 13-14 years group in females. In Yang s, et al. (72) studied found in girl had higher mean HDL-C than boys after 14 years of age ($p<0.001$). The prevalence of low HDL-C in obese groups (BMI $\geq 95^{th}$ percentile) was more than 3 and 1.5 times that of

the normal weight group (BMI for age $\geq$5 to<85th percentile) and overweight group (BMI for age $\geq$85th to<95 percentile), respectively in United States adolescents. In our study found the significantly negative correlation between weight and HDL-C levels (r=-0.1733, p<0.0005) and in females had higher mean HDL-C than males since 12 through 18 years of age (P<0.002). Moreover in Yang s, et al. (72) studied found the mean LDL-C decreased from 12 years of age and then stabilized subsequently only in boys but in girl LDL-C still stable from 12 years and the prevalence of high LDL-C (>130 mg/dL) was greater in girls than in boys (5.5% and 4.1%, P<0.001). In our study found the prevalence of high LDL-C (>130 mg/dL) was greater in males than in females (17.7% and 13.9%) but the prevalence of borderline LDL-C (110-130 mg/dL) was greater in females than in males (39.5% and 33.8%). We gave nutritional therapy for hypercholesterolemia subjects group throughout the study, which the results show in Teeratititum S, et al. (Thesis, unpublished data).

Hypercholesterolemia (high LDL-C) and obesity are the major risk factors of atherosclerosis (74, 75), thus preventing childhood obesity and/or hypercholesterolemia will reduce the prevalence of cardiovascular disease at the adult age in the future.

In spite of high LDL-C is often genetic in origin, however unhealthy dietary intake also is the important cause of high LDL-C (76). Not only obese and/or hypercholesterolemia lead to cardiovascular disease, in Bibbrin-Demiko K, et al., studied and He FJ, et al., studied (8, 33) showed that the excessive sodium is a major cause of hypertension and importance risk of cardiovascular disease.

Therefore, the nutritional therapy and nutritional education about sodium intake and sodium reduction is main importance of this study. Sodium status in this study was assessed by urinary sodium excretion, dietary assessment, and questionnaires.

5.2 Questionnaires on sodium knowledge, health and food behavior

After screening unintentional subjects, we got the valid questionnaires from 784 subjects (299 males and 485 females) throughout the study. We also observed 100% of M.4 and 97.8% of M.1 subjects answered the questionnaires

intentionally which were higher than the other levels. This evidence may be due to both of M.4 and M.1 students were admitted to study in PCCCR by new entrance examination which providing fund for all new students.

5.2.1 Sodium knowledge

After giving the nutritional education, percentage of 784 students correctly answered the SN questions was significant increase from the pretest at the beginning of study, 56.6% to 78.9% ($p<0.005$).

In our study, average of percentage of 379 M.1-M.3 students knew that atomic number and weight, periodic table group of sodium, and chemical formula of table salt average lower than percentage of 405 M.4-M.6 students (39.4% VS 79.0%). Because of basic chemistry is which one of core curriculum requirement for senior high school level.

Moreover, in our study, most of M.1-M.6 students knew that which foods have low or high sodium content, however, most of them, 74.8% did not know that some vegetables are high in sodium, e.g. tomato. Because of fresh tomato did not have the salty taste.

North SL and Neale RJ., (77) studied in 214 students of secondary school in the Nottingham City area, aged 11-16 years found lowest percentage of subjects correctly answered about food high in salt (cornflakes and tomato ketchup). Even among adult aged 35-50 years in Papadakis S, et al. (78) studied in 3,130 participants found approximately 50% of respondents did not identify the following food high in sodium: hamburgers, processed cheese, canned or bottle tomato sauce, and mustard and ketchup. Therefore, the early nutritional education about sodium intake and sodium reduction is important to prevent the excessive sodium since childhood on the development of hypertension and importance risk of cardiovascular disease at adulthood.

5.2.2 Sodium and health

After giving the nutritional education, percentage of 784 students correctly answered the SH questions was significant increase from the pretest at the beginning of study, 56.2% to 71.5% ($p<0.005$).

Only in 379 M.1-M.3 students, the percentage of subjects correctly answered the SH questions was significant increase from the pretest at the beginning of study, 52.1% to 70.2% ($p<0.05$). This evidence may be due to their higher intention to study about nutrition knowledge more than senior high school students.

North SL and Neale RJ., (77) studied in 195 students of secondary school in the Nottingham City area, aged 11-16 years found in the younger age group (11-13 years), 10-15% do not know about family use any food product labeled “reduced salt” or “low in salt” which percentage of girls know in this question more than boys (40.6% of boys and 56.7% of girls). We also found in our study, 16.3% of 784 students did not know that potassium chloride has the salty taste.

5.2.3 Sodium and Food behavior

North SL and Neale RJ., (77) studied in 214 students of secondary school in the Nottingham City area, aged 11-16 years found four of the most popular items orders of snack, more than times a week, were bread/toast (78.7%), fruit (73.3%), crisps (68.6%), and chocolate (65.8%). From information of North SL and Neale RJ., bread/toast had sodium content 650 mg Na/100g within a range of medium (200-699 mg Na/100g) and crisps had sodium content 1,070 Na/100g within a range of high (>700mg Na/100g) would be an important source of dietary salt due to its high frequency of consumption. As same in our study, M.1-M.6 students, 72.1% ate bakery (cake, pancake, and bread) and 66.3% ate snack (potato chip, fish snack, and crisp rice) more than times a week at the beginning of study. After giving the nutritional education, our subjects concerned about their nutritional status and excess of sodium intake, thus their high sodium food intake decreased from the beginning of study, e.g., bakery (72.1% to 62.7%) and crispy snack (66.3% to 59.3%).

After receiving the nutritional education about sodium reduction, we found percentage of positive food behavior of 784 students increased from pretest.

Throughout of study, we gave nutritional education by various medias e.g. poster about high sodium of snack were stick in PCCCR school canteen and PCCCR school co-operatives shop for awareness of excessive sodium consumption. But some negative food behavior increased, this evidence may be due to at the end of study were

during second semester examination they thought that they should have more snacks during study in the evening.

Furthermore, we found 414 of M.4-M.6 students drank carbonated beverage after exercise increased from baseline, because at the end of academic year there was a lot of competitive sports outside school.

From the aforementioned nutritional status of PCCCR students, we found some students with nutritional problems especially obesity and hypercholesterolemia which are the cardiovascular risk factors. Thus we need to give nutritional therapy for reducing the severity of these nutritional problems in adolescent students.

Our study about the effect of nutritional therapy on obesity and hypercholesterolemia, as well as salt intake and salt reduction performed in 21 obese subjects, 50 LDL subjects, and 4 obese + LDL subjects.

5.3 In 21 obese subjects

The results from 21 obese subjects were selected to analyze because all of them had completed data throughout the study including body composition, blood chemistry, questionnaire on sodium knowledge, health and food behavior, 3-days 24-hour dietary records, and 1-day 24-hour urinary sodium excretion.

After giving the nutritional therapy and nutritional education, mean BMI at weeks 16, 24, and 32 decreased significantly from baseline. Most change was at week 16 because it is first 8 weeks of receiving the nutritional therapy and nutritional education, thus subjects intend to follow the advice for reduce your body weight. Whereas mean BMI at week 24 increased significantly from week 16 because, those subjects returned to stay at home during the end of first semester, so they had over consumption. However, mean BMI at week 32 decreased from week 24 but this difference did not reach statistical significance, when they back to stay at boarding school, all meal were prepared by PCCCR school canteen, snack sold were controlled by teachers who concerned the nutritional values and we gave the advice. Thus, obese subjects should be receiving nutritional therapy and nutritional education constantly, they can also improvement your body weight in long-term.

Reinehr T, et at., (79) studied in long-term follow-up of overweight children: after training, after a single consultation session, and without treatment, aged 6-15 years found overweight children do not reduce body weight without therapy, a single consultation session is not reach reduce body weight, and reducing weight to be at least two years to be reach part of the participant of a long-term.

In our study, using body fat (%bw) indicator (42) which is the best parameter to classify obesity in the growing adolescents, after receiving the nutritional therapy, at week 32, 42.8% obese subjects had become normal body fat, and 85.7% of them had body fat reduction.

We also observed change of body composition (body weight and percentage of body fat) in 21 obese subjects with energy intake from 3-days 24-hour dietary records.

When comparison energy intake from 3-days 24-hour dietary records, range 1,826-2,730 kcal/d, with energy requirement (80), for their current body weight (obese weight), range 1,822-3,038 kcal/d, their recorded energy intakes were lower than their energy requirement. Thus this evidence may be due to the students try to reduce their energy intake for weight reduction. As same Lioret s, et al., (81) studied in children (aged 3-10 years) and adolescent (aged 11-17 years), using a 7 day diet record and self-administered questionnaire found under-reporting was positively associated with overweight, as well as in adolescents, under-reporting was associated with current and past restrictive diets and a wish to weigh less.

However, at the end of study 9 of 21 obese subjects had weight gain, but their actual energy intake lower than their energy requirement, thus their 3-days 24-hour dietary records were underreports. Twelve of 21 obese subjects had weight loss, 8 of them had their energy intake from 3-days 24-hour dietary records lower than their energy requirement for maintain their current weight. However, 4 of them had unreliable dietary records.

When we followed-up with percentage body fat, 18 of 21 obese subjects had decrease body fat, 13 of them had their energy intake from 3-days 24-hour dietary records lower than their energy requirement for maintain their current weight. However, 5 of them and 3 of increase body fat subjects had unreliable dietary records.

Although, energy intake of 21 obese subjects from 3-days 24-hour dietary records cannot expect to quantitative intake but it can expect to qualitative intake of them. At the end of study, we also observe distribution of energy intake found increased of protein intake and decreased of carbohydrate intake but not reach significant from baseline, change of distribution may be due to they had awareness to excessive energy intake from we gave the advice in this obese subjects group. This evidence may be due to one reason of underreports in obese subjects. As same association of under-reports with a higher distribution of proteins to energy intake and a lower distribution of simple carbohydrates to energy intake in Lioret s, et al., studied (81).

However, mean dietary intake of 8 obese subjects had reliable dietary records, because their body weight, percentage body fat and energy intake were decrease. The beginning of this study mean sodium intake was 4,370 mg/day of obese subjects more than the daily intake recommended by Department of Health and Nutrition in 2009 (Na<2,400 mg/day) and decreased at end of study but did not reach statistical significance, moreover in our study found significant positive correlation of sodium intake with energy intake ($r=0.97$, $p=0.0005$), fat intake ($r=0.945$, $p=0.0005$) and cholesterol intake ($r=0.98$, $p=0.0005$). As same Zhu H, et al., (32) studied in 766 healthy white and African American adolescents, aged 14-18 years. Dietary sodium intake was estimated by 7-day 24-hour dietary recall, percent body fat was measured by dual-energy x-ray absorptiometry, visceral adipose tissue was assessed using magnetic resonance imaging, and fasting blood sample were measured for tumor necrosis factor-α, leptin and adiponectin found mean sodium intake was 3,280 mg/day of adolescents more than twice the daily intake recommended by American Heart Association (Na<1,500 mg/day), moreover found positive association of high sodium intake with adiposity and inflammation independent of total energy intake.

In other hand, result of mean urinary sodium excretion of 21 obese subjects from 1-day 24-hour urinary sodium excretion was 122.6 mmol/day, increased at end of study but did not reach statistical significance which opposite result was observed in sodium intake from 3-days 24-hour dietary records. Marrero NM, et al., (30) studied in 103 adolescents, aged 13-17 years, found dietary salt intake was assessed by 24-hour urinary sodium excretion, was 7.55 g/day. Our study in obese

subjects, dietary salt intake was assessed by 24-hour urinary sodium excretion, was 7.17 g/day or sodium intake 2,820 mg/day which more than recommended (23) (Na<2,400 mg/day) as same Pinho AP, et al., (31) studied in overweight/obese female adolescent (aged 12-18 years) found 24-hour urinary sodium excretion was 116.3 mEq/day more than control group although not significant.

At the beginning of study, mean snack sodium intake in 5 obese subjects who had reliable dietary snack records, was 535 mg/day (11.7% of daily total sodium intake). Mean snack sodium intake increased to 12.3% of daily total sodium intake at the end of study but not significant, this evidence may be due to at the end of study were during second semester examination they thought that they should have more snacks during study in the evening, and higher accuracy dietary records from new modify dietary record forms. Therefore, nutritional therapy and nutritional education about sodium intake and sodium reduction were important especially in 21 obese subjects because of both obesity and excess of sodium intake were risk factor of cardiovascular disease (8, 33, 75).

Moreover, beside obesity, and excess of sodium intake, hyperuricemia, hypercholesterol are risk factors of cardiovascular disease (8, 33, 74, 75, 82). Thus, nutritional therapy and nutritional education would be covered obesity consequences which are the above mentioned diseases, e.g. at the end of study, we found 2 new hypercholesterolemia cases in these 21 obese subjects.

We also observed change of body composition (body weight and percentage of body fat) in 21 obese subjects with blood chemistry. At the end of study, 12 of 21 obese subjects had weight loss and percentage of body fat decreased found 1(100%) of them, he had became normal FBS and serum triglyceride level, when we observed 3-days 24-hour dietary records found sugar-sweetened beverage consumption of him was 158 kcal (7% of total energy) per day it may be cause of high of FBS and serum triglyceride level at the beginning study. As same in Miller PE, et al., studied (83) in participants aged $\geq$2 years who had reliable 1-day 24-hour dietary recall data from the household interview found sugar-sweetened beverage consumption of male adolescents (aged 12–19 years) was 293 kcal/day (12% of total energy) had the highest mean intakes.

Moreover, after giving nutritional therapy, 12 of 21 obese subjects had weight loss found anemia 1(100%) of them, she had became normal hemoglobin level. From the relation between overweight and the impairment in iron status (68) it may be cause of anemia. The nutritional therapy and nutritional education, we suggested the local menu is "Khanomjean Nam-ngeaw" for anemia subject because in "Khanomjean Nam-ngeaw" consists of ferric from pork blood and vitamin C from tomatoes and lemons as well as recommend PCCCR school canteen serve fruits after lunch and dinner, and recommend subject drink low fat milk as snack.

Furthermore, the positive correlation between BMI and serum uric acid (71), it may be cause of hyperuricemia, as well as positive correlation between serum uric acid concentration and other cardiovascular disease risk factors (82). In 21 obese subjects found 19 (90.5%) of 21 obese subjects had high serum uric acid (>5.5 mg/dL). After giving nutritional therapy and nutritional education, 12 of 21 obese subjects had weight loss found 10 (83.4%) of 12 obese subjects uric acid level decreased from baseline and 2 (20.0%) of 10 obese subjects had become normal uric acid level. The nutritional therapy and nutritional education, we suggested them to avoid organ meats and protein supplement e.g. chicken essence because it have high purine, and drink a lot of water for increase uric acid excretion. However, 1 (8.3%)of 12 obese subjects uric acid level did not change and 1 (8.3%) of 12 obese subjects uric acid level increased from baseline, when we observed 3-days 24-hour dietary records found animal protein intake increased more than twice at the end of study. Thus this evidence may be due to subject try to reduce their energy intake for weight reduction. From studied in Villegas R, et al., (84) found positive correlation between animal protein and prevalence of hyperuricemia as well as negative correlation between plant protein and prevalence of hyperuricemia.

Therefore, improvement of body composition from the receiving nutritional therapy and nutritional education in long-term follow-up effect to improvement of blood chemistry. Moreover, nutritional therapy and nutritional education about sodium intake and sodium reduction is especially important in our study.

We also observed change of body composition (body weight and percentage of body fat) in 21 obese subjects with questionnaires on sodium

knowledge, health and food behavior. At the end of study, 12 of 21 obese subjects had weight loss and percentage of body fat decreased found 9 (75.0%) of 12 obese subjects correctly answered the SN and SH questions increased from pretest at the beginning of study. Nine (75.0%) of 12 obese subjects had positive of food behavior about sodium intake increased from pretest at the beginning of study.

After we gave nutritional education about sodium intake and sodium reduction found 10 (47.6%) of 21 obese subjects correctly answered the SN and SH questions increased from pretest at the beginning of study and subjects had positive of food behavior about sodium intake increased from pretest at the beginning of study.

We also observed the number of subjects who correctly answered questionnaires on sodium knowledge, health, and positive of food behavior was increase, as well as their urinary sodium excretion and sodium intake were decrease. At the end of study, 10 (47.6%) of 21 obese subjects correctly answered the SN and SH questions increased from pretest and subjects had positive of food behavior about sodium intake increased from pretest, found 5 (50.0%) of 10 obese subjects urinary sodium excretion decreased form baseline, 7 (70.0%) of 10 obese subjects sodium intake decreased form baseline. As same He FJ, et al., (34) studied found the difference between the intervention and control group in the change in 24 hour urinary sodium from baseline to the end of follow-up for children and for adults.

Therefore, in obese group would be receiving the nutritional therapy and nutritional education in earlier time for increase knowledge and understanding about weight reduction and especially sodium intake and sodium reduction, their improvement of body composition and blood chemistry will result in their better health.

5.4 In 50 LDL subjects

The results from 50 LDL subjects were selected to analyze because all of them had completed data throughout the study including body composition, blood chemistry, questionnaire on sodium knowledge, health and food behavior, 3-days 24-hour dietary records, and 1-day 24-hour urinary sodium excretion.

At the beginning of study, we did not found body composition (BMI and percentage of body fat) in 50 LDL subjects overweight or over body fat. However, we found 12.0% and 18.0% of 50 LDL subjects had underweight and low body fat, respectively is malnutrition. The adverse effects both had overnutrition all above mentioned in obese subjects and a part of subjects had undernutrition in these LDL subjects is malnutrition(85). Adverse effects of undernutrition, effect to decrease absorption of nutrient, more likely to have slowed growth, delayed development and high rates of illness and they may remain malnourished in to adulthood if we not giving nutritional therapy since in to childhood (86).

In our study, after giving the nutritional therapy and nutritional education, at week 32, underweight and low body fat in 50 LDL subjects decreased from 12.0% to 4.0%, and 18.0% to 14.0%, respectively.

We also observed change of body composition (body weight and percentage of body fat) 6 of underweight and 9 of low body fat in 50 LDL subjects with energy intake from 3-day 24-hour dietary records.

When comparison energy intake from 3-days 24-hour dietary records, range 1,826-2,815 kcal/d, with energy requirement (80), for their current body weight (thin weight), range 1,543-2,053 kcal/d, their recorded energy intakes were higher than energy requirement. This evidence may be due to the subjects try to increase their energy intake for weight gain. As same Johansson L, et al., studied in 3,144 subjects, aged 16-79 years in Norway found overreporting of energy intake from estimated basal metabolic rate (BMR) in younger and low BMI subjects, were more likely to want to increase their weight. (87)

However, 5 of 6 underweight had weight gain, only 1 of them had their energy intake from 3-days 24-hour dietary records higher than their energy requirement for maintain their current weight, thus she had weight gain. However, 4 of them and 1 of decrease body weight subjects had unreliable dietary records.

When we followed-up with percentage body fat, 4 of 9 low body fat subjects had increase body fat, 1 of them had their energy intake from 3-days 24-hour dietary records higher than their energy requirement for increase their current weight. However, 8 of them and 5 of decrease body fat subjects had unreliable dietary records.

On the other hand, at the beginning of study found 12.0% of 50 LDL subjects had at risk of overweight. After giving the nutritional therapy and nutritional education, at week 32, at risk of overweight in 50 LDL subjects decreased from 12.0% to 8.0%.

When comparison energy intake from 3-days 24-hour dietary records, range 1,826-3,198 kcal/d, with energy requirement (80), for their current body weight (at risk of overweight), range 1,852-2,544 kcal/d, their recorded energy intakes were lower than energy requirement. Thus this evidence may be due to the subjects try to reduce their energy intake for weight reduction.

However, at the end of study 4 of 6 at risk of overweight had weight loss, only 1 of them had their energy intake from 3-days 24-hour dietary records lower than their energy requirement for maintain their current weight, thus she had weight loss. However, 3 of them and 2 of increase body weight subjects had unreliable dietary records.

Moreover, at the end of study, we found 1 new over body fat cases in these 50 LDL subjects, when we observed questionnaire on sodium food behavior found she added fish sauce <1 teaspoons in noodle from never add at baseline, she small dipped sauce when you ate meat ball sausage from never dip at baseline, and she ate the following meat products (meat ball, sausage) increased from 1 time/week to 2-3 times/week at the end of study. From Zhu H, et al., studied (32) found positive correlation of high sodium intake with adiposity. Thus beside we create awareness in 50 LDL subjects to reduce LDL-cholesterol would be reduce sodium intake at the same time. Because of both hypercholesterol and excess of sodium intake are risk factors of cardiovascular disease (8, 33, 74).

Moreover, beside hypercholesterolemia and excess of sodium intake, hyperuricemia, hypertriglyceridemia are risk factors of cardiovascular disease (8, 33, 74, 82, 88) including low hemoglobin level adverse effect to health.

We also observed blood chemistry in 50 LDL subjects. At the end of study found 2 (100%) of them, hemoglobin level increased, 1 (50.0%) of them, she had become normal hemoglobin level, and 1 (50.0%) of them, hemoglobin level increased but still low hemoglobin level. However, we found 2 new low hemoglobin level cases in LDL subjects. Kabir Y, et al., (89) studied in 65 adolescent girls, aged 15-19 years,

used 24-hour recall method for assessed nutrient intake, found means of carbohydrate and fat intake lower than RDA, while protein, iron, and vitamin C intake were much higher. In our study, 1 of 2 new low hemoglobin level cases, had reliable of dietary record found protein and fat intake more than Thai RDI (2008) and increased from baseline, while carbohydrate, iron, and vitamin C lower than Thai RDI (2008) and at the end of study, iron and vitamin C still lower than Thai RDI (2008). Moreover, Kabir Y, et al., (89) studied found positive correlation between plasma vitamin C with serum hemoglobin. We need more further investigation for the other one.

Moreover, after giving nutritional therapy, 13 (54.2%) of 24 LDL subjects had serum uric acid level decreased, 3 of them, they had became normal serum uric acid level. When we observed 13 LDL subjects had serum uric acid level decreased found 8 (61.5%) of them, they had serum LDL-cholesterol level decreased from baseline. This evidence may be due to subjects reduce food intake such as organ meat, which have reduce effect to serum uric acid and serum cholesterol.

Furthermore, 1 case of 50 LDL subjects had borderline serum triglyceride level (192 mg/dL), and increased at the end of study (194 mg/dL), when we observed serum LDL-cholesterol of her increased from 151 mg/dL to 161 md/dL, this evidence may be due to she had percentage of body fat increased from baseline. As same Elaine M, et al., (90) studied in 893 subjects, aged 10-26 years found a progressive increase in BMI and BMI z-score across TG/HDL-C tertiles. However, nutritional therapy and nutritional education in our study, we suggested them to reduce fatty meals, sweet dessert, table sugar, and sweetened soft drinks.

In our study, 50 LDL subjects had LDL-cholesterol level higher than 130 mg/dL (hypercholesterolemia). After giving the nutritional therapy and nutritional education at week 32, mean of LDL-cholesterol decreased significantly from baseline, 38(76.0%) of 50 LDL subjects had LDL-cholesterol level decreased from baseline, 24(63.2%) of them LDL subjects had LDL-cholesterol level decreased less than 130 mg/dL, and 2(5.3%) of them had become normal LDL-cholesterol level ($\leq$110 mg/dL). The nutritional therapy and nutritional education, we suggested them to avoid egg yolk, organ meat, some seafood (shrimp, squid, oyster), fatty meat and meat with skin including snack especially bakery. From serum LDL-cholesterol level, at the end of study we confirmed that most of LDL subjects had followed our above suggestions.

However, 1(2.0%) of 50 LDL subjects not change of LDL-cholesterol level, whereas 11(22.0%) of 50 LDL subjects had LDL-cholesterol level increased from baseline, 4(36.4%) increase LDL-cholesterol 1-10 mg/dL, 5(45.4%) of them increase LDL-cholesterol 11-20 mg/dL, and 2(18.2%) of them increase LDL-cholesterol 25 mg/dL and 32 mg/dL may be due to they had weight gain 1.8 kg and 4.3 kg and body fat increased 2.4 %bw and 3.3%bw, respectively from baseline. We still followed up, they had decrease LDL-cholesterol 31 mg/dl (135 mg/dL) and 28 mg/dl (137 mg/dL), respectively.

We also observed change of serum LDL-cholesterol level in 50 LDL subjects with cholesterol intake from 3-day 24-hour dietary records. At the end of study, we found mean serum LDL-cholesterol level in 50 LDL subjects was significant decreased from baseline, this evidence is supported by their decreased mean dietary cholesterol intake but not reach significant, this evidence may be due to LDL subjects try to reduce their cholesterol intake for serum LDL-cholesterol level reduction.

Although, (76) cholesterol in food has only a small effect on serum LDL cholesterol level, but excess of dietary cholesterol causes a much greater increase in LDL cholesterol.

However 15 LDL subjects had reliable dietary record, at the beginning of this study mean cholesterol intake was 439.4 mg/day of LDL-cholesterol subjects more than the daily recommend by Dietary Guidelines for Americans, 2010 (cholesterol intake <300 mg/day) (91). From analysis in 146 main course menu of PCCCR school we found 104 (71.2%) menus had cholesterol 0-100 mg/serving, 22 (15.1%) menus had cholesterol 101-200 mg/serving, 15 (10.3%) menus had cholesterol 201-300 mg/serving, and 5 (3.4%) menus had cholesterol >300 mg/serving, which 4 of 5 menus had cholesterol >300 mg/serving were fast food menus. Thus cholesterol from main course menus of PCCCR school few had cholesterol >300 mg/serving. Although high cholesterol in main course menu of PCCCR school, had a few items of the menu but only source of food in main course menu effect to increase serum LDL-cholesterol levels, still source of food in light meal were snack menu. Snack menu were replace or eat to increase in main course of some LDL subject may be one reason of excess daily energy intake.

When we observed 3-day 24-hour dietary record and food behavior from questionnaires of 15 LDL subjects had reliable dietary record found at the beginning of study, energy intake from snack were 230 kcal/day (11.7% of total energy intake), only cholesterol intake from snack were 21.1 mg/day (9.2% of total cholesterol intake). Because major sources of dietary cholesterol are animal foods such as organ meats, eggs, shellfish, etc (92). Thus, labels of some snack in cholesterol-free labels are misleading in another way. Foods with high saturated fat or high Trans fats, they can claim those foods had zero cholesterol or not (93). From Mustad VA, et al., (94) studied in 25 healthy men and women, aged 22-65 years, in randomized cross-over design found LDL-receptor abundance increased by 10.5% after the low saturated fatty acids ($P<0.05$). Moreover they found associated LDL-receptor with 11.8% decreased in serum LDL-cholesterol ($P<0.05$). Thus nutritional therapy and nutritional education would be cover many source of food effect to increase serum LDL-cholesterol, especially common source of food in students are snack. In our study, energy intake of 50 LDL subjects significant increased at the end of study, especially energy and sodium intake from snack.

Nutrition facts in snack are mainly composed of total energy, carbohydrate, protein, cholesterol, and total fat (especially saturated fats raise blood cholesterol more than foods high in dietary cholesterol) (95)

“Saturated” is a word that refers to the chemical structure of some fats. Saturated fats are usually firm or hold their shapes at room temperature. There are two main sources of saturated fat in the typical American diet are: foods from animals: including beef, beef fat, lamb, pork, lard, poultry fat, butter, cream, milk, cheeses, and other dairy products made from whole milk. Foods from plants: including coconut oil, palm oil, and cocoa butter (95).

In our study, snack and beverage in PCCCR school co-operatives shop were divided into 5 groups followed by cholesterol content, Pueng-noi bakery group in 100 g; 29 items had cholesterol<100 mg, 5 items had cholesterol 100-200 mg, and 2 items had cholesterol >200 mg, Biscuit group in 41-47 g; 5 items had cholesterol<6 mg, Meat ball and sausage in 30 g had cholesterol 10 mg and 25 mg, respectively. Beverage group in 150-250 ml; 7 items had cholesterol 0-8 mg, and 13 items of fish snack group did not cholesterol. Thus excess snack intake in LDL subjects may be one

reason of increase and did not change of serum LDL-cholesterol level in some subject at the end of study.

When snack and beverage were divided into 5 groups followed by sodium, Pueng-noi bakery group in 100 g; 10 items had sodium <100 mg, 24 items had sodium 100-1,000 mg, and 2 items had sodium >1,000 mg. Biscuit group in 41-47 g; 5 items had sodium 85-170 mg, Meat ball and sausage in 30 g had sodium 199 mg and 388 mg, Beverage group in150-250 ml; 7 items had sodium 10-50 mg, and fish snack group 13 items; 1 item had sodium 130 mg, 10 items had sodium 130-210 mg, and 2 items had sodium 160-210 mg.

Moreover, snack was source of high sodium, we observed mean sodium intake of 15 LDL subjects had reliable dietary records. The beginning of this study mean sodium intake was 4,129 mg/day of LDL subjects more than the daily intake recommended by Department of Health and Nutrition in 2009 (Na<2,400 mg/day) and increased at end of study but did not reach statistical significance. We found mean of sodium intake from snack was 154 mg/day (3.73% of total sodium intake), was significant increase at the end of study, 371 mg/day (8.65% of total sodium intake), which we confirmed result was observed in urinary sodium excretion.

From we observed result of mean urinary sodium excretion of 50 LDL subjects from 1-day 24 hour mean urinary sodium excretion was 89.0 mmol/day, was significant increased at the end of study. Therefore nutritional therapy and nutrition education about sodium intake and sodium reduction in 50 LDL subjects is especially important.

We also observed change of serum LDL-cholesterol level in 50 LDL subjects with questionnaires on sodium knowledge, health and food behavior. At the end of study, 38 of 50 LDL subjects had serum LDL-cholesterol decreased found 26 of 38 (68.4%) LDL subjects correctly answered the SN and SH question increased from pretest at the beginning of study. 15 of 38 (39.5%) LDL subjects had positive of foods behavior about sodium intake from pretest at the beginning of study.

After we gave the nutritional therapy and nutrition education about sodium reduction with 38 of 50 LDL subjects had serum LDL-cholesterol decreased from baseline. In four questionnaires of food behavior effect to serum LDL-cholesterol level, 8 of 38 (21.0%) LDL subjects ate the following snack (potato chip, fish snack,

and crispy rice) decreased from pretest, 7 of 38 (18.4%) subjects ate the following bakery (cake, pancake, and bread) decreased from pretest, 6 of 38 (15.8%) subjects ate the following meat products (meat ball, sausage) decreased from pretest, and 26 of 38 (68.4%) subjects ate salted peanuts decreased from pretest. As same Levy AS, et al., (96) studied found knowledge about dietary fats of consumer and cholesterol is poor. Reduction of cholesterol intake on self-prescribed was related to higher knowledge, but reduction of cholesterol intake on physician-recommended was related to higher knowledge scores only for younger respondents. Thus nutritional education in student of our study is most important.

We also observed the number of subjects who correctly answered questionnaires on sodium knowledge, health, and positive of food behavior was increase, whereas their urinary sodium excretion and sodium intake were increase. At the end of study, 21 of 50 (42.0%) LDL subjects correctly answered the SN and SH questions increased from pretest and subjects had positive of food behavior about sodium intake increased from pretest, found 6 of 21(28.6%) LDL subjects had urinary sodium excretion decreased form baseline, 2 of 21 (9.5%) LDL subjects had sodium intake decreased form baseline. As same He FJ, et al., (34) studied found the difference between the intervention and control group in the change in 24 h urinary sodium from baseline to the end of follow-up for children and for adults.

Therefore, in 50 LDL group would be receiving the nutritional therapy and nutritional education in earlier time for increase knowledge and understanding about serum LDL-cholesterol level reduction both effect to direct and indirect results and especially sodium intake and sodium reduction, their improvement of body composition and blood chemistry will result in their better health.

5.5 In 4 obese + LDL subjects

The results from 4 obese + LDL subjects were selected to analyze because all of them had completed data throughout the study including body composition, blood chemistry, questionnaire on sodium knowledge, health and food behavior, 3-days 24-hour dietary records, and 1-day 24-hour urinary sodium excretion.

At the end of study, first subject had weight gain in appropriate normal growth rate by age, however his obese status was improved because his body fat decreased from baseline. We observed serum LDL-cholesterol level, he had become normal LDL-cholesterol level and serum uric acid level decreased but not reach normal level. These improvement because of nutritional therapy and nutritional education, we suggested him to avoid organ meats and bakery, when we observed food behavior from questionnaire found that he ate the following bakery (cake, pancake, and bread) decreased from $\geq$4 times/week to 2-3 times/week, however, serum uric acid level still in high hyperuricemia, thus we suggested he drink a lot of water for increase uric acid excretion. Nevertheless, 1-day 24-hour urinary sodium excretion increased from baseline, 102.0 mmol/day to 305.2 mmol/day. It should be come from increased sodium intake, whereas 3-day 24-hour dietary record of him was unreliable dietary record, so we observed number of item correctly answered of him increased in sodium knowledge part, but not change in sodium and health, and he had positive sodium and food behavior increased from pretest but not supported with urinary sodium excretion.

At the end of study, second subject had weight loss, moreover his obese status was improved because his body fat decreased from baseline. We observed serum LDL-cholesterol level, he had become normal LDL-cholesterol level and serum uric acid level decreased but not reach normal level. These improvement because of nutritional therapy and nutritional education, we suggested him to avoid organ meats and bakery, however, serum uric acid level still in high hyperuricemia, thus we suggested he drink a lot of water for increase uric acid excretion. Whereas serum triglyceride level increased into borderline hypertriglyceridemia level, from interview at the end study, he drink sugar-sweetened beverage almost every day it may be cause of high serum triglyceride level. As same Chan TF, et al., (97) cross-sectional study in 200 adolescent found high-quantity high-fructose corn syrup-rich beverage consumption is associated with higher TG. Nevertheless, 1-day 24-hour urinary sodium excretion increased from baseline, 239.4 mmol/day to 251.2 mmol/day. It should be come from increased sodium intake, whereas 3-day 24-hour dietary record of him was unreliable dietary record, so we observed questionnaire found number of item correctly answered of his increased in sodium knowledge part, but not change in

sodium and health, whereas he had negative sodium and food behavior (he like salty and crispy snack at the end of study) from pretest which supported with urinary sodium excretion.

At the end of study, third subject had weight gain in appropriate normal growth rate by age, however his obese status was improved because his body fat become normal body fat. We observed serum uric acid level decreased but not reach normal level, this improvement because of nutritional therapy and nutritional education, we suggested him to avoid organ meats, however, serum uric acid level still in borderline high hyperuricemia, thus we suggested he drink a lot of water for increase uric acid excretion. Whereas serum LDL-cholesterol level increased from baseline, we observed 3-day 24-hour were reliable dietary record found throughout the study, no change of cholesterol intake (461.8 mg/day and 460.2 mg/day), whereas cholesterol intake from snack increased 35.0 mg/day to 58.5 mg/day. Nevertheless, 1-day 24-hour urinary sodium excretion increased from baseline, 144.4 mmol/day to 432.0 mmol/day. It should be come from increased sodium intake, in the contrary his sodium intake was 4,581 mg/day, and sodium intake from snack was 545 mg/day (11.9% of total sodium intake) decreased at the end of study but not supported with urinary sodium excretion. However we observed questionnaire found number of item correctly answered of him increased in sodium knowledge part, and sodium and health part, moreover he had increased positive sodium and food behavior from pretest but not supported with urinary sodium excretion.

At the end of study, fourth subject had weight loss, moreover his obese status was improved because his body fat decreased from baseline. We observed serum LDL-cholesterol level decreased but not reach normal level. Whereas serum uric acid level increased from baseline but still in high level, moreover serum triglyceride level increased into borderline hypertriglyceridemia level. Moreover, 1-day 24-hour urinary sodium excretion increased from baseline, 133.8 mmol/day to 141.0 mmol/day. It should be come from increased sodium intake, whereas his 3-day 24-hour dietary record was unreliable dietary record, so we observed questionnaire found number of item correctly answered of him increased in sodium knowledge part and sodium and health part, whereas he had increased negative sodium and food behavior from pretest (he ate whole noodle soup and ate salted peanuts snack

increased from 2-3 times/week to ≥4 times/week) which supported with urinary sodium excretion.

Therefore, nutritional therapy and nutritional education about sodium intake and sodium reduction were important especially in 4 obese + LDL subjects because of obesity, hypercholesterolemia, and excess of sodium intake were risk factor of cardiovascular disease (8, 33, 74).

CHAPTER VI
CONCLUSION

The prospective study on salt intake and salt reduction among adolescence, age12-18 years at PCCCR school which is a boarding high school located in Chiang Rai province, Northern Thailand during 2012 academic year. This study including 813 PCCCR students consisted of 317 males and 496 females. Salt intake and salt reduction were assessed during the 32 week-study period. Salt intake and salt reduction were assessed by 24-hour urinary sodium excretion, 24-hour dietary record, and questionnaire consisted of 3 parts: sodium knowledge, sodium and health, and sodium and food behavior. This study assesses the quantity of daily sodium intake in obesity and hypercholesterolemic students and also the association of dietary sodium intake and nutritional disease (obesity and hypercholesterolemic) based on nutritional education, food behavior, food menu modification and choose appropriate snack menu for reducing dietary sodium intake in the risk group.

6.1 Nutritional status

During 2012 academic year at PCCCR science high school, we found 4.9% of 813 students were underweight, 8.2% at risk of overweight, and 6.8% overweight based on BMI-for age, whereas based on percentage of body fat, we found low, over, and excess body fat 15.9%, 3.4%, and 3.2%, respectively.

Our study using body fat (%bw) indicator which is the best parameter to classify obesity during in the growing adolescents, found only 3.4% of PCCCR students were obese when used body fat (%bw) indicator from 15% were obese when used BMI-for-age as an indicator.

We also assessed the other diet-related chronic diseases which affect the health status of adolescent including anemia, hyperuricemia, and dyslipidemia. Prevalence of anemia, hyperuricemia, hypertriglyceridemia, low HDL-cholseterol

level, and hypercholesterolemia students were 13.5%, 46.1%, 1.4%, 10.7%, and 15.4% respectively.

The present study found correlation between body compositions with anemia, hyperuricemia, and dislipidemia.

In obese subjects, we found 19.0% of obese subjects were at risk of overweight, and 81.0% overweight based on BMI-for-age, whereas based on percentage of body fat, we found over, and excess body fat 47.6% and 52.4%, respectively.

We found obesity consequences which are anemia, hyperuricemia, hypertriglyceridemia, and low HDL-cholesterol in these obese subjects, 4.8%, 90.5%, 4.8%, and 23.8%, respectively.

In LDL subjects, we found 12.0% of LDL subjects were underweight, and 12.0% at risk of overweight based on BMI-for age. All of them had normal body fat.

We also found assessed the other diet-related chronic disease are anemia, hyperuricemia, hypertriglyceridemia in these LDL subjects, 4.0%, 48.0%, and 2.0%, respectively.

In obese + LDL subjects, we found all of them had hyperuricemia.

6.2 Nutritional therapy

On the condition nutritional therapy for 32 weeks can improve body weight status in PCCCR students, which 31.1% of at risk of overweight and overweight subjects and 21.3% of at risk of overweight and overweight subjects had become normal body weight. When we follow-up by percentage of body fat 29.6% of over and excess body fat subjects had become normal body fat, 66.7% of them had body fat reduction. A part of improvement of other diet-related chronic disease including anemia, hyperuricemia, and dyslipidemia after we giving nutritional therapy throughout the study, which the results show in Teerattitum S, et al.

Most of obese subjects had body fat reduction (85.7%) and 42.8% obese subjects had become normal body fat effect to anemia, high of FBS, hyperuricemia, and hypertriglyceridemia had improved. However, obese subjects had 2 new case of mild increased hypercholesterolemia. Therefore, improvement of body composition

from the receiving nutritional therapy and nutritional education in long-term follow-up effect to improvement of blood chemistry.

Most of LDL subjects (serum LDL-cholestrol > 130 mg/dL) had serum LDL-cholestrol reduction (76.0%) and 63.2% LDL subjects had become LDL-cholestrol less than 130 mg/dL. Anemia and hyperuricemia of LDL subjects had improved but found 2 new case of decrease serum hemoglobin. However, hypertriglyceridemia of 1 LDL subject had increased. Moreover underweight, at risk of overweight and low body fat status in LDL subjects had improved. However, LDL subjects had 1 new case of mild increased over body fat.

All of obese + LDL subjects had body fat reduction and 1 obese + LDL subject had become normal body fat effect to hypercholesterolemia of 2 obese + LDL subjects had become normal LDL-cholestrol and hyperuricemia of 3 obese + LDL subjects had decreased. However, hypertriglyceridemia of 2 obese + LDL subject had increased.

6.3 Sodium status

Mean daily sodium intake in main course menu of PCCCR school was 4,036 mg. Most of snack of high sodium was bakery (cake, pancake, and bread).

We assessed sodium status by sodium questionnaires on sodium knowledge (SN), health (SH), and food (SFB) behavior. In PCCCR students found 56.6% correctly answered the SN questions at pretest. Most of PCCCR students knew that food have low or high sodium content, however, most of them, 74.8% did not know that some vegetable are high in sodium, e.g. tomato.

In PCCCR students found 56.2% correctly answered the SH questions at pretest. We also found in our study, 16.3% of PCCCR students did not know that potassium chloride has the salty taste.

Food behavior questions of PCCCR students found most of PCCCR students ate bakery (cake, pancake, and bread) and snack (potato chip, fish snack, and crisp rice).

Mean daily sodium intake of obese subjects from 3-day 24-hour dietary records was 4,370 mg more than the daily intake recommended (Na<2,400 mg/day).

Mean snack sodium intake from dietary snack record was 535 mg/day (11.7% of daily total sodium intake).

Mean urinary sodium excretion of obese subjects from 24-hour urinary sodium excretion was 122.6 mmol/day (one day collection).

Mean daily sodium intake of LDL subjects from 3-day 24-hour dietary records was 4,129 mg more than the daily intake recommended (Na>2,400 mg/day). Mean snack sodium intake from dietary snack record was 154 mg/day (3.73% of daily total sodium intake).

Mean urinary sodium excretion of LDL subjects from 24-hour urinary sodium excretion was 108.6 mmol/day (one day collection).

Trend in daily sodium intake of obese + LDL subjects from 3-day 24-hour dietary records more than obese, LDL subjects and the daily intake recommended (Na>2,400 mg/day). However, trend in total sodium intake and snack sodium intake decreased at the end of study. Mean urinary sodium excretion of obese + LDL subjects from 1-day 24-hour urinary sodium excretion was 154.9 mmol/day, which trend more than obese and LDL subjects.

6.4 Sodium reduction

After giving the nutritional education about sodium reduction, PCCCR students correctly answered the SN questions and SH questions was significant increase and had increased positive food behavior. However, we found some negative food behavior increased during second semester examination at the end of study.

After receiving the nutritional education about sodium reduction, daily sodium intake of obese subjects decreased but did not reach significant. However, mean snack sodium intake increased at the end of study but not significant. Our study found significant positive correlation of sodium intake with energy, fat and cholesterol intake. In other hand, result of mean urinary sodium excretion of obese subjects was significant increase at the end of study. Moreover, in obese subjects correctly answered the SN questions and SH questions was significant increase and had increased positive food behavior.

After receiving the nutritional education about sodium reduction, daily sodium intake of LDL subjects increased but did not reach significant and mean snack sodium intake was significant increase at the end of study, which confirmed result by increasing of urinary sodium excretion but did not reach significant. Moreover, in LDL subjects correctly answered the SN questions and SH questions were significant increase and had increased positive food behavior.

After receiving the nutritional education about sodium reduction, trend daily sodium intake and snack sodium intake of obese + LDL subjects decreased at the end of study, which contrast result with trend in increasing of urinary sodium excretion. Moreover, in obese + LDL subjects trend in correctly answered the SN questions and SH questions were increased but increasing of positive food behavior in some subjects.

In conclusion, this study revealed that the range of sodium from food menu of PCCCR school were 1,693-5,779 mg/day, 95.4% of estimated daily food menu of PCCCR school had sodium intake more than 2,400 mg/day, most of those high sodium menus consisted of high sodium ingredients such as soup, processed foods, and pickled foods. Thus we recommended them to modify such high sodium menus by using fresh meats and fresh vegetables instead of processed foods and pickled foods.

In 21 obese subjects, 8 of 21 (38.0%) obese subjects had reliable dietary records. Daily sodium intake including three main meals from school canteen and their snacks ranged from 4,036-5,812 mg. After giving the nutritional therapy these obese subjects had lower daily sodium intake ranged from 3,916-5,119 mg, which 4 of 8 obese subjects sodium intake decreased 1.3%-20.1%, however 4 of 8 obese subjects sodium intake increased 0.3%-8.6% from baseline. However, ongoing nutritional therapy about sodium reduction in obese subjects should be continuous and implemented into their health education class.

In 50 LDL subjects, 15 of 50 (30.0%) LDL subjects had reliable dietary records. Daily sodium intake including three main meals from school canteen and their snacks ranged from 4,036-4,387 mg. After giving the nutritional therapy these LDL subjects had daily sodium intake ranged from 3,985-5,076 mg, which 5 of 15 LDL subjects sodium intake decreased 0.4%-2.4%, however 10 of 15 LDL subjects

sodium intake increased 0.6%-21.3% from baseline. Therefore nutritional therapy about sodium reduction is most important in LDL subjects.

Throughout the study 23 subjects (obese and/or LDL subjects) completed 1-day 24-hour urine collections. At the beginning of study 24-hour urinary sodium excretion ranged from 36.0-210.0 mmol/day which were within normal limit. However, their estimated sodium intake (main meals from canteen school + their own snacks) ranged from 4,091-5,867 mg/day which higher than the recommended level. Thus we need more investigations to clarify this evidence. After giving the nutritional therapy for sodium intake reduction, 7 of 23 (30.4%) subjects had decreased of 24-hour urinary sodium excretion from baseline, whereas 16 of 23 (69.6%) subjects had increased 24-hour urinary sodium excretion from baseline, however 10 of 16 (62.5%) subjects had 24-hour urinary sodium excretion were within normal limit.

Therefore, the nutritional therapy had potential to improve nutritional status in PCCCR students, especially in obese and LDL subjects had improved nutritional status. Moreover, our study providing the nutritional therapy about sodium reduction by nutritional education for all students and individual student by use both the instruction media and show and explain the food groups which can continue to use in the future and they can contribute this nutritional education knowledge to their family, social group, and community. Because obesity and/or hypercholesterolemia and the excessive sodium lead to cardiovascular disease. Therefore, nutritional therapy in our study covers for reducing the severity of these nutritional problems including salt intake and salt reduction in adolescent students.

REFERENCES

1.The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. JAMA. 2003;289:2560-72.

2. แพทย์หญิงแสงโสม สีนะวัฒน์ และคณะ.บทสรุปผู้บริหาร การสำรวจการบริโภคโซเดียมคลอไรด์ของประชากรไทย ปี พ.ศ 2551. กองโภชนาการ กรมอนามัย กระทรวงสาธารณสุข คณะสาธารณสุขศาสตร์ มหาลัยมหิดล; 2552.

3. Mulder KA, Zibrik L, Innis SM. High dietary sodium intake among young children in Vancouver, British Columbia. J Am Coll Nutr. 2011 Feb;30(1):73-8.

4. Magriplis E, Farajian P, Pounis GD, Risvas G, Panagiotakos DB, Zampelas A. High sodium intake of children through 'hidden' food sources and its association with the Mediterranean diet: the GRECO study. J Hypertens. 2011 Jun;29(6):1069-76.

5. สำนักนโยบายกระทรวงและยุทธศาสตร์, สำนักงานปลัดกระทรวงสาธารณสุข. ข้อมูลสติถิจำนวนและอัตราการตาย การเจ็บป่วยของประชากรไทย; 2553.

6. Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, Pletcher MJ, et al. Projected Effect of Dietary Salt Reductions on Future Cardiovascular Disease. New England Journal of Medicine. 2010;362(7):590-9.

7. Feber J, Ahmed M. Hypertension in children: new trends and challenges. Clin Sci (Lond). 2010 Aug;119(4):151-61.

8. He FJ, Marrero NM, Macgregor GA. Salt and blood pressure in children and adolescents. J Hum Hypertens. 2008 Jan;22(1):4-11.

9. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. Circulation. 2008 Jun 24;117(25):3171-80.

10. The seventh report of the joint national committee on prevention, detection, evaluation,and treatment of high blood pressure. JAMA. 2003;289:2560-72.

11. Rattanayosee Y, Leelahagul P. Obesity and cardiovascular risk factors in secondary shool-aged students of Princess Chulabhorn's College Chiangrai. In: Tontisirin K, Wasantwisut E, editors. Abstracts 19 th International Congress of Nutrition Oct 4-9; Bangkok(THA)2009. p. 573.
12. Leelahagul P. (2012, October 1). Interview by Puengputtho W [Oral Communication]. Ramathibhodi hotpital, Bangkok.
13. Public, Health, Agency, of, Canada. Sodium. IT'S YOUR HEALTH. 2008.
14. Bellows L, Moore R. Sodium and the Diet. Colorado State University. 2014;9(354).
15. Metheny NM. Fluid and electrolyte balance. 5 ed. Sibley A, editor. Sudbury2011.
16. Cohen I, Hurwitz S, Bar A. Acid-base balance and sodium-to-chloride ratio in diets of laying hens. J Nutr. 1972 Jan;102(1):1-7.
17. PhysiologyWeb. Secondary Active Transport. 2011; Available from: http://www.physiologyweb.com/lecture_notes/membrane_transport/secondary_active_transport.html.
18. Lodish H, Berk A, Zipursky SL. Molecular Cell Biology. 4 ed. Freeman WH, editor. New York; 2000.
19. Health, Canada. Sodium in Canada. 2012; Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/sodium/index-eng.php.
20. American, Heart, Association. Preventoin and treatment shaking the salt habit2014 [cited 2014 13 June]: Available from: http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/PreventionTreatmentofHighBloodPressure/Shaking-the-Salt-Habit_UCM_303241_Article.jsp.
21. Prevention CfDCa. Americans Consume Too Much Sodium (Salt). Sodium intake from processed and restaurant foods contributes to increased rates of high blood pressure, heart attack, and stroke Decreasing sodium intake to within recommended limits could prevent thousands of deaths annually [serial on the Internet]. 2011 [cited 2014 13 June]: Available from: http://www.cdc.gov/features/dssodium/.
22. Sodium Recommended Daily Allowance. RDA [cited 2014 13 June]: Available from: http://www.annecollins.com/sodium-rda-diet.htm.

23. Department, of, Health, B.E.,. Recommended Daily Dietary Allowances and Consumption Guidelines for Healthy Thais. 2541 (1998).
24. Determination of sodium and potassum ion concentration2014 [cited 2014 14 June]: Available from: http://www.liv.ac.uk/~agmclen/Medpracs/practical_2/practical_2.pdf.
25. Thompson FE, Subar AF. Nutrition in the Prevention and Treatment of Disease. 2 ed. Coulston AM, Rock CL, Monsen ER, editors. San Diego: Nutrition in the Prevention and Treatment of Disease; 2001.
26. World, Health, Organization. Sodium intake round the world. In: Brown PEaI, editor. Background document prepared for the Forum and Technical meeting on Reducing Salt Intake in Populations (Paris 5-7th October 2006) Geneva, Switzerland; 2007.
27. Jeejeebhoy KN, Detsky AS, Baker JP. Assessment of Nutritional Status. JPEN J 1990;14:193s-6s.
28. Whelton PK, Appel LJ, Sacco RL, Anderson CA, Antman EM, Campbell N, et al. Sodium, blood pressure, and cardiovascular disease: further evidence supporting the American Heart Association sodium reduction recommendations. Circulation. 2012 Dec 11;126(24):2880-9.
29. Reducing salt intake in populations. Report of a WHO Forum and Technical meeting 5-7 October 2006; Paris2006.
30. Marrero NM, He FJ, Whincup P, Macgregor GA. Salt intake of children and adolescents in South London: consumption levels and dietary sources. Hypertension. 2014 May;63(5):1026-32.
31. Pinho AP, Brunetti IL, Pepato MT, Almeida CA. Metabolic syndrome in overweight/obese female adolescents. Rev Paul Pediatr 2012;30(1):51-66.
32. Zhu H, Pollock NK, Kotak I, Gutin B, Wang X, Bhagatwala J, et al. Dietary sodium, adiposity, and inflammation in healthy adolescents. Pediatrics. 2014 Mar;133(3):e635-42.
33. Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, Pletcher MJ, et al. Projected effect of dietary salt reductions on future cardiovascular disease. N Engl J Med. 2010 Feb 18;362(7):590-9.

34. He FJ, Wu Y, Ma J, Feng X, Wang H, Zhang J, et al. A school-based education programme to reduce salt intake in children and their families (School-EduSalt): protocol of a cluster randomised controlled trial. BMJ Open. 2013;3(7).

35. WHO. Maternal, newborn, child and adolescent health. 2014; Available from: http://www.who.int/maternal_child_adolescent/topics/adolescence/dev/en/

36. Spano S. Research facts and findings. ACT for Youth Upstate Center of Excellence; 2004 [cited 2014 15 June]; Available from: http://www.actforyouth.net/resources/rf/rf_stages_0504.pdf.

37. Leelahagul P, Klawisait K, Kongpun P, Udomlap J, Janthranant G, Hoiyeephoo K. Segmental bioelectrical impedance analysis in northern Thai secondary school-age students (PCCCR). Ann Nutr Metab. 2013;63(suppl 1):1426.

38. BS-400 Chemistry Analyzer [Internet]. Shenzhen:Mindray Bio-Medical Electronics Co., Ltd. Shenzhen, China [cite 2013 Jul 6]; Available from: http://www. diasystem.se/uploads/9/6/6/7/9667782/bs-400201307.pdf.

39. Institute of nutrition, Mahidol University. Food composition database for INMUCAL PROGRAM D.7 Nakhon Pathom (Thailand): Institute of Nutrition, Mahidol University. 2007.

40. Mengrai Lab. Sodium (Na+) analysis, Jul 1, 2555

41. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1-452.

42. McCarthy HD, Cole TJ, Fry T, Jebb SA, Prentice AM. Body fat reference curves for children. Int J Obes (Lond). 2006 Apr;30(4):598-602.

43. Kavey RE, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. J Pediatr. 2003 Apr;142(4):368-72.

44. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care. 2003 Jan;26 Suppl 1:S5-20.

45. WHO. Iron deficiency anaemia assessment, prevention, and control. World Health Organization. 2001:114.

46. Feig DI, Johnson RJ. Hyperuricemia in childhood primary hypertension. Hypertension. 2003 Sep;42(3):247-52.

47. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics. 2004 Aug;114(2 Suppl 4th Report):555-76.

48. กรมอนามัย. ข้อกำหนดสารอาหารที่ควรได้รับประจำวันและแนวทางการบริโภคสำหรับคนไทย; 2552.

49. Levesque R. SPSS Programming and Data Management: A Guide for SPSS and SAS Users. 4th ed. Chicago: SPSS Inc; 2007.

50. Barlow RJ, Connell MA, Levendig BJ, Gear JS, Milne FJ. A comparative study of urinary sodium and potassium excretion in normotensive urban black and white South African males. S Afr Med J. 1982 Dec 11;62(25):939-41.

51. Jitnarin N, Kosulwat V, Rojroongwasinkul N, Boonpraderm A, Haddock CK, Poston WS. Prevalence of overweight and obesity in Thai population: results of the National Thai Food Consumption Survey. Eat Weight Disord. 2011 Dec;16(4):e242-9.

52. Li P, Yang F, Xiong F, Huo T, Tong Y, Yang S, et al. Nutritional status and risk factors of overweight and obesity for children aged 9-15 years in Chengdu, Southwest China. BMC Public Health. 2012;12:636.

53. Etchison WC, Bloodgood EA, Minton CP, Thompson NJ, Collins MA, Hunter SC, et al. Body mass index and percentage of body fat as indicators for obesity in an adolescent athletic population. Sports Health. 2011 May;3(3):249-52.

54. Kurtoglu S, Mazicioglu MM, Ozturk A, Hatipoglu N, Cicek B, Ustunbas HB. Body fat reference curves for healthy Turkish children and adolescents. Eur J Pediatr. 2010 Nov;169(11):1329-35.

55. Kelsey MM, Zaepfel A, Bjornstad P, Nadeau KJ. Age-related consequences of childhood obesity. Gerontology. 2014;60(3):222-8.

56. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA. 2014 Feb 26;311(8):806-14.

57. CHAPUT J-P, TREMBLAY A. Obesity at an Early Age and Its Impact on Child Development In: RE T, M B, RDeV P, editors. Encyclopedia on Early Childhood Development2012. p. 1-8.

58. Jensen MD, Ryan DH, Apovian CM, Loria CM, Ard JD, Millen BE, et al. 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol. 2013 Nov 7.

59. NICE. Managing overweight and obesity among children and young people:lifestyle weight management services. public Health Nutr. 2013(Oct 2013):9.

60. Birch LL, Parker L, and Burns A. Early childhood obesity prevention policies. Committee on obesity prevention policies for young children. Institute of medicine of the national academic. 2012.

61. Iughetti L, China M, Berri R, Predieri B. Pharmacological treatment of obesity in children and adolescents: present and future. J Obes. 2011;2011:928165.

62. Aikenhead A, Knai C, Lobstein T. Do surgical interventions to treat obesity in children and adolescents have long- versus short-term advantages and are they cost-effective? In: Permanand G, editor. Denmark: World Health Organization; 2012.

63. Franca SL, Sahade V, Nunes M, Adan LF. Adherence to nutritional therapy in obese adolescents; a review. Nutr Hosp. 2013 Jul-Aug;28(4):988-98.

64. Cornier MA, Marshall JA, Hill JO, Maahs DM, Eckel RH. Prevention of overweight/obesity as a strategy to optimize cardiovascular health. Circulation. 2011 Aug 16;124(7):840-50.

65. Marques M, Moleres A, Rendo-Urteaga T, Gomez-Martinez S, Zapatera B, Romero P, et al. Design of the nutritional therapy for overweight and obese Spanish adolescents conducted by registered dieticians: the EVASYON study. Nutr Hosp. 2012 Jan-Feb;27(1):165-76.

66. Report, of, a, WHO, Expert, Committee. Population-based approaches to childhood obesity prevention. Guiding principles for the development of a

population-based childhood obesity prevention strategy. Geneva2012. p. 16-20.

67. Singh P, Khan S, Ansari M, Mittal R. Anemia amongst Adolescent Girls and Boys Attending Outpatients and Inpatient Facilities in Far Western Part of Nepal. Ibnosina J Med BS. 2013:330-4.

68. Bagni UV, Luiz RR, Veiga GV. Overweight is associated with low hemoglobin levels in adolescent girls. Obes Res Clin Pract. 2013 May-Jun;7(3):e218-29.

69. Sanad M, Osman M, Gharib A. Obesity modulate serum hepcidin and treatment outcome of iron deficiency anemia in children: a case control study. Ital J Pediatr. 2011;37:34.

70. Zimmermann MB, Zeder C, Muthayya S, Winichagoon P, Chaouki N, Aeberli I, et al. Adiposity in women and children from transition countries predicts decreased iron absorption, iron deficiency and a reduced response to iron fortification. Int J Obes (Lond). 2008 Jul;32(7):1098-104.

71. Lin JD, Lin PY, Lin LP, Hsu SW, Yen CF, Fang WH, et al. Serum uric acid, hyperuricemia and body mass index in children and adolescents with intellectual disabilities. Res Dev Disabil. 2009 Nov-Dec;30(6):1481-9.

72. Yang S, Hwang JS, Park HK, Lee HS, Kim HS, Kim EY, et al. Serum lipid concentrations, prevalence of dyslipidemia, and percentage eligible for pharmacological treatment of Korean children and adolescents; data from the Korea National Health and Nutrition Examination Survey IV (2007-2009). PLoS One. 2012;7(12):e49253.

73. Park J, Hilmers DC, Mendoza JA, Stuff JE, Liu Y, Nicklas TA. Prevalence of metabolic syndrome and obesity in adolescents aged 12 to 19 years: comparison between the United States and Korea. J Korean Med Sci. 2010 Jan;25(1):75-82.

74. Lacoste L, Lam JY, Hung J, Letchacovski G, Solymoss CB, Waters D. Hyperlipidemia and coronary disease. Correction of the increased thrombogenic potential with cholesterol reduction. Circulation. 1995 Dec 1;92(11):3172-7.

75. Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX, et al. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: an update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation. 2006 Feb 14;113(6):898-918.

76. Ighosotu S, Tonukari NJ. The influence of dietary intake on the serum lipid profile, body mass index and risk of cardiovascular diseases in adults on the Niger Delta region IJNAM 2010;2(3):40-4.

77. North SL, Neale RJ. Knowledge, attitudes and eating habits of teenagers with respect to salt in their diet. British Food Journal. 1995;97(5):3-11.

78. Papadakis S, Pipe AL, Moroz IA, Reid RD, Blanchard CM, Cote DF, et al. Knowledge, attitudes and behaviours related to dietary sodium among 35- to 50-year-old Ontario residents. Can J Cardiol. 2010 May;26(5):e164-9.

79. Reinehr T, Kersting M, Alexy U, Andler W. Long-term follow-up of overweight children: after training, after a single consultation session, and without treatment. J Pediatr Gastroenterol Nutr. 2003 Jul;37(1):72-4.

80. Roza AM, Shizgal HM. The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass. Am J Clin Nutr. 1984 Jul;40(1):168-82.

81. Lioret S, Touvier M, Balin M, Huybrechts I, Dubuisson C, Dufour A, et al. Characteristics of energy under-reporting in children and adolescents. Br J Nutr. 2011 Jun;105(11):1671-80.

82. Chu NF, Wang DJ, Liou SH, Shieh SM. Relationship between hyperuricemia and other cardiovascular disease risk factors among adult males in Taiwan. Eur J Epidemiol. 2000 Jan;16(1):13-7.

83. Miller PE, McKinnon RA, Krebs-Smith SM, Subar AF, Chriqui J, Kahle L, et al. Sugar-sweetened beverage consumption in the U.S.: novel assessment methodology. Am J Prev Med. 2013 Oct;45(4):416-21.

84. Villegas R, Xiang YB, Elasy T, Xu WH, Cai H, Cai Q, et al. Purine-rich foods, protein intake, and the prevalence of hyperuricemia: the Shanghai Men's Health Study. Nutr Metab Cardiovasc Dis. 2012 May;22(5):409-16.

85. WHO. Child growth standards [cite 2014 June 23]. Available from: http://www.who.int/nutrition/media_page/backgrounders_4_en.pdf.

86. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, et al. Maternal and child undernutrition: consequences for adult health and human capital. Lancet. 2008 Jan 26;371(9609):340-57.

87. Johansson L, Solvoll K, Bjorneboe GE, Drevon CA. Under- and overreporting of energy intake related to weight status and lifestyle in a nationwide sample. Am J Clin Nutr. 1998 Aug;68(2):266-74.

88. Miller M, Stone NJ, Ballantyne C, Bittner V, Criqui MH, Ginsberg HN, et al. Triglycerides and cardiovascular disease: a scientific statement from the American Heart Association. Circulation. 2011 May 24;123(20):2292-333.

89. Kabir Y, Shahjalal HM, Saleh F, Obaid W. Dietary pattern, nutritional status, anaemia and anaemia-related knowledge in urban adolescent college girls of Bangladesh. J Pak Med Assoc. 2010 Aug;60(8):633-8.

90. Urbina EM, Khoury PR, McCoy CE, Dolan LM, Daniels SR, Kimball TR. Triglyceride to HDL-C ratio and increased arterial stiffness in children, adolescents, and young adults. Pediatrics. 2013 Apr;131(4):e1082-90.

91. Services. USDoAaUSDoHaH. Foods and Food Components to Reduce. Dietary Guidelines for Americans. 7 ed., Washington, DC: U.S. Government Printing Ofice; 2010. p. 20-32.

92. Cholesterol [cite 2014 May 24). Available from: http://tgrule.com/health/cardiac-health/what-is-cholesterol/cholesterol-post-by-georgia-ede-md-httpdiagnosisdiet-comfoodcholesterol/.

93. Zelman K. Does cholesterol-free food protect your heart. Available from: http://www.webmd.com/food-recipes/features/cholesterol-food.

94. Mustad VA, Etherton TD, Cooper AD, Mastro AM, Pearson TA, Jonnalagadda SS, et al. Reducing saturated fat intake is associated with increased levels of LDL receptors on mononuclear cells in healthy men and women. J Lipid Res. 1997 Mar;38(3):459-68.

95. American, Heart, Association. Saturated Fats. Available from: http://www.heart.org/HEARTORG/GettingHealthy/FatsAndOils/Fats101/Saturated-Fats_UCM_301110_Article.jsp.

96. Levy AS, Fein SB, Stephenson M. Nutrition knowledge levels about dietary fats and cholesterol: 1983-1988. Journal of Nutrition Education. 1993;25(2):60-6.

97. Chan TF, Lin WT, Chen YL, Huang HL, Yang WZ, Lee CY, et al. Elevated serum triglyceride and retinol-binding protein 4 levels associated with fructose-sweetened beverages in adolescents. PLoS One. 2014;9(1):e82004.

APPENDICES

APPENDIX A
INFORMED CONSENT FROM

หนังสือยินยอมโดยได้รับการบอกกล่าวและเต็มใจ

(Informed Consent Form)

ชื่อโครงการ ปริมาณการบริโภคโซเดียมของนักเรียนระดับมัธยมศึกษา โรงเรียนจุฬาภรณราชวิทยาลัย เชียงราย (โรงเรียนวิทยาศาสตร์ภูมิภาค)

ผู้ทำการวิจัย รศ.ดร. ปรียา ลีพหกุล

หลักสูตรโภชนศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

*** ชื่อผู้เข้าร่วมการวิจัย.....**

คำยินยอมของผู้เข้าร่วมการวิจัย

ข้าพเจ้า ด.ช./ด.ญ./นาย/นางสาว..... ได้ทราบรายละเอียดของโครงการวิจัยตลอดจนประโยชน์ และข้อเสี่ยงที่จะเกิดขึ้นต่อข้าพเจ้าจากผู้วิจัยแล้วอย่างชัดเจน ไม่มีสิ่งใดปิดบังซ่อนเร้นและยินยอมให้ทำการวิจัยในโครงการที่มีชื่อข้างต้น และข้าพเจ้ารู้ว่าถ้ามีปัญหาหรือข้อสงสัยเกิดขึ้น ข้าพเจ้าสามารถสอบถามผู้วิจัยได้ และข้าพเจ้าสามารถไม่เข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบต่อการรักษาที่ข้าพเจ้าพึงได้รับ นอกจากนี้ผู้วิจัยจะเก็บข้อมูลเฉพาะเกี่ยวกับตัวข้าพเจ้าเป็นความลับและจะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัย การเปิดเผยข้อมูลเกี่ยวกับตัวข้าพเจ้าต่อหน่วยงานต่างๆที่เกี่ยวข้อง กระทำได้เฉพาะกรณีจำเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ลงชื่อ ..... (ผู้เข้าร่วมการวิจัย)

..... (พยาน)

..... (พยาน)

วันที่ .....

คำอธิบายของผู้วิจัย

ข้าพเจ้าได้อธิบายรายละเอียดของโครงการ ตลอดจนประโยชน์ของการวิจัย รวมทั้งข้อเสี่ยงที่อาจจะเกิดขึ้นแก่ผู้เข้าร่วมการวิจัยทราบแล้วอย่างชัดเจน โดยไม่มีสิ่งใดปิดบังซ่อนเร้น

ลงชื่อ ..... (ผู้วิจัย)

วันที่ .....

หนังสือยินยอมโดยได้รับการบอกกล่าวและเต็มใจ
สำหรับผู้เข้าร่วมการวิจัยที่ไม่สามารถแสดงความยินยอมได้ด้วยตนเอง

ชื่อโครงการ ปริมาณการบริโภคโซเดียมของนักเรียนระดับมัธยมศึกษา โรงเรียนจุฬาภรณราชวิทยาลัย เชียงราย (โรงเรียนวิทยาศาสตร์ภูมิภาค)

ผู้ทำการวิจัย รศ.ดร. ปรียา ลีฬหกุล
หลักสูตรโภชนศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

*** ชื่อผู้เข้าร่วมการวิจัย……..**

คำยินยอมของผู้มีอำนาจกระทำการแทนผู้เข้าร่วมการวิจัย

ข้าพเจ้า นาย/นาง/นางสาว ..... ซึ่งเป็นผู้มีอำนาจกระทำการแทน ด.ช./ด.ญ./นาย/นางสาว ..... ในฐานะ.....ได้ทราบรายละเอียดของโครงการวิจัย ตลอดจนประโยชน์ และข้อเสี่ยงที่จะเกิดขึ้นต่อผู้เข้าร่วมการวิจัยจากผู้วิจัยแล้วอย่างชัดเจน ไม่มีสิ่งใดปิดบังซ่อนเร้นและยินยอมให้ทำการวิจัยในโครงการที่มีชื่อข้างต้น และข้าพเจ้ารู้ว่าถ้ามีปัญหาหรือข้อสงสัยเกิดขึ้นข้าพเจ้าสามารถสอบถามผู้วิจัยได้ และข้าพเจ้าสามารถไม่ให้ผู้เข้าร่วมการวิจัยเข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบต่อการรักษาที่ผู้เข้าร่วมการวิจัยได้รับ นอกจากนี้ผู้วิจัยจะเก็บข้อมูลเฉพาะเกี่ยวกับตัวผู้เข้าร่วมการวิจัยเป็นความลับและจะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัย การเปิดเผยข้อมูลเกี่ยวกับตัวผู้เข้าร่วมการวิจัยต่อหน่วยงานต่างๆที่เกี่ยวข้อง กระทำได้เฉพาะกรณีจำเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ลงชื่อ ..... (ผู้มีอำนาจกระทำการแทน)
..... (พยาน)
..... (พยาน)
วันที่ .....

คำอธิบายของผู้วิจัย

ข้าพเจ้าได้อธิบายรายละเอียดของโครงการ ตลอดจนประโยชน์ของการวิจัย รวมทั้งข้อเสี่ยงที่อาจจะเกิดขึ้นแก่ผู้เข้าร่วมการวิจัยทราบแล้วอย่างชัดเจน โดยไม่มีสิ่งใดปิดบังซ่อนเร้น

ลงชื่อ ..... (ผู้วิจัย)
วันที่ .....

APPENDIX B
GENERAL QUESTIONNAIRE

Waisaihealth Project Questionnaires by Assoc. Prof. Dr. Preeya Leelahagul
Postgraduate Program in Nutrition,
Faculty of Medicine Ramathibodi Hospital, Mahidol University

"Dietary related chronic disease"
Waisaihealth School

Explanation

1. This questionnaire is designed to assess the understanding and knowledge of diet-related chronic diseases, and health.
2. This information will be used for developing the nutritional therapy.
3. Please read the explanation before answer the questions and answer truthfully.
4. The questionnaires are divided into three sections, 3 pages and 22 questions.

Section 1 Primary information	(5 Questions)
Section 2 Socio-economic information	(7 Questions)
Section 3 Health information	(10 Questions)

Thank you very much for your cooperation.

Assoc. Prof. Dr. Preeya Leelahagul, Advisor
Wutarak Puengputtho, Graduate Students in Nutrition
Faculty of Medicine Ramathibodi Hospital
Mahidol University
Jul 8-12, 2012

Name…… Surname…… Class……..…
Student ID…….. Email…….…… Date……..….

<u>Explanation</u> In sections 1, 2 and 3, please check ✓ in the appropriate box ☐ and answer truthfully.

Section 1 General information **For researcher**

1.1 Sex ☐1. Male ☐2.Female	**A1**
1.2 Date of birth Date……..Month……Year…….	**A2**
1.3 Religion ☐1. Buddhism ☐2. Christian	**A3**
☐3. Islam ☐4. Other ……	**A4**
1.4 Number of sibling…….(include yourself) Birth order…….	**A4a**
1.5 Father's age……..year Mother's age……..year	**A5**
	A5a

Section 2 Socio-economic information

2.1 Person who live with	**B1**
☐1. Father and mother ☐2. Father	
☐3. Mother ☐4. Other, *identify*_____	
2.2 Parent's marital status	
☐1. Married ☐2. Divorced	**B2**
☐3. Father passed away ☐4. Mother passed away	
2.3 Family's income	
☐1. < 10,000 Baht/month ☐2. 10,000-20,000 Baht/month	**B3**
☐3. 20,001-30,000 Baht/month ☐4. 30,001-40,000 Baht/month	
☐5. 40,001-50,000 Baht/month ☐6. > 50,000 Baht/month	
2.4 Money expense…….. Baht/month	
2.5 The most of expense (Choose only one answer, please)	**B4**
☐1. Stationery ☐2. Snack	
☐3. Personal ☐4. Other, *identify*_____	**B5**
	_____

2.6 Parent's occupation

Father	Mother	Guardian**	
☐1. Government official/ State enterprise ☐2. Business/Trade ☐3. Personal ☐4. Employee ☐5. Househusband ☐6. Other, *identify*__	☐1. Government official/ State enterprise ☐2. Business/Trade ☐3. Personal ☐4. Employee ☐5. Housewife ☐6. Other, *identify*__	☐1. Government official/ State enterprise ☐2. Business/Trade ☐3. Personal ☐4. Employee ☐5. Husehusband/wife ☐6. Other, *identify*____	**B6a** **B6b** **B6c**

2.7 Parent's educational level

Father	Mother	
☐1. Less than primary school ☐2. Primary school ☐3. Junior high school ☐4. Senior high school ☐5. Vocational certificate ☐6. High vocational certificate ☐7. Bachelor's degree ☐8. Master's degree ☐9. Doctorate degree	☐1. Less than primary school ☐2. Primary school ☐3. Junior high school ☐4. Senior high school ☐5. Vocational certificate ☐6. High vocational certificate ☐7. Bachelor's degree ☐8. Master's degree ☐9. Doctorate degree	**B7a** **B7b**

Section 3 Health information

3.1 Do you have underlying diseases? **C1**

☐ 1. No (go to answer 3.3) ☐ 2.Yes

3.2 What are your underlying diseases? **C2**

☐ 1. Gastritis/peptic ulcer ☐ 2. Allergy

☐ 3. Skin disease ☐ 4. Thalassemia

☐ 5. Others, *identify*_____

3.3 Family medical history related to diet-related chronic diseases, please check the disease and identify the relationship of that person such as father, mother, grandmother, grandfather etc.)

C3a

☐ 1. Obesity, *identify*_____ ☐ 2. Diabetes, *identify*_____ **C3b**

☐ 3. Hypertension, *identify*__ ☐ 4. Hypercholesterolemia, *identify*_ **C3c**

☐ 5. High triglyceride, *identify*_____ ☐6. Nothing **C3d**

☐ 7. Don't know ☐ 8. Other____, *identify*__ **C3e**

C3f

C3g

C3h

3.4 Except physical education, do you exercise? **C4**

☐ 1. No (go to answer 3.8) ☐ 2.Yes

3.5 How many times do you exercise a week? **C5**

☐ 1. <3 times/week ☐ 2.3-5 times/week

☐ 3. >5 times/week

3.6 How long do you exercise? **C6**

☐ 1. <30 minutes ☐ 2. 30-60 minutes

☐ 3. >60 minutes

3.7 What kind of exercise do you like most? (Choose one answer only) **C7**

☐ 1. Sports ☐ 2. Cardio exercise such as Aerobic

☐ 3. Jogging ☐ 4. Walking

☐ 5. Housework such as sweeping and mopping the floor

☐ 6. Other, *identify*_____

3.8 How often do you spend for watching TV and play on the computer in a week?

☐ 1. < 3 times/week ☐ 2. ≥3 times/week **C8**

3.9 How much time do you spend for watching TV and play on the computer in each time? **C9**

☐ 1. <30 minutes ☐ 2. ≥30 minutes

3.10 How many hours of sleep a night?

☐ 1. <6 hours ☐ 2. 6-8 hours **C10**

APPENDIX C
QUESTIONNAIRE OF SODIUM

Waisaihealth Project Questionnaires by Assoc. Prof. Dr. Preeya Leelahagul
Postgraduate Program in Nutrition,
Faculty of Medicine Ramathibodi Hospital, Mahidol University

"Sodium knowledge and sodium and food behavior"
Waisaihealth School

Explanation

1. This questionnaire is designed to assess the understanding and knowledge of salt intake and salt reduction.
2. This information will be used for developing the nutritional therapy.
3. Please read the explanation before answer the questions and answer truthfully.
4. The questionnaires are divided into three sections, 6 pages and 39 questions.

Section 1 Sodium knowledge	(12 Questions)
Section 2 Sodium and health	(12 Questions)
Section 3 Sodium and food behavior	(15 Questions)

Thank you very much for your cooperation.

Assoc. Prof. Dr. Preeya Leelahagul, Advisor
Wutarak Puengputtho, Graduate Students in Nutrition
Faculty of Medicine Ramathibodi Hospital
Mahidol University
Jul 8-12, 2012

<u>Explanation</u> In sections 1 and 2 please answer the following questions by check (X) the correct choice.

<u>Explanation</u> In sections 3 please check (X) in answer truthfully behavior.

Section 1: Sodium knowledge **For researcher**

1. What is atomic number of sodium? C
    1. 11
    2. 12
    3. 21
    4. 22

2. What is atomic weight of sodium? C
    1. 21
    2. 22
    3. 23
    4. 24

3. What group is sodium in the periodic table? C
    1. IA
    2. IIV
    3. VIIA
    4. VIIIA

4. What is chemical formula of table salt? C
    1. $NaPO_3$
    2. Na_2CO_3
    3. NaCl
    4. $NaHCO_3$

5. . How much does a teaspoon of salt weigh? C
    1. 3 gram
    2. 5 gram
    3. 7 gram
    4. 9 gram

6. How much does sodium of a teaspoon salt weigh? C
    1. 1.4 gram
    2. 2.4 gram
    3. 3.4 gram
    4. 4.4 gram

L

7. What kind of ingredients give salty taste?
    1. Sugar
    2. Vinegar
    3. Ground red pepper
    4. Salt

C

8. Which item is all high sodium foods?
    1. Bacon, Sausage, Imitation Crab Stick
    2. Meatballs, dessert, green tea
    3. Instant noodles, Salad, Milk
    4. Rice porridge, Chocolate, Carbonated, beverage

C

9. Which item is all low sodium foods?
    1. Fruits and Vegetables
    2. Processed foods: ready to eat and frozen food
    3. Soy sauce, Ketchup
    4. Yogurt, Sausage

C

10. Which plant does have the highest sodium content?
    1. Strawberries
    2. Tomato
    3. Banana
    4. Fresh asparagus

C

11. Which item of 100 gram seasoning does have the highest sodium content?
    1. Salt
    2. Monosodium glutamate
    3. Fish sauce
    4. Soy sauce

L

12. Which water has high sodium?
    1. Rain
    2. Carbonated beverage
    3. Distilled water
    4. Saline

Section 2: Sodium and health

1. Which of the following is not a function of sodium to the body? **C**
    1. Fluid balance
    2. Acid base balance
    3. Stimulates the nervous system and muscles.
    4. Regulation of cellular energy metabolism

2. How much sodium recommended per day? **C**
    1. 1,400 mg
    2. 2,400 mg
    3. 3,400 mg
    4. 4,400 mg

3. Sodium excretion through many organs, except? **C**
    1. Sweat
    2. Urine
    3. Breath
    4. Stools

4. Patient with renal failure should avoid …….? **L**
    1. Sour
    2. Sweet
    3. Spicy
    4. Salty

5. Which substance is used to replace for salty taste? **C**
    1. NaCl
    2. KCl
    3. MgCl
    4. CaCl

6. What to drink when you have severe diarrhea? **C**
    1. Milk
    2. Soybean milk
    3. Normal saline
    4. Soda

C

7. Which sign or symptom caused by high sodium?
    1. Confusion
    2. Decreased Urinary Excretion of Water
    3. Thirsty
    4. Stomachache

C

8. Which sign or symptom caused by low sodium?
    1. Weakness
    2. Nausea, Vomiting
    3. Lethargy
    4. Increased Urinary Excretion of Water

C

9. Which disease caused by high sodium intake?
    1. Hypertension, Gout
    2. Kidney disease, Hypertension
    3. Kidney disease, Diabetes mellitus
    4. Cancer, Hypertension

C

10. Which kind of meats can cause high blood pressure?
    1. Process food
    2. Half-cooked meat
    3. Fatty meat, meat with skin
    4. Fatty meat

C

11. We can assess sodium intake by several methods, except?
    1. Dietary record
    2. Physical examination
    3. Urinary test
    4. Questionnaire

L

12. Which of the following snack has high sodium, except?
    1. Salted peanuts
    2. Salted popcorn recipe
    3. Thong yip and Thong yot
    4. Salted potato chip

Section 3: Sodium and food behavior

1. Do you dip salt and chili when you eat sour fruits? C

1. Never 2. Sometime 3. Always

2. Do you add fish sauce when you eat noodle? C

1. Never (cross to item 4) 2. Sometime 3. Always

3. How much fish sauce do you add to your noodles? ……teaspoon C

4. How do you eat your noodle soup? C

1. Never
2. Some soup
3. Whole noodle soup

5. Do you dip sauce when you eat meat ball, sausage? C

1. Never 2. Small dip 3. Big dip

6. Do you add ketchup, chili sauce when you eat omelet, French fries, pizza or fried chicken? C

1. Never 2. Add……teaspoon per dish

7. Which taste would you like? C

1. Sweet 2. Salty 3. Sour

8. Which snack would you like? C

1. Crispy 2. Dessert 3.Bread

9. After exercise, which beverage would you drink? C

1. Water 2. Carbonated beverage 3. Sport drink

C

10. Which mango do you flavor?

1. Fresh mango 2. Pickled mango

C

11. How often did you eat dried fruits?

1. Never 2. 1 time/week
3. 2-3 times /week 4. $\geq$ 4 times /week

C

12. How often did you eat the following snacks
(potato chip, fish snack, and crispy rice) ?

. 1. Never 2. 1 time/week
3. 2-3 times /week 4. $\geq$ 4 times /week

C

13. How often did you eat the following bakery
(cake, pancake, and bread) ?

1. Never 2. 1 time/week
3. 2-3 times /week 4. $\geq$ 4 times /week

C

14. How often did you eat the following meat products
(meat ball, sausage) ?

1. Never 2. 1 time/week
3. 2-3 times /week 4. $\geq$ 4 times /week

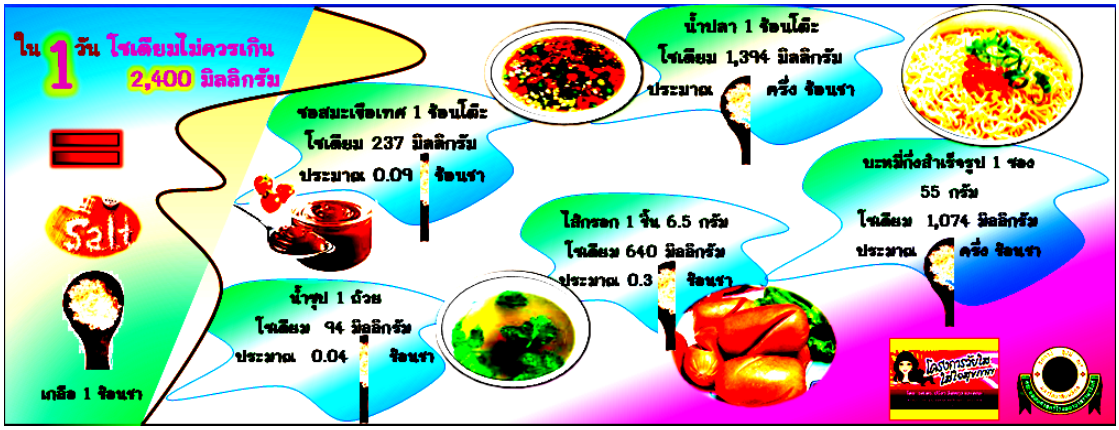
C

15. How often did you eat salted peanuts?

1. Never 2. 1 time/week
3. 2-3 times /week 4. $\geq$ 4 times /week

APPENDIX D

NUTRITION EDUCATION



BIOGRAPHY

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