



**ENERGY, NUTRIENT INTAKE AND ENERGY EXPENDITURE  
OF NURSING STUDENTS AT NAVAL NURSING COLLEGE**

**PANLAPA SANTAVAMAITREE**

อธิษัณนทนาการ

จาก

บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER OF SCIENCE (PUBLIC HEALTH)  
MAJOR IN NUTRITION  
FACULTY OF GRADUATE STUDIES  
MAHIDOL UNIVERSITY**

**2000**

**ISBN 974-664-416-5**

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Thesis  
Entitled

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NURSING STUDENTS AT NAVAL NURSUNG COLLEGE**

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**ENERGY, NUTRIENT INTAKE AND ENERGY EXPENDITURE OF  
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was submitted to the Faculty of Graduate Studies, Mahidol University  
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## **ACKNOWLEDGEMENTS**

I am deeply grateful to my advisor, Lecturer Rewadee Chongsuwat for her kindness, devotion and invaluable suggestion throughout the course of this study.

I would like to express my gratitude and thanks to my co-advisor, Assistant Professor Rattanaporn Charoenpong and Assistant Professor Wongdyan Pandii for their advice and suggestion on this thesis.

I would like to also thank Associate Professor Charuvan Hematorn for her devotion and suggestion on my thesis defense.

I would also like to express my thanks to the Captain in the Navy Somkid Timsard, Director of Prevention Medicine Division and the Captain in the Navy Orawan Chuduang, Deputy Director of Prevention Medicine Division for their advice and assistance. Special thanks are given to all teachers and nursing students at Naval Nursing College, and all officers at the canteen of Naval Nursing College for their help and support during the data collection.

I am very grateful to Ms.Puangtip Monarumit for her devotion and editorial on my thesis

A acknowledgement is also made to all those who help me in many ways and whose names which were not mentioned but contributed much to the completion of my study.

Finally, I am heartedly grateful to my parents and friends for their moral support, encouragement and assistance during my study.

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4136122 PHPH / M : MAJOR : NUTRITION ; M.Sc. (PUBLIC HEALTH)  
KEY WORDS : ENERGY AND NUTRIENT INTAKE / ENERGY  
EXPENDITURE / NURSING STUDENT

LT.PANLAPA SANTAVAMAITREE: ENERGY, NUTRIENT INTAKE  
AND ENERGY EXPENDITURE OF NURSING STUDENTS AT NAVAL  
NURSING COLLEGE. THESIS ADVISORS: REWADEE CHONGSUWAT, Ph.D.,  
RATTANAPORN CHAROENPONG, M.P.H., WANGDYAN PANDII, Dr.Ph.D.112 P.  
ISBN 974-664-416-5

The main objectives of this descriptive research were to assess energy and nutrient intake, in proportion to energy distribution from food consumption, and energy expenditure, in terms of physical activity patterns among nursing students at Naval Nursing College. The population in this study was 178 nursing students (nursing science degree) who were studying in the second, third and fourth year at Naval Nursing College for the academic year 1999. These students answered demographic questionnaires for inclusion criteria as a participant in this study. The participants were 63 students who were asked to record their food consumption and activities in their diaries for four days.

The result showed that the mean energy intake from food consumption of nursing students: aged 18-19 years and aged 20-22 years were  $1471.9 \pm 268.5$  kcal and  $1441.8 \pm 263.5$  kcal respectively. When the mean energy and nutritional intake from food consumption of nursing students were compared with the same age group according to the Thai Recommended Dietary Allowance (RDA). It showed that the energy intake was at adequate level. Nutritional intake with respect to eight nutrients as follows: carbohydrates, fat, protein, iron, vitamin B1, vitamin B2, vitamin C and niacin were at adequate level; more than 67 % of the RDA, except for the intake of calcium and vitamin A which were at 25.9% and 64.9 % respectively for the age group of 18 – 19 years. As for the intake of calcium of age group of 20-22 years, it was 32.7%, which was considered inadequate. The vitamin A intake for this age group was rated as adequate. The proportion of energy from carbohydrates was slightly higher than recommended amount, but from protein and fat was proportionate. The mean energy expenditure was  $2031.6 \pm 179.0$  kcal. It was divided into three parts: First, Basal Metabolic Rate was  $1219.1 \pm 72.1$  kcal. Second, Energy for Physical Activity was  $627.8 \pm 116.4$  kcal, i.e., most energy was spent for walking and the least energy for dishwashing and ironing. Finally, The Specific Dynamic Action was  $184.7 \pm 16.3$  kcal. Nursing students spent energy in moderate activities. In addition, the energy requirement for nursing students was 2,000 kcal. The patterns of activity in terms of time spent for certain activities, were as follows: most time was spent on sitting, followed by sleeping, walking, standing relaxed and bath taking, standing at work, lying, dressing and undressing, floor sweeping and moping – cleaning bed and laundry, walk rapidly, exercise, making bed, walking upstairs, walking downstairs and dishwashing and ironing.

4136122 PHPH / M : สาขาวิชาเอก : โภชนาวิทยา ; วท.ม. (สาธารณสุขศาสตร)

เรือเอกหญิง พัลลภา สันถวไมตรี : พลังงานและสารอาหารที่ได้รับจากอาหารบริโภคและพลังงานที่ใช้ของนักเรียนพยาบาล ในวิทยาลัยพยาบาลกองทัพเรือ (ENERGY, NUTRIENT INTAKE AND ENERGY EXPENDITURE OF NURSING STUDENTS AT NAVAL NURSING COLLEGE) คณะกรรมการควบคุมวิทยานิพนธ์ : เรวดี จงสุวัฒน์, Ph.D., รัตนาภรณ์ เจริญพงศ์, M.P.H., วงเดือน ปั่นดี, วท.ม., สด. 112 หน้า ISBN 974-664-416-5

การศึกษานี้เป็นการวิจัยเชิงพรรณนา ซึ่งมีวัตถุประสงค์เพื่อศึกษาปริมาณพลังงานและสารอาหาร สัดส่วนการกระจายของพลังงานจากสารอาหารที่ได้รับจากอาหารบริโภคของนักเรียนพยาบาล ศึกษาปริมาณพลังงานที่ใช้และแบบแผนการทำกิจกรรมของนักเรียนพยาบาล กลุ่มประชากรเป็นนักเรียนพยาบาล (หลักสูตรพยาบาลศาสตร)ที่กำลังศึกษาในระดับชั้นปีที่ 2, 3 และ 4 ปีการศึกษา 2542 จำนวน 178 คน โดยให้นักเรียนพยาบาลทุกคนตอบแบบสอบถามข้อมูลส่วนบุคคล เพื่อคัดเลือกกลุ่มประชากรที่มีคุณสมบัติตามที่กำหนดไว้ ได้จำนวนผู้เข้าร่วมในการวิจัยทั้งหมด 63 คน ซึ่งผู้เข้าร่วมในการวิจัยเป็นผู้บันทึกข้อมูลเกี่ยวกับอาหารที่บริโภคและการทำกิจกรรม เป็นเวลา 4 วัน โดยให้จดบันทึกลงในสมุดบันทึก ซึ่งประกอบไปด้วยแบบบันทึกการบริโภคอาหาร และแบบบันทึกการทำกิจกรรม

ผลการศึกษาคือ ค่าเฉลี่ยปริมาณพลังงานที่ได้รับจากอาหารบริโภคโดยแบ่งเป็น 2 กลุ่มอายุคือ กลุ่มอายุ 18 - 19 ปี และกลุ่มอายุ 20 - 22 ปี เท่ากับ  $1471.9 \pm 268.5$  กิโลแคลอรี และ  $1441.8 \pm 263.5$  กิโลแคลอรี เมื่อเปรียบเทียบกับปริมาณพลังงานและสารอาหารที่ได้รับเป็นร้อยละของปริมาณพลังงานและสารอาหารประจำวันสำหรับคนไทย (%RDA) เป็นสองกลุ่มอายุพบว่า ค่าเฉลี่ยพลังงานที่ได้รับจากอาหารบริโภคใน 1 วันอยู่ในระดับที่เพียงพอ สารอาหารอื่นๆได้รับในระดับที่เพียงพอคือ มากกว่าร้อยละ 67 ยกเว้นในกลุ่มอายุ 18 - 19 ปีได้รับแคลเซียมและวิตามินเอ เท่ากับ ร้อยละ 25.9 และร้อยละ 64.9 ตามลำดับ และในกลุ่มอายุ 20 - 22 ปี ได้รับแคลเซียมเท่ากับ ร้อยละ 32.7 สัดส่วนการกระจายพลังงานจากคาร์โบไฮเดรตสูงกว่าเกณฑ์เล็กน้อย แต่สัดส่วนการกระจายจากโปรตีนและไขมัน อยู่ในสัดส่วนที่เหมาะสม ค่าเฉลี่ยปริมาณพลังงานที่ใช้ใน 1 วันของนักเรียนพยาบาลเท่ากับ  $2031.6 \pm 179.0$  กิโลแคลอรี เมื่อจำแนกออกตามประเภทของพลังงานได้แก่ ค่าเฉลี่ยพลังงานที่ต้องการขั้นพื้นฐานใน 1 วัน เท่ากับ  $1219.1 \pm 72.6$  กิโลแคลอรี ค่าเฉลี่ยพลังงานที่ใช้ในการทำกิจกรรมใน 1 วัน เท่ากับ  $627.8 \pm 116.4$  กิโลแคลอรี ซึ่งมีการใช้พลังงานในกิจกรรมประเภทเดินตามปกติมากที่สุด และใช้เวลาในการทำกิจกรรมประเภทล้างจานหรือรีดผ้าน้อยที่สุด และค่าเฉลี่ยพลังงานที่ใช้เพื่อการเปลี่ยนแปลงอาหารภายในร่างกายเท่ากับ  $184.7 \pm 16.3$  กิโลแคลอรี นักเรียนพยาบาลมีการใช้พลังงานในระดับกิจกรรมประเภทงานหนักปานกลาง โดยมีความต้องการพลังงานจากอาหารบริโภควันละ 2,000 กิโลแคลอรี แบบแผนการทำกิจกรรมใน 1 วันของนักเรียนพยาบาลคือ นักเรียนพยาบาลใช้เวลาในการทำกิจกรรมประเภทนั่งมากที่สุด รองลงมาคือ นอนหลับ, เดินตามปกติ, ยืนตามสบายและอาบน้ำ, ยืนทำงาน, นอนเล่น, แต่งตัวและผลัดเสื้อผ้า, กวาดถูพื้น เช็ดเตียง และซักผ้า, เดินเร็ว, ออกกำลังกาย, เก็บที่นอนและปูเตียง, เดินขึ้นบันได, เดินลงบันได และล้างจานและรีดผ้า ตามลำดับ

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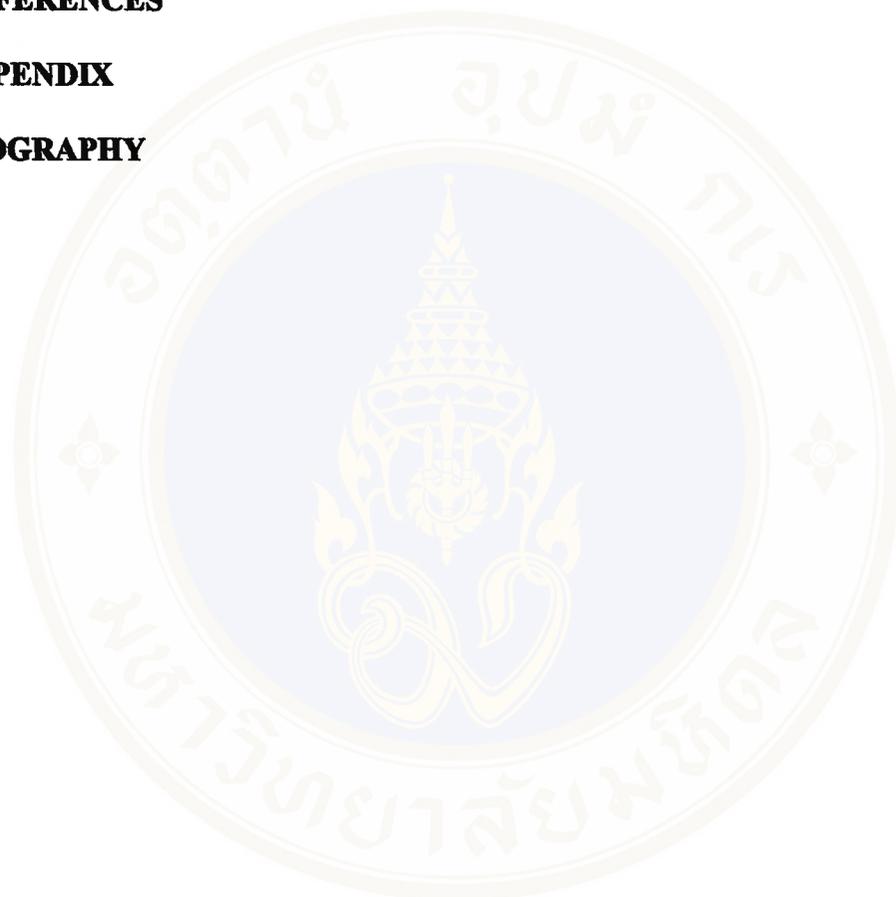
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**FIGURE 1 : Nomogram of surface area**

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## **CHAPTER I**

### **INTRODUCTION**

#### **Rational**

Most nursing students are in the adolescence who age between 18-22 years. The adolescence is considered as the most important period of life. It is a period of much physical, emotional, mental and social development from childhood to adulthood. There are several physical changes notably (1) e.g. increasing of endocrine excretion and growth of cells and tissues. Therefore, the adolescents' food intake need to be adequately increased for proper physical and growth that should contain adequate energy and nutrients for their numerous performing activities and for maintaining good nutritional status.

The nursing students study health-related subjects of nursing both theoretical and practical, e.g. injection, infusion, bed bath, oral and tube feeding and checking temperature, blood pressure, pulse and respiration measurements, etc. throughout the college years. The second, third and fourth-year students must work in shifts on morning, afternoon and night alternately at hospital wards. It is apparent that the nursing students have other different educational activities to perform as well. Thus they need additional energy intake to keep away tiredness. As adolescents tend to have extreme appetite (1); however, they might lose their appetite when they are too tired or too hungry. Moreover, as adolescents give the social success high priority. The failure of which would cause their emotional stress (2). From this reason,

Nursing students who have to successfully study both theoretical and practical nursing might get emotional stress which might cause flatulence, nausea, vomit and diarrhea in some cases, lost of appetite or overeating, etc. (3). As a result, the students have consumed inadequate nutrients and energy to meet requirement, which can cause undernutrition. If undernutrition prolongs, it will lead to health problem.

Undernutrition is a malnutrition, which is one of the important public health problem of the country. The major problem is protein calorie malnutrition; PCM. The nutrition status of Thai population ages between 15-19 years based by weight per age showed 1<sup>st</sup> degree PCM at 17.3%, 2<sup>nd</sup> at 1.8% and 3<sup>rd</sup> at 0.5%, by weight per height, 1<sup>st</sup> degree PCM was at 6.1% but no 2<sup>nd</sup> and 3<sup>rd</sup> degree PCM. As in the report of the Nutrition Division, Health Department of Ministry of Public Health 1995 (4) indicated that protein – calorie malnutrition might cause underweight and affected personal health such as slow growth rate, low productivity, low learning ability, low immunity, irritableness and depression (5). There was a report that low body fat in females caused delay or loss of menstrual function, which may lead to problems of reproduction and general deterioration of health. This phenomenon occurs in female athletes (6). Moreover, the epidemiological data indicated that death rate of adult was higher if Body Mass Index (BMI) was lower than 20 kg/m<sup>2</sup> (7). The impact of underweight on the public is lack of efficient manpower and delay national economic development (5).

It is inevitable that underweight in adolescents is an important health problem. Body weight status of the fourth year medical students at Chiang Mai University totaling 95 persons (78 males and 17 females) evaluated by the BMI indicator showed

56.5% male and 53% female students were underweight (8). Furthermore, A study in Thai College students from both private and public universities and institutes showed that by BMI indicator percentage of the students with the BMI lower than low normal ( $BMI > 18.5 - < 20.0$ ) were 28.3% in male and 31.8% in female, with chronic energy deficiency ( $BMI \leq 18.5$ ) were 13.3% in male and 27.8% in female (9).

From the above, it indicated that the adolescents were malnourished with underweight problems. However, there are no information regarding nutrition status of the nursing students. Therefore, the researcher collected and analyzed weight and height of 244 nursing students at Naval Nursing College in the 1998 academic year by inquiring the students to provide their weight and height. These data were evaluated by BMI indicator, it was found 87% students with normal weight ( $BMI \geq 18.5 - 24.9 \text{ kg/m}^2$ ) and 13% with underweight ( $BMI < 18.5 \text{ kg/m}^2$ ) at 13%. But overweight students were not found.

Underweight among nursing students are a vital and significant malnutrition problem. Underweight ( $BMI < 18.5 \text{ kg/m}^2$ ) of 3-5% in Thai population is considered a public health problem that needs surveillance and to be resolved (10). Since nursing students are medical personnels other than doctors and nurses working in hospitals who have the duty to provide service on health care and information on food consumption and treatment for patients and their family. They must have proper food consumption behavior to be a healthy model for the public.

The causes of underweight in nursing students were studied. Because the students had numerous activities both on lecture and practice so they might have to increase their energy expenditure. Thus the students might need higher Energy intake

than other groups of adolescent. If they have sufficient energy and nutrients intake to meet their body requirement of body, their bodyweight would be normal and they would be healthy. Energy intake and energy expenditure of nursing students has not been studied. Thus, the researcher had studied the energy and nutrients intake, proportion of energy distribution, energy expenditure and patterns of physical activity of nursing students. The results of this research will be significant information to advocate administrator in prevention and improvement of the underweight problem of nursing students. In addition, the result would be used in meal planning to improve the quality of the canteen food hence to a better nutrition status of the nursing students at Naval Nursing College.

### **Research Question**

Do the energy intake, nutrient intake and energy expenditure of the nursing students age 18 - 22 years meet RDA energy and nutrients requirement for Thai females of the same ages?

### **Objective**

To study energy and nutrient intake and energy expenditure of the nursing students at Naval Nursing College.

### **Specific Objectives**

1. To study the energy and nutrient intake, and proportion of energy distribution of the nursing students.
2. To study energy expenditure of the nursing students.

3. To compare energy and nutrient intake of the nursing students with Thai RDA.

4. To compare energy expenditure with Thai RDA.

5. To study the patterns of physical activity of the nursing students.

### **Scope of the study**

This research is limited to the 18-22 years old nursing students (nursing science degree) studying at the second, third and fourth year of 1999 academic year at Naval Nursing College.

### **Assumption of the study**

1. The population group must not be the athletic group of Naval Nursing College.

2. The population group must not have a chronic disease.

3. The population group must not be on diet or exercise for weight-losing program.

4. The population group must not be under a recuperating period after an sickness or operation.

5. The population group must not be ill from infectious diseases or thyroid-gland diseases such as hyperthyroidism or hypothyroidism.

### **Limitation of the study**

1. The energy expenditure was measured by estimating Basal Metabolic Rate based on FAO/WHO/UNO equations and comparison the energy for Physical

Activities with the referent value in the physical activities taken from a foreign data.

The energy-measuring instrument was not directly or indirectly measure.

2. There may be discrepancy on time and energy for Physical Activities data from recording by the nursing students.

### **Variables in the study**

1. Energy and nutrient intake
2. Energy expenditure.

### **Definition of terms**

1. Energy Intake is the mean energy intake of the Nursing students.
2. Nutrients are proteins, fat, carbohydrate, calcium, iron, vitamins A, B1, B2 and C and niacin.
3. Energy Expenditure is the mean energy expenditure of the Nursing students derives from the sum of Basal Metabolic Rate, the energy for Physical Activities and Specific Dynamic Action.
4. Nursing students are the students (nursing science degree) who are studying in the second, third and fourth year of 1999 academic year at Naval Nursing College.
5. Patterns of physical activity are the repeated activities in accordance with time spent for doing activities which classified into 14 types i.e. lying, sitting, standing relaxed and bath taking, standing at work, dressing and undressing, dishwashing and ironing, floor sweeping and moping- cleaning bed and laundry, walking, walking rapidly, making bed, walking upstairs, walking downstairs, exercise and sleeping.

## CHAPTER II

### LITERATURE REVIEWS

#### Definition of adolescent

The term adolescence comes from the Latin word *adolescere*, the meaning of which is to grow to maturity. Adolescence was initiated when the individual becomes sexually mature until they reach legal maturity(11). Adolescence is the time period that begins with the onset of puberty, which is the appearance of secondary sexual characteristics. In addition, adolescence continues through the completion of puberty development, resulting in function reproductive organs, and the attainment of final physical growth (12).

However, Adolescence period is identified approximately with the age- range of 11 to 22 years when the first signs of the transition to sexual maturity and the social behavior development have been shown. The interest in the opposite sex has increased. The adolescence period will end when the social and financial independence from parents have been attained (13). Besides the rapid physical and behavioral changes. Adolescents are encouraged to develop patterns of responsibility, independence, morality, intelligence, emotional stability, and other social sanctions to prevent the adolescent from enjoying too much freedoms and privileges granted by their parents. Laws and social discipline on the other hands, cause difficulties and frustrations that often produce tremendous stress to these adolescents, as well as to their peers, parents, teachers, and other associates (14).

Based on sociology, adolescence is a period of transitions: biological, psychological, social, economic from children to young adult. It is an exciting time of life. Individuals become interested in sex and become biologically capable of having children. They become wiser, more sophisticated, and better able to make their own decisions. Adolescents are permitted to work, to get married, and to cast their votes. Adolescents are eventually expected to be able to support themselves financially. The period of age of adolescence has categorized into three-stage (15).

Early adolescence is from about age 11 through age 14.

Middle adolescence is from about age 15 through age 18.

Late adolescence is from about age 18 through age 21.

In conclusion, adolescence is a period of life that physical, mental, emotional and social have been changed for adulthood development. It is the prosperity period of physical and social behavior development to prepare the adolescents to take full responsibility and to maintain their normal and happy life. Therefore, The adolescence is an important period of life.

### **Underweight in adolescent**

Underweight is one of the problems of adolescents. Because adolescents want to be socially accepted and to be one of the group, so their appearances are their almost concern. Fear of overweight and imperfect figure, they refrain from consuming some meals e.g. breakfast, lunch or only take lunch besides energy food such as milk, egg that can cause weight gain. Starchy food and oils are also eaten sparingly. These consumption practices cause malnutrition which is the cause of low body immunity. A study by Collier et al (16) reported the assessment of attitudes weight and dieting

among 186 males and 784 females adolescent. The results showed significantly more women than men reported that they believed themselves to be fat even though friends told them they were thin, panicked if they gained 2 lb., viewed weight gain as their most powerful fear, and were concerned with being thinner than their friends. Moreover, physical change causes tension among adolescents. They tend to keep away from friends have stress, low appetite, do not want to consume nutritious foods. So eventually they are malnourished the consequence of which is adolescence ailments: protein calorie malnutrition, tuberculosis and iodine deficiency anemia.

#### **Definition of underweight**

Underweight refers to mere slenderness, whereas to other it signifies undernourishment to the extent that a risk to health may be present. It is a body weight that is notably low for a person's age height, sex and other personal characteristic (17). Sometime it can be state of lower fat deposit standard. In case of severe underweight muscle deposit will be lower than the normal deposit or actually lean. (5)

The evaluation of underweight can use by several standard e.g. ten to 15 or more below the desirable weight (18) or based on the ideal weight for a given height, build, and sex. Weight more than 10% below the ideal weight is usually considered to be abnormal, especially in persons under 25, and is worthy of medical investigation (19). Besides, It is applicable to those who are 15 to 20 % or more below accepted weight standards (20).

Underweight in adult is when the body weight falls below 10 percent of the recommended body weight. However, in children age 3 years to 18 years the underweight will be evaluated by National Center for Health Statistics Growth Charts.

For a child not over 3 years the underweight can be evaluated by weight for age and weight for length at 5<sup>th</sup> – 15<sup>th</sup> percentile. In girls: age 3 – 10 year, in boys aged 3-11/2 year and in children aged 3 –18 year, underweight can be determines by weight for age at < 5<sup>th</sup> percentile (21).

Thai standard for evaluation the underweight of child and adolescent age 10 through age 20 in Thailand. It apply weight for height at below third percentile (22). WHO (10) defines underweight by Body Mass Index as when the body weight is below standard or undernutrition. Body Mass Index (BMI) can be calculated by body weight (kilogram) / height (meter)<sup>2</sup>.

Underweight can be categorized into three grades:

Grade 1: BMI 17.0 – 18.49 (mild thinness)

Grade 2: BMI 16.0 – 16.99 (moderate thinness)

Grade 3: BMI < 16.0 (severe thinness)

In conclusion, the definition of underweight is the same that is the body weight below the standard weight. There are different standard evaluate underweight. However, the researcher used weight for height on standard growth chart to determine underweight in the 18- 19 years age group of population and BMI for adolescent aged 20 years or over. Body Mass Index is an indication because BMI relate to body's fat mass ( $r = 0.5 - 0.8$ ). Besides, BMI indicates prevalence of underweight in population. The proportion of the population with BMI below 18.5 kilogram/ meter<sup>2</sup> is calculated by percent. About 3-5% of underweight population is a public health problem. In addition, the WHO Expert Committee on Physical Status suggested the following classification of the public health problem of low BMI, based on BMI distribution in adult population worldwide. (10)

- 5- 9 % of population with low BMI: low prevalence
- 10-19 % of population with low BMI: medium prevalence
- 20-39 % of population with low BMI: high prevalence
- > 40% of population with low BMI: very high prevalence

Because the nutritional survey of Thailand 1995 used these standards to evaluate nutritional status of the population so the researcher applied the same standards to evaluate underweight in the nursing students.

#### **Cause of underweight (5, 20)**

Underweight may be caused by:

1. Insufficient food consumption in people.

If energy intake is insufficient, the body will use store energy in form fat for energy expenditure. Thus cause underweight. The causes of insufficiently consumption include:

- 1.1 Poor or lack of food cause insufficient energy and nutrient intake from food.

- 1.2 lack of nutrition knowledge, people can not correctly select nutritious food for the body so they do not receive food intake sufficiently for body requirement.

- 1.3 Poor food consumption behavior.

- 1.4 Determination to lose weight. The Minnesota adolescent Health Survey(MAHS) in 36284 female adolescents showed 12% with chronic dieting, 30% binge eating, 12% self- induced vomiting, and 2% using diuretics or laxative. (23)

2. Too much activity increase energy expenditure such as heavily trained athletics.

3. Physical abnormality; for example: poor food absorption and utilization, operation, cancer, infectious disease, abnormality of endocrine gland chronic e.g. Hyperthyroidism etc.

4. Psychological or emotional stress, the cause of poor appetite and abnormal food digestion.

#### **Effect of underweight on health (17)**

The desirable or undesirable effect of underweight on the health of different people depend somewhat upon factor such as their life-styles, their overall states of physical fitness and the other health conditions. This means that some people are likely to be healthiest when they are moderately underweight, whereas others might be fittest for the important activities of their lives when they are average weight, or a little overweight. Therefore, the various effects of underweight are two characteristics.

#### **Beneficial effects**

The people who many benefit the most from being moderately underweight are those who engage in predominantly intellectual work (artists, office workers, students, teachers, writers, etc) and live otherwise sedentary lives because it is generally believe that slender people are less likely to become sleepy and tired when physical activity is limited. Runners and other athletes whose sports require the ability to maintain a rapid pace may also benefit from being a little underweight. Finally, people living in tropical climates or those troubled with one or more of the following conditions may be better off underweight than overweight: adult onset diabetes, angina pectoris, atherosclerosis, breathing difficulties, chronic tiredness, congestive heart failure, coronary heart disease, enlargement of the heart, exercise numbers of red blood cells (polycythemia), gall stones, and troubles with the legs and feet.

### **Potentially harmful effects**

In the early 1900s, underweight people were charged higher life insurance premiums than other policy holders because they were more susceptible to tuberculosis, which at that time often fatal. Today, tuberculosis is rare, except in certain poverty stricken areas, and leanness is extolled as a virtue. (Now, some obese policyholders may be charged higher premiums). Nevertheless, there are certain other potentially harmful effects of a pronounced underweight, which may sometimes be the result of chronic undernutrition. Some of the more common undesirable effects are: increased susceptibility to chilling and infections, lack of vigor, endurance, and sexual drive, low resistance to certain stresses, slow healing of injuries and surgical wounds, tendencies to be apathetic, irritable, listless, mentally depressed, nervous, restless, sleepless, weak muscles. In addition, It can cause cessation or irregularity of menstrual periods in females and complications in pregnant women particularly in malnourished or low body weight before pregnancy, the consequence of which is premature labour, higher than the pregnant with normal body weight before pregnancy. The intake of lower food and nutrient by half of the RDA in pregnant will cause abnormal labour, premature and fetal distress. In addition, It can cause growth retardation in growing infants and children.

## **Daily requirements of nutrients and foods in female adolescents**

### **Nutrients requirements (1,25)**

Adolescent is one of the most dynamic life stages experienced by human begins with rapid physical growth during adolescence period the adolescent requires more nutrient. Besides, as adolescents have to perform active activities such as sports, study related activities, they need higher energy intake. Energy and nutrient requirement in adolescent includes:

#### **1. Energy**

Energy requirements in adolescent depends on body growth, BMR, energy expenditure for studying and exercising. Daily energy requirement in female adolescent aged 16 – 19 years is 1,850 kcal and 2,000 kcal in 20 – 22 years aged group. Proportion of energy distribution in adolescent is similar to that in adult. (26)

That is 50 – 60 % of total energy intake from Carbohydrate

That is 10 – 15 % of total energy intake from protein

That is 25 – 30 % of total energy intake from fat

#### **2. Protein**

Adolescent needs adequate amount of protein for increasing cell and tissue formation i.e. muscle, bone, blood and hormone. Protein intake should be quality protein, 2/3 should be animal protein such as meat, egg, milk. Besides, protein from legumes should be intake.

#### **3. Minerals**

Adolescent needs more minerals to help physical growth. Mineral deficiently is a problem in adolescence.

3.1 Calcium is vital information of bone cell for growth and strong bone and teeth as well as nerve system. Adolescent must receive sufficient calcium intake. Thai RDA for calcium is 1,200 mg/day for female adolescent aged 16 – 19 years and 800 mg/day for 20-22 years. Milk and milk products are good source of quality calcium for body utilization because of some of amino acid and lactose found only in milk. Other foods that are calcium rich foods are small fish, pounded fish, dried small shrimp, crisp fried fish. Green vegetables e.g. kale, Chinese cabbage are also good source of calcium.

### 3.2 Iron

Adolescent needs adequate iron especially in menstruated female who loses higher blood iron. Iron deficiency causes anemia. Thai RDA for iron for female adolescent is 15 mg/day. High iron foods are entrails, egg yolk and green vegetables.

### 3.3 Iodine

In adolescence because of increase of thyroid function, adolescent requires adequate iodine from foods. Iodine deficiency causes goiter, lower thyroxin hormone, mental retardation, lower learning ability, deaf mute and others. Therefore, Thai RDA for iodine for female adolescent is 15 microgram/day. They should consume marine food at least 1-2 times a week and use iodated salt regularly in meals preparation.

4. Vitamins for normal growth and prevention of vitamin deficiency, adolescents should receive vitamins intake sufficiently. Vitamins that commonly deficient in Thai diet are:

#### 4.1 Vitamin A.

Vitamin A is essential for growth and maintain health condition of epithelial cell such as epithelial of eyes and skins. Vitamin A deficiency is nutrition

problem of Thailand higher rate in North East because of low consumption of vitamin A rich foods and fats. Thai RDA for vitamin A for female adolescent is 600 RE/day. The high vitamin A foods are animal livers, egg yolk, milk, butter, green vegetables such as kale, swamp cabbage, sesbania leaves etc, yellow vegetables such as squash, carrot, yellow potato, yellow sesbania flower etc.

#### 4.2 Vitamin B<sub>2</sub>

Vitamin B<sub>2</sub> deficiency causes angular stomatitis, found often in school children and adolescents. As a mean for prevention, Thai RDA for vitamin B<sub>2</sub> for female adolescent aged 16-19 years is 1.3 mg/day and 1.2 mg for 20-22 years age. The high vitamin B<sub>2</sub> foods are animal offal, pulse, milk, soybean milk, egg and green vegetables.

#### 4.3 Vitamin C

Vitamin C is essential for formation of collagen which is membrane composition. Vitamin C deficiency causes delay in wound cure and scurvy. Thai RDA for vitamin C for female adolescent is 60 mg/day. The vitamin C rich foods are fresh vegetables and fruits e.g. orange, guava, ripe papaya, pineapple etc.

5. Water is a vital nutrient as it is body cell composition and helps regulate body function. Therefore, body needs sufficient water consumption particularly during exercise and sweat. Adolescent should drink at least 6 - 8 glasses of pure water a day or should drink other beverages such as milk, fruit juice etc.

**Kinds and quantities of foods requirements (1,26)**

Adolescent should consume three meals a day breakfast, lunch and dinner. Foods to be consumed should include foods from five food groups in appropriate amount for total nutrient intake.

1. Milk is protein and calcium rich food besides vitamin A and E, good for growing children. Drinking milk everyday will receive higher protein and calcium intake. Adolescent should drink 1 - 2 UHT milk a day (1 UHT milk = 250 CC. provides 283 mg calcium). Soybean milk can be consumed, instead of cow milk, but at higher quantity as 240 cc. Soybean milk provides only 46 mg calcium. Besides, protein from soybean milk is of low quality than animal protein.

2. Egg is good source of protein besides iron and Vitamin A. Adolescent should consume at least 1 egg a day.

3. 180 - 200 g of meat or fish (3/4 cup or 4 table spoons a meal) should be consumed. Of the amount, animal entrails and marine foods should be consumed 2 - 3 times a week.

4. Legumes such as soybean, mungbean, black bean, red bean is protein rich foods. They also provide content of vitamin B1 and B<sub>2</sub>. Adolescent should consume more beans.

5. Green and yellow vegetables are sources of Vitamin A, Beta-carotene, minerals and nutrition fiber. About 1 - 1 1/2 cup per day or 1/2 cup per meal should be consumed.

6. Fresh fruits will provide vitamins, minerals and nutrition fiber. Two portions of fruits should be consumed daily. A portion of fruit will be different based on sweetness of each fruit. For instance, weight of one portion of tangerine will be 100 g.

or 1 large tangerine, a portion of papaya = 80 g or 8 - 10 pieces, a portion of guava = 120 g or 1 medium size, a portion of pineapple = 85 g or 8 pieces.

7. Rice and rice products e.g. rice noodle, wheat noodle, rice vermicelli should be consumed 3 - 4 cups per day or 2 - 3 ladles per meal.

8. Fats and oils should be consumed 6-8 portions daily. One portion fat is equivalent to 1 teaspoon fat or 1-tablespoon coconut milk. Fat to be consumed should derive from milk, animal fat from fried or day fried foods.

## **Energy Intake**

### **Units of Measurement (28, 29)**

The energy content of food is measure in kilocalories, often abbreviated as calories or kcal. A kilocalorie is the amount of heat required to raise 1 kilogram of water 1 °c. Kilocalories are what lay people and the media call calories. Chemically, a calorie is the amount of heat required to raise 1 gram of water 1 °c

One kilojoule is the energy required to more a mass of 1 kilogram with an acceleration of 1 meter per second. The kilojoule is equal to 0.239 kilocalories; a kilocalorie equals 4.184 kilojoules.

The energy content of individual foods is measured by a device called a bomb calorimeter. A bomb calorimeter is an insulated container that has a chamber in which food is burned. The amount of heat (kilocalories) produced by the burning of the food is determined by the change in the temperature of a measured amount of water that surrounds the chamber. All energy in food is in the form of chemical energy. The generally accepted heat of combustion value obtained for carbohydrate is 4.1 kcal/g,

for fat is 9.45 kcal/g and for protein is 5.65 kcal/g. Alcohol also yields energy but is not nutrient 1 gram of alcohol provides 6.93 kilocalories.

A process similar to the combustion of food in the bomb calorimeter occurs in the body. The process of digestion does not proceed with 100% efficiency, the coefficient of digestibility is 0.98 (indicating that 98% of ingested carbohydrate become available). For fat, the coefficient of digestibility is 0.95 (95% becomes available), and for protein it is 0.92 (92% becomes available). The processes of digestion of protein are not completely efficient, and the nitrogenous portion of amino acids is not oxidized but is excreted in the form of urea.

The amount of energy actually available to the body from a given amount of nutrient is known as the physiological fuel value of the nutrient. The physiological fuel values of the four energy releasing components of food are as follows:

Carbohydrate	:	4 Kcal/g
Fat	:	9 Kcal/g
Protein	:	4 Kcal/g
Alcohol	:	7 Kcal/g

## **Dietary Assessment**

Objective of dietary assessment is to assess quantity of food, nutrient intake and pattern of food consumption of individual, group of people and whole population to study whether food intake is sufficient for better nutrition of the people. Besides, unbalanced diet is risk factor of related diseases e.g. obesity, diabetes, hypertension, heart disease, cancer, gallstone, osteoporosis etc. Methods to be used for dietary assessment depend on objective of the study, level of validity and types of data,

experience of co-workers, ability and cooperation of population as well as operational budget.

**Patterns of dietary assessment.** There are two patterns of dietary assessment :-

1. Present dietary assessment
2. Past dietary assessment

**Present dietary assessment includes:**

**Food records, Estimated records (30,31,32)**

By this method the subjects will record in detail food consumed by recording kind, brand, composition, quantity of foods and beverages at the time of consumption. Researcher will provides the particular food recording form. Method of how to record and estimate food intake will be explained. To quantify food intake using home appliances such as teaspoon, tablespoon, cup etc or using food illustration or food model will be also explained. When food record were completed, the researcher will collect and check the record form for correction and completion by interviewing the recorder thoroughly. Data collected will be analyzed in gram of food intake to determine nutrient intake. Usually the survey will be conducted for 1-7 days; but 3 consecutive days, 2 weekdays and 1 holiday, is common. The advantage of this method is no need to remember the data because they are recorded. If more than one-day survey is performed, the data to be derived will better cover food consumption pattern than by 24-hour food recall method. Food records will provide complete data especially the proper portion of food consumed than those from food recall. Besides, it is simple, rapid and low cost than weighed records method because weighing scale is not needed. The limitation of this method is that the quantities of food are less

accurate than weighed records so it needs capable of recorder to assess food quantity, to quantify the food data. As the recorder must be literate so the food records can not be conducted in some population groups (e.g. low socioeconomic status, recent migrant, children and some elderly groups). The food records needs well cooperation in recording otherwise predisposition on selection, quantification as well as change of food consumption pattern might occur.

#### **Weighed record (32,33,34)**

Weighed record is to record food by weighing each kind, quantity and preparation of food and beverage every meal for 3-7 days. Subjects who are to prepare food must weigh raw foods, foods refuse, cooked food to be consumed and its left over as well as between meals i.e. snacks, beverages and other foods. In case of eating out, subjects must record description of all food consumed, and the researcher will buy and weigh eating out food to determine weight of food consumed. The data will then be assessed for nutrient intake in a day using food composition table or by food composite analysis. This method is appreciated for evaluation accuracy of dietary assessments and the most accurate dietary assessment method. The limitation of this method are high cost, requirement of high cooperation and can be used among literate people only. Subjects may change their used eating pattern to simplify the measure or weighing process, or alternatively, to impress the researcher. Misreading the weighing scale and recording error may still occur.

#### **Observed weighed records (32)**

Observed weighed records is the method used among illiterate people. It is the responsible of the researcher to record weight record usually is being conducted in hospital or in rural areas of developing countries that the literacy rate is low to assess

food consumption of pregnant, infants and children. To conduct observed weighed record survey in community, the surveyor must be acceptable by community and be able to talk the local dialect because they have to visit and to question about the food consumption pattern of pregnant and lactating mothers and children every meal as well as food weighing and record. In case of the observed weighed records in hospital patients, food weighing will be done before and after meal. The between meal will be assessed by recall method.

The advantage of observed weighed records is to be able to assess average food consumption of group of people. The surveyor will receive close cooperation if they stay in the community for a long time and provide medical service to community. It is suitable for assessing food consumption among farmers due to the two meals normal pattern of food consumption and limitation of between meal items. The limitation of this method is that to record only one day a week of food consumption, the information collected with not demonstrate the deviation of one day or seasonal food consumption suitable for assessing correctly. The error in the recall component for the between meal foods, because subjects might under report their consumption. In addition, normal food consumption of subjects can not be assessed.

### **Past dietary assessment**

#### **Twenty hours dietary recalls (31,33)**

Twenty hours dietary recalls is the method to assess food consumption by interview. Subjects will recall what food. They consumed during past 24 hours or one day before interview session and inform in detail food and averages consumed in kinds and quantities, food preparation, food branches. The household measurement

food teaspoon, tablespoon, cup will be used to quantity. The quantity of food consumed. Food sample, food picture or food model can be used as will. This method will be used to assess the individual dietary intake.

The advantages of 24 hours dietary recall is less time consuming fast, lower expense, can be applied among subjects of different literate level, only short time interruption the subjects, no chance for the subjects to alter food to be consumed, and the assessment can be repeated. However the limitation of this method can be summarized as follows: -

1. One-day food consumption recall might not demonstrate typical food intake in present and past period.
2. The difference of food consumption might cause by appetite, activities, and time.
3. In some community date collected on weekend or holiday will be of high variations.
4. Because of the difference of food consumed each day, the date collected can not demonstrate typical dietary intake of the individual.
5. The 24 hours dietary recall will provide the better result if conducted in large size of sample.

The accuracy of the 24 hours dietary recall depends on the recall ability of samples and the capability of researches. This method should not be applied among children and elderly. To collect complete date the interviewer should be nutritionist. If the nutritionist is not available, the interviewer must be trained to be effective, has knowledge of food, food preparation. Interview test must be performed for recording

accurately food kinds and quantity before actual interview. Underestimate and overestimate may occur.

### **Dietary history (30,34)**

Dietary history is the method used to assess food consumption in the past. The sample will recall the frequency of food consumed last week, last month or last year.

The food to be implemented consists of three parts: -

Part 1: 24 hours dietary recall collecting general information of one-day food consumption of the sample. Details, frequency, portion of food consumed will be collected. The date collected will be used to prepare food groups and frequency of consumption.

Part 2: Checking food groups and frequency information of food consumption by the subject for accuracy.

Part 3: Three days dietary recall.

Subjects will record food consumed during past 3 days to check the accuracy of information of part 1.

The advantages of dietary history are that it can assess normal food consumption and provide more details of food consumed than the short time dietary assessment. The dietary history will provide details of food preparation, food frequency, and nutrient intake. Subjects need not to be higher literate. This method is able to study specified food intake of subjects. The limitations are that it needs more personnel, not suitable to study in large population, not appropriate for study among groups of irregular food consumption behavior.

**Food Frequency Questionnaire (FFQ) (30, 33, 34).**

Questionnaire will be used to assess frequency of food consumed in specific time frame. FFQ consists of parts is food items and food frequency. Food frequency information must be related e.g. time/day, time/week, time/month, less than 1 time/month, never. Interview or self-reply can be used in FFQ.

Questions in FFQ questionnaire might be increased to include portion and quantity of food consumed. This type of FFQ questionnaire is called Semiquantitative Food Frequency Questionnaire: SFFQ. FFQ is used in epidemiology study.

The advantages of FFQ is that it can be used if the budget is limited because the existed questionnaire can be used offer modification has been made to suit the objective of FFQ. The questionnaire can be mailed to the subjects good for use in large group of sample. To fill the questionnaires is of lesser burden to the subject than other methods. FFQ can be used in the study of specific interesting nutrients in a longer period of time. These nutrients might be the risk factors of some chronic disease e.g. heart dies, hypertension, concur, diabetes etc.

The disadvantages of FFQ are that it can not provide food consumption in details and inaccuracy of quantity of food consumed. The inaccuracy might be the cause of incomplete food items, miscalculation of food frequency and food portion size due to change in food measuring. Generally, long food item question cause overestimate while short food item cause underestimate.

In conclusion, the dietary assessment of the participants' food consumption in this study used a combination of the methods of dietary assessment i.e. observed weighed records and estimated records that is the method in used currently. Observed weighed records is suitable for food consumption assessment because the participants

were nursing students who consumed three meals of the college canteen. It was convenient to weigh food and record food consumption of the students so the data collected was accurate. Another method of this study was estimated records that let the students to record between meal or food consumption outside the canteen. The method is suitable for literate people who are the participants of this study. They were able to record description of their own food consumption. Besides, it was not a burden for them because only between meal and food eating outside was recorded by them.

### **Research on food consumption in females adolescent**

A study by Brevard and Ricketts (35) reported dietary intake, physical activity, and serum lipid levels of college students living on and off campus. The 104 subjects, aged 18 to 41 years (mean = 20 years) completed a questionnaire regarding lifestyle factors; a 3 – days food record. Their lipid levels were determined. The results showed that women living off campus had significantly higher serum triglyceride and ratio of TC to HDL ( $p < 0.05$ ) levels than women living on campus. No relationship was found between weekly energy expenditure, mode of exercise, or activity level and residence ( $p > 0.05$ ). Dietary intake of the students living on and off campus were  $1,877 \pm 539$  kcal and  $1,755 \pm 640$  kcal for female respectively. Reported Percentage of energy from protein was significantly higher in subjects living off campus, especially for men ( $P < 0.05$ ).

A study by Ortega (36) reported the foods, energy and nutrient intakes of normal weight and overweight/obese adolescents totaling 60 persons. The subjects kept a 5 – days dietary record, including one Sunday. Adolescents were divided into two study groups: overweight and obese subjects ( $BMI > 23$  kg/m<sup>2</sup>) and subjects at normal

weight (BMI < 23/m<sup>2</sup>). The results found that no differences in the energy intake between obese and normal adolescence. Imbalances in the contribution to the total energy intake appear contribution of macronutrients of the total energy intake appear greater in overweight/obese adolescents with a greater proportion of their energy from fats and a lower percentage of their energy from carbohydrate. In addition, overweight and obese subjects take-in significantly larger amounts of cholesterol and took 50% of their calories from fat, 21.9% from proteins and only 27.5% from carbohydrate, in conclusions, this survey found the diet composition rather than energy consumption that was higher in fat and lower in carbohydrate and may contribute to obesity in adolescents.

A study by Koszewski et al. (37) studied factors that influence the food consumption behavior and nutritional adequacy of college women. The subjects were 163 student in New York and 130 student in California. The survey requested basic demographic height, weight, dieting methods used, and level of weight satisfaction. The questionnaire of 92 students in New York were returned. Forty two students in California completed a questionnaire. The results showed that the means and standard deviations of percent of carbohydrate, fat, protein, sweets, and alcohol from total daily energy were  $54 \pm 9$ ,  $29 \pm 8$ ,  $16 \pm 3$ ,  $9 \pm 7$ ,  $3 \pm 4$ , respectively. A large portion (48%) of the sample population had the recommended intake of 50% to 60% of energy from carbohydrate. Nonetheless, 38% of the students had a fat intake grater than 30% of energy. The percentage of students with satisfactory diet adequate for each nutrient, as suggested by NAR >80%. Subject with >80% NAR of protein, calcium, iron, vitamin A, vitamin C, thiamin, riboflavin and niacin was 80.6%, 29.1%, 43.4%, 90.8%, 95.7%, 77.3%, 78.0% and 70.2% respectively. Mean intake of all nutrients except in calcium,

iron and energy. Altogether, 54% of the subjects were not satisfied with their weight. The mean beginning age of food resurrection by those who dieted (53%) was  $15.2 \pm 2$  year.

A study by Hurson et al. (38) investigated lifestyle, food consumption and nutrient intake patterns among Irish teenagers aged between 12 –18 years old. Demographic information and anthropometric measurements included weight, height, and skinfold thickness were taken. Nutrient intake was assessed using the 7 days dietary history method. The results showed that the mean energy intakes for boys and girls aged 12 –15 and 15 –18 were 11.3 MJ and 14 MJ and 9.13 MJ and 8.9 MJ respectively. As percentage energy, protein fat and carbohydrate intakes varied little between the different age-sex groupings and were approximately 13.7 – 14.5, 35.4 – 37 and 46.8 – 50 percent respectively. For boys micronutrient intake for iron and folate achieving only 83% and 78% and 98% and 90% of the recommended nutrient intake for ages 12 –15 and 15 –18 respectively. The main sources of energy were bread, meat and meat products, potatoes/chips, confectionery and pressers. Fruit and vegetable consumption was low for all groups. The snack foods consumed were generally of a high fat/high sugar content. Overeater than 68% of girls and 79.5% of boy surveyed participated in some form of sport. Boy were more physically active than girls were.

As for the study of food consumption of adolescents in Thailand by Parichart Kanjana (39) studied food consumption and serum lipid in 199 male adolescents aged 14 –16 year who were studying in grades 4 and 5 of Yothinburana School. General information had been collected. Body weight and height as well as blood samples of the sample students were collected. The students were also asked to record their one-

day food consumption. The results showed that the energy intake of fat adolescents was 90% over the requirement, and energy distribution from carbohydrate, protein, and fat was 48%, 14% and 38% respectively. As for normal body weight adolescents, they were high-energy intake over 90% per day but energy distribution from carbohydrate, protein and fat was different at 56%, 15% and 30% respectively. It can be concluded that energy intakes of both groups were similar but high-energy intake from fat can cause obesity.

A study of body weight perception and food consumption patterns by Panichayakarn Chaopraya School, Bangkok female adolescents aged 14 – 18 years were study by Worawan Faikratok (40). The subjects were interviewed food consumption 24 hours recall. The result showed that the mean energy and nutrients intake was less than Thai RDA Nutrients were below 75% of RDA as follows: iron, vitamin A, vitamin B1 and niacin. The proportion of energy distribution from carbohydrate, protein and fat were 51.3%, 11.5% and 37.2% respectively.

Chamaiporn Yonniyom (41) had conducted comparative study or nutritive value of food consummated by 168 male and female high school students aged 16 – 19 year. The student recorded their two consecutive days food consumption 1 weekday and 1 weekend. The results showed that the students received energy and nutrients intake higher than 67% of Thai RDA except calcium and niacin proportion of energy distribution from fat is over 30%, protein over 100% of RDA. Source of protein was mostly animal protein. The intake of cholesterol was over 300 g/day. Dietary fiber intake was minimal.

In conclusion, The energy intake between individual were same but the energy distribution weight different. The reports indicated that no differences in the energy intake were between obese and normal adolescence. However, the energy distribution from nutrients found different. It found that the energy intake from fat of obese adolescent were grater proportion than normal weight and the recommended proportion of energy distribution. Furthermore, energy intake from fat can cause obesity in adolescents. In addition, nutrients intake of females adolescent were less than the Thai RDA especially calcium and niacin. Moreover, the study on energy intake of nursing student was not report before.

## **Energy Expenditure**

The human body's total energy needs can be subdivided into three separate categories as follows: (42)

1. Basal Metabolic rate or Basal Metabolism; BMR
2. Physical Activity; PA
3. Specific Dynamic Action; SDA or Thermic Effect of Food; TEF

### **Basal Metabolic Rate ; BMR (42)**

The energy need to power Basal Metabolism is the amount require to sustain the basic essential metabolic processes involved in keeping the body alive and healthy such as maintaining required nervous activity; ventilate the lungs; keep the heart pumping to circulate the blood; maintain minimal levels of protein synthesis, hormone production, glandular secretion, nutrient uptake, and waste excretion and maintaining body temperature.

**Factors affecting Basal Metabolic Rate (7,27,42,43)****1. Body Size.**

A tall, large person usually has a higher BMR than a short, small person. The different BMR reflects the different total amounts of lean tissue each body contains. There may not be much difference in BMR between a fat person and thin person of the same height because fat tissue is not very active metabolically and does not use much energy.

**2. Body composition.**

Muscular men such as athletes need higher basic energy requirements than the one with lesser muscle mass e.g. obese people because oxidation processes usually in muscle than in adipose tissue.

**3. Age.**

Lean body mass changes with age causing variation of BMR. The number of kilocalories used for basal processes increased during the growth development for synthesizing the tissue. The BMR is high at 1 - 2 years of age and adolescence period. After early adulthood, lean body mass and BMR decrease gradually by anywhere from 2% to 3% per decade.

**4. Sex.**

There are differences in body composition between men and women. The BMR for women are lower about 10% to 12% than BMR for men of the same age, height, and weight because females have proportionately less lean tissue than males have.

**5. Growth.**

BMR increases during the period of rapid growth such as in infants, adolescence and pregnancy. The additional energy required covers the cost of

synthesizing and depositing body tissue is about 5 kcal/g of tissue gained. Growing infants may store much as 12% to 15 % of the energy value of their food intake in the form of new tissue.

#### 6. Sleep.

During sleep the metabolic rate falls approximately 10% because of both muscular and emotional relax, however, these losses may be compensated for by increased needs caused by involuntary tossing and turning during sleep.

#### 7. Temperature

BMR is also affected by temperature as follows:

Environmental temperature affects BMR because kilocalories are needed to maintain body temperature.

Increasing of body temperature will increase BMR. A rise of 1°C in body temperature leads on average to increase of 13% in BMR.

#### 8. Thyroid gland and adrenal gland

The iodine-containing thyroxine or thyroxin, which is secreted by the thyroid gland, is a powerful stimulator of metabolism. Hyperthyroidism is a condition in which BMR is elevated by as much as 50% to 75% above normal because of oversecretion of thyroxin. Hypothyroidism is a condition in which the BMR may be depressed by as much as 30% results from undersecretion of thyroxin.

The hormone adrenaline, which is secreted by the adrenal gland, is response to intense emotional stimuli such as anger or fear. This results in an intense but relatively short-lived within 2 or 3 hours.



### 9. Smoking and caffeine beverage

Nicotine in cigarette will increase BMR by about 10%. Both smoking and caffeine beverage will increase BMR.

### 10. Nutritional status

The prolonged caloric undernutrition will cause the BMR to fall to at least 20% to 30% below normal predicted levels.

### 11. Health status

Fever, injuries or surgery will increase BMR.

### Physical Activity; PA (7)

Energy requirement for activities include the energy required by all of the muscular movements such as sport as well as everyday activities. Each people expenses different energy depending on the following factors:

#### 2.1 Type of activity

Activities that use a large amount of muscle mass more energy for example, walking requires more energy than sitting and typing. The intensity of the activity also has a direct influence on energy usage for instance walking and running use the same amount of muscle mass but intensity of walking is lighter so it requires less energy.

#### 2.2 Duration of activity

Physical Activity that has been done continually or intermittently will affect different energy expenditure. The longer an activity continues, the more energy will be used.

### 2.3 Body weight

Body weight also influences energy expenditure. Anyone with heavy weight, expends more energy in moving his mass.

#### **Specific Dynamic Action: SDA (43)**

Specific Dynamic Action (SDA) represents the amount of extra energy used by the body during digestion, absorption, metabolism, and storage of energy-yielding nutrients. This elevates body temperature within one hour following a meal and virtually disappears 4 hours afterward. This process depends on composition of the meal and the rate of metabolism of individual. It is not conclusive biochemically the source of elevating body temperature but it occurs after food digestion and absorption process. The increasing heat is considered wasted heat that always happens after meals. The elevated heat might be useful in warming human body. Approximately 10% of the energy is used for internal processing in the body.

SDA of each nutrient is different as follows:

SDA of protein is about 30% of energy intake from protein

SDA of carbohydrate is about 5-6% of energy intake from carbohydrate

SDA of fat is about 30% of energy intake from fat.

### **Measuring Human Energy Expenditure**

The amount of energy generated by the body can be assessed by direct or indirect calorimetry. (42,44)

#### **Direct calorimetry**

When using direct calorimetry, a person is placed in an insulated chamber and the amount of heat he or she releases is calculated by measuring the increase in the

temperature of the water surrounding the chamber. The amount of heat take to rise the temperature of 1 L of water 1°C, the number of kilocalories expended can be determined. This method resembles that of using a bomb calorimeter to measure the energy content of food. Direct calorimetry work because almost all the energy used by the body eventual exits as heat. Nevertheless, few investigators use direct calorimeter, mostly because of its expense and complexity.

### **Indirect calorimetry**

The indirect method measures the energy expenditure by determining the oxygen consumption and carbon dioxide production of the body over a given period of time. Data are obtained in a form that permits calculation of the respiratory quotient (RQ):

$$\text{RQ} = \text{moles CO}_2 \text{ expired} / \text{moles O}_2 \text{ consumed}$$

This determination is converted into kilocalories of heat produced per square meter of body surface per hours and is extrapolated to energy expenditure in 24 hours.

The RQ depends on the fuel mixture being metabolized. The RQ for carbohydrate is 1.00, 0.4 for fat and 0.85 for protein. The RQ for a mixed diet is generally accepted to be 0.85. When metabolizing a typical mixed diet containing carbohydrate, fat, and protein, the body uses 1 L of oxygen to expend about 4.85 Kcal.

**Instruments used to measure oxygen consumption for indirect calorimetry including: (43,45,46)**

**The Douglas bag method** is both simple and reliable for collecting expired air samples over periods of from 5 to 15 minutes. The limitations of this method result from interference with locomotive activity caused by the need to carry a cumbersome 100 – 200 liter bag, and the limited duration of the collection or sampling period

because of bag capacity. Its percentage of oxygen is analyzed and the volume is then recorded using a dry gas meter.

**The K-M respirometer** is much smaller (3kg) than the Douglas bag so that interference with normal activities is far less severe. This method has proved highly reliable for normal work activity and use under field conditions. The limitation of this method is that its design causes the equipment to begin to resist the airflow at high ventilation rate.

**Calorimetric chambers and ventilated hoods** are more comfortable because subject is able to breathe naturally without having to use a mask or a mouth. A stream of air is directed over the subject thereby mixing with the expired air; a sample of the mixed air is then collected. In the ventilated hood the sample is collected from a transparent Perspex hood placed over the subject's head, whereas in calorimetric chambers the air is sampled either in the chamber or from the chamber outflow. The rate of air through the hood or chamber can be calculated the rate of energy expenditure. The limitation of this method is its that can be used only for static activities.

**Spirometer** is the instrument, which measured oxygen intake and CO<sub>2</sub> production by calculation of the respiratory quotient. The advantage of this method are mobility and low equipment cost and may be applied when the subject is lying at rest or engaged in various activities.

**Doubly labeled water method (DLW)** is the newest approach to indirect calorimeter uses stable isotopes of oxygen and hydrogen. In this method a person consumes topically labeled water (<sup>2</sup>H<sub>2</sub> <sup>18</sup>O). A technician measures the <sup>2</sup>H<sub>2</sub>O and the H<sub>2</sub><sup>18</sup>O later found in body fluid, such as urine. Using these values and some

mathematical formulas, total carbon dioxide (CO<sub>2</sub>) output per day can be estimated. This estimated of CO<sub>2</sub> output is used to calculate energy use. The advantages of this method are quite accurate and can be applied validly to infants, sick patients, and other groups who are difficult to study by other methods. The drawbacks of this method are very expensive and of the analytical equipment. Furthermore, highly skilled personnel are needed to perform the analyses.

**Heart Rate Monitoring** is based on an association between heart rate and oxygen consumption or energy expenditure. The advantage of this method is the relation of heart rate to energy expenditure may be highly significant in a single subject at any one time. The limitation of this method is vary energy expenditure both between individuals and within one individual under different conditions, and cannot use people with sedentary activities. Furthermore, factors influence with heart rate including age, sex and temperature. It is necessary first to establish heart rates and associated oxygen consumption rates for each subject for various levels of physical exertion and develop a regression equation for each subject in order to estimate energy expenditure for monitored activities.

#### **Measurement of basal metabolic rate (29)**

BMR is measured while the subject is reclining in bed, immediately after awakening, in a state of physical and emotional relaxation. They should not have participated in any formal exercise in the 24 hours immediately before the measurement and not have eaten for at least 12 hours. The term basal metabolic rate, sleeping metabolic rate, resting metabolic rate and resting energy expenditure are used interchangeably. In practice, REE is slightly higher than BMR, they differ by less than 10%. Because the subject is permitted to walk about immediately before the

measurement REE and REE may include the residual thermic effect of a periods meal (46).

The measurement of BMR is three method including direct calorimetry, indirect calorimetry and estimating BMR. First and second method had been mentioned before. The estimating BMR were five formulas as follows:

### **1. BMR based on age and body weight.**

This method is most appropriate for people of average body build and hence average body composition. It predicts a basal energy need on the bases of 1 kcal/kg/hr for men and 0.9 kcal/kg/hr for women in the 20 – 50 year of age. However, it predicts a basal energy need on the basis of 0.9 kcal/kg/hr for men and women in over 50 years of age.

### **2. Harris and Benedict formula**

This method uses for males over 10 years of age and for females of all ages. The formula uses measured body weight, height, and age in combination with four constant values to calculate BMR.

$$\begin{aligned} \text{BMR for males} &= 66.4 + [13.7 \times \text{weight (kg)}] + [5.0 \times \text{height (cm)}] \\ &\quad - [6.8 \times \text{age}] \end{aligned}$$

$$\begin{aligned} \text{BMR for females} &= 655.0 + [9.60 \times \text{weight (kg)}] + [1.8 \times \text{height (cm)}] \\ &\quad - [4.7 \times \text{age}] \end{aligned}$$

### **3. Metabolic body size method**

Values for basal metabolism energy needs obtained in this method seem to be remarkably applicable for different body builds.

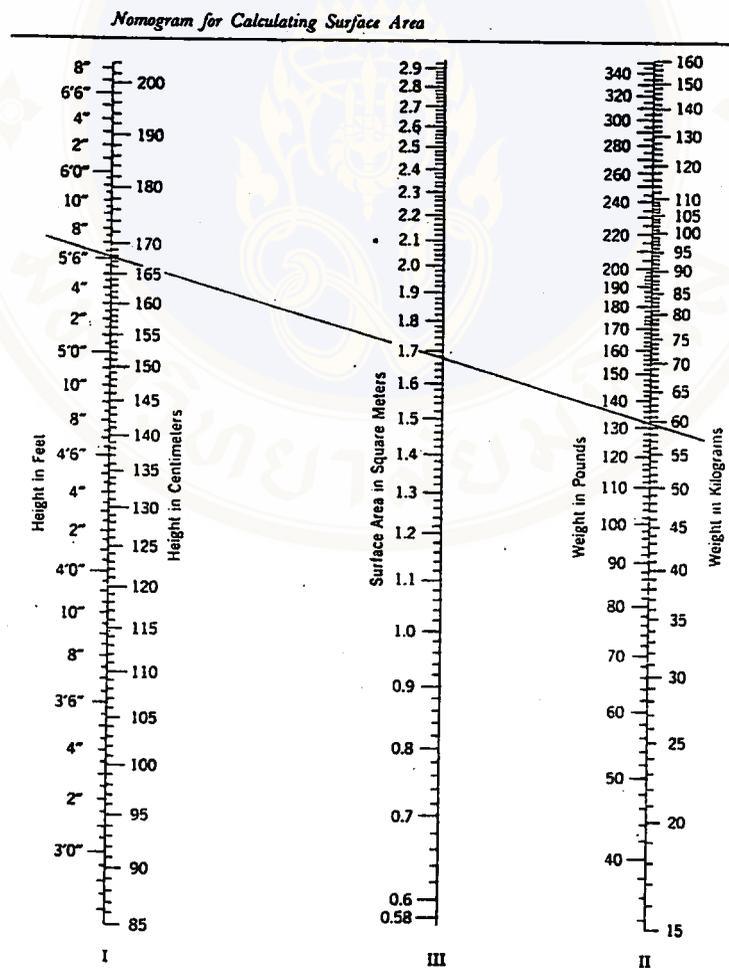
$$\text{BMR} = 70 \times [\text{weight (kg)}]^{3/4}$$

**4. BMR associates with surface area by the equation:**

$$\text{BMR} = \text{surface area (s.q.m.)} \times 24 \text{ (hours)} \times \text{BMS}$$

Basal metabolic standard; BMS is the standard of BMR in people following sex and age as shown in table 1.

Surface area can be achieved by using nomogram by Dobois that consists of three columns. The first column is height, second is weight and third is surface area. The surface area situated between first and second column that will be known when a line to link 1<sup>st</sup> and 2<sup>nd</sup> columns is drawn as shown in figure 1 (46)



**Figure 1: Nomogram for calculating surface area**

**Table 1** BMR in people following sex and age (46)

BMR (kcal/ s.q.m./ hour)			BMR (kcal/ s.q.m./ hour)		
Age (years)	male	Female	Age (years)	male	female
3	60.1	54.5	26	38.2	35.0
4	57.9	53.9	27	38.0	35.0
5	56.3	53.0	28	37.8	35.0
6	54.0	51.2	29	37.7	35.0
7	52.3	49.7	30	37.6	35.0
8	50.8	48.0	31	37.4	35.0
9	49.5	46.2	32	37.2	34.9
10	47.7	44.9	33	37.1	34.9
11	46.5	44.1	34	37.0	34.9
12	45.3	42.0	35	36.9	34.8
13	44.5	40.5	36	36.8	34.7
14	43.8	39.2	37	36.7	34.6
15	43.7	38.3	38	36.7	34.5
16	42.9	37.7	39	36.6	34.4
17	41.9	36.2	40	36.5	34.3
18	40.5	35.7	45	36.3	33.8
19	40.1	35.4	50	36.0	33.4
20	39.8	35.3	55	35.4	32.9
21	39.4	35.2	60	34.8	32.4
22	39.2	35.2	65	34.0	31.8
23	39.0	35.2	70	33.1	31.3
24	38.7	35.1	75 or over	31.8	31.1
25	38.4	35.1			

### 5. FAO/WHO/UNU Equations

Calculations of predicted BMR base on the FAO/WHO/UNU equations applied to six ages – groups of both headers as shown in table 2. (47)

**Table 2** Equations for predicting Resting Energy Expenditure from body weight

Sex and age range (years)	Equation to derive REE in kcal/ day
<b>Males</b>	
0 - 3	$60.9 \times \text{weight (kg)} - 54$
3 - 10	$22.7 \times \text{weight (kg)} + 495$
10 - 18	$17.5 \times \text{weight (kg)} + 651$
18 - 30	$15.3 \times \text{weight (kg)} + 679$
30 - 60	$11.6 \times \text{weight (kg)} + 879$
> 60	$13.5 \times \text{weight (kg)} + 487$
<b>Females</b>	
0 - 3	$61.0 \times \text{weight (kg)} - 51$
3 - 10	$22.5 \times \text{weight (kg)} + 499$
10 - 18	$12.2 \times \text{weight (kg)} + 746$
18 - 30	$14.7 \times \text{weight (kg)} + 496$
30 - 60	$8.7 \times \text{weight (kg)} + 829$
> 60	$10.5 \times \text{weight (kg)} + 596$

Estimating BMR by each method were showed in appendix .

### **Measurement of Physical Activity (45,46)**

Physical Activity is measured by three methods including direct calorimeter, indirect calorimeter and time and motion assessment. First and second method had been mentioned before.

Time and motion assessment is the record of time and motion for determining the time and energy spent in activities. The energy for Physical activities were calculated by multiplying the number of minute spent in each activity by the caloric value of that activity. The energy costs of activities in tables were the average energy cost of a wide range of activities. The overall accuracy of calculations based on it depends not only on the accuracy of information in the tables, but also on the accuracy of the record that is kept of the kinds of activities participated in and the time spent on each. A data – collection period of three days including one weekend day is usually acceptable by this method.

Time and motion assessment can practice by three method including:

#### **1. Direct observation**

Observers record activity and time spent on each activity of subjects. This technique is highly accurate; however its does not practice under most conditions. Except in situations where subjects are engaged in similar activities and can be monitored as a group and the number of subject, who can be monitored is quite small.

#### **2. Diary technique**

Diary technique requires the subject to keep a record of all activities by simple code letters. The subject records his/her activities for each minute or a five – minute interval, depending on the precision required. Whenever possible the subject should be continuously observed in order to record data more reliable. However; this

technique are expensive, the problem of having to write down activities, and hence interfering with habitual activity. So the diary technique requires that subject be literate and sufficiently motivated.

### **3. 24 hours self assessment**

24 hours-self assessment questionnaires may also ask the subject to estimate his/her level of activity in various activities. The subject is asked to recall the time spent sleeping, bathing, dressing and eating, travelling to and from work, working and engaging in leisure activities during the previous 24-hour period. The advantage is cheaper than the diary technique, the subject is not influenced by the continued presence of an observer and will not tend to modify his or her activity pattern. The limitation of this method is the lack of reliability, especially in that subjects tend to exaggerate the duration and for intensity of their physical activities.

#### **Measurement of Specific Dynamic Action (44)**

SDA is determined as 10% of the sum of the BMR and energy expended in physical activity.

In conclusion, Energy Expenditure was divided into 3 parts including Basal Metabolic Rate, energy for Physical Activities and Specific Dynamic Action. Each part were measure by different method. First, it was evaluated by estimating BMR. Second, it was measured by activity diary method that reference value of energy for Physical Activities from Taylor and Method (48) showed in Table 3. Finally, it was determined by equation as 10% of the sum of the BMR and energy for Physical Activities. The overall of these methods were call as a factorial method. A factorial method used by the FAO/WHO/UNU Expert Committee to estimate total energy

requirement and usually taken as the reference method for daily energy expenditure in free living subjects. (45)

**Table 3** Costs of Activities in Kilocalories per kilogram per Hour Exclusive of Basal Metabolism and the Influence of Food (48)

Activity	Energy cost (kcal/kg/hour)
Bicycling (century run)	7.6
Bicycling (moderate speed)	2.5
Bookbinding	0.8
Boxing	11.4
Carpentry (heavy)	2.3
Cello playing	1.3
Crocheting	0.4
Dancing, foxtrot	3.8
Dancing, waltz	3.0
Dishwashing	1.0
Dressing and undressing	0.7
Driving automobile	0.9
Eating	0.4
Fencing	7.3
Horseback riding, walk	1.4
Horseback riding, trot	4.3
Horseback riding, gallop	6.7
Ironing (5-lb iron)	1.0
Laundry, light	1.3
Knitting sweater	0.7
Lying still, awake	0.1
Organ playing (30 to 40% of energy hand work)	1.5
Painting furniture	1.5
Paring potatoes	0.6

**Table 3 (continued)**

<b>Activity</b>	<b>Energy cost (kcal/kg/hour)</b>
Playing Ping-Pong	4.4
Piano playing (Mendelsohn's songs)	0.8
Piano playing (Beethoven's "Appassionata")	1.4
Piano playing (List's "Tarantella")	2.0
Reading aloud	0.4
Rowing in race	16.0
Running	7.0
Sawing wood	5.7
Sewing, hand	0.4
Sewing, foot-driven machine	0.6
Sewing, motor-driven machine	0.4
Shoemaking	1.0
Singing in loud voice	0.8
Sitting quietly	0.4
Skating	3.5
Singing at attention	0.6
Standing relaxed	0.5
Stone masonry	4.7
Sweeping with a broom, bear floor	1.4
Sweeping with a carpet sweeper	1.6
Sweeping with a vacuum sweeper	2.7
Swimming (2 mi./h)	7.9
Tailoring	0.9
Typewriting rapidly	1.0
Violin playing	0.6
Walking (3 mi./h)	2.0
Walking rapidly (4 mi./h)	3.4
Walking at high speed (5.3 mi./h)	9.3

**Table 3 (continued)**

Activity	Energy cost (kcal/kg/hour)
Walking downstairs	*
Walking upstairs	+
Washing floors	1.2
Writing	0.4

\*Allow 0.012 kcal/kg for an ordinary staircase with 15 steps without regard to time.

+Allow 0.036 kcal/kg for an ordinary staircase with 15 steps without regard to time.

### Research on energy expenditure

A study by Bratteby et al. (49) investigated the average daily levels of physical activity, Energy Expenditure and the time and energy spent on different activities in two cohorts of Swedish adolescents. Subjects were selected by a randomization computer program from a database of the official population register of 15 year old adolescents in the University City of Uppsala and the industrial town of Trollhattan. Total subjects were 171 boys and 203 girls living in the two different regions of Sweden. Subjects were required to complete questionnaire about their family, social situation, their activity habits and attitudes towards physical activity and sports, and complete seven day activity diary (AD). BMR of subject was predicted by Schofield, 1985. The results showed that no significant differences in total energy expenditure (TEE) and physical activity level (PAL = TEE / BMR) were found between the adolescents of two regions. High levels of TEE (14.2 and 10.9 MJ/d in boys and girls, respectively) were observed [The mean BMR, TEE, TEE/BW, Activity Energy Expenditure (AEE =

TEE -BMR) were significantly greater in the boys than in the girls in all groups.] The mean length of time and the percentage of TEE spent at the different categories of Physical Activity were almost identical in the adolescents from the two regions, and showed a similar pattern in boys and girls. The longest time and the highest percentage of TEE were spent at activity of the two lowest categories with mean values of approximately 9.2 hour and 19% of TEE for sleeping and 8.3 hour and 27% of TEE for sitting activities. A mean of 1.5 – 2.5 hour was spent each day at each of the activities including standing, walking indoors and outdoors. The mean length of time devoted to physical work or sports varied 0.34 and 0.5 hours.

A study by Bratleby et al. (50) validated TEE and PAL in adolescent by 7 day activity diary with DLW method. Subject were 50 adolescents (25 boys and 25 girls) who were 15 years old living in Uppsala. TEE and PAL estimated from activity diary records kept for seven days and BMR predicted by formulary (Schofield, 1985) were compared with the results of DLW measurement and indirect calorimeter performed during the same time period. The results showed that the mean difference between TEE estimated in all adolescents by the activity diary and by DLW method was 1.2% in conclusion, the activity diary method provides a close estimate of TEE and PAL in population groups.

A study by Davies et al. (51) compared energy expenditure with recommendation for energy intake in 93 children aged 1.5 to 4.5 years. Subjects were divided into three aged groups: 1.5 – 2.5, 2.5 – 3.5 and 3.5 – 4.5 years. TEE was measured with DLW. The results showed that mean energy intake for TEE for the boys were 359, 341 and 327 kJ / kg respectively ,and for the girls were 347, 317 and

310 kJ /kg respectively that were approximately 12% and 10% below current recommendations for energy intake in girls and boys respectively.

A study by Prentice et al. (52) studied the relationship between graded levels of obesity and free living energy expenditure in men and women in affluent societies. Energy Expenditure in 319 adults aged 18-16 years were analyzed. Subjects were interview information about age, sex, weight, height that divide into four groups; ( $< 25.0$ ,  $25.0 - 29.9$ ,  $30.0 - 35.0$  and  $> 35.0$  kg/m<sup>2</sup>). The variables analyzed were: (TEE, assessed by the DLW method); BMR; AEE; PAL. The results showed that TEE increased steadily with increasing BMI ( $P < 0.0001$  for both sexes). BMR also increased (5.7 to 8.2 MJ/d, in women, 7.2 to 11.6 MJ/d in men,  $P < 0.0001$  for both). AEE increased steadily in women (3.8 to 5.3 MJ/d,  $P < 0.0003$ ), but in men increased up to the third BMI category (5.7 to 7.5 MJ/ d, ns) and then declined in the most obese group (5.9 MJ/d, n.s.) The increased in EE were not in direct proportion to body weight since, when expresses per kg, both TEE and AEE declined significantly with increasing BMI. PAL remained quite constant across the three lowest BMI groups, indicating similar levels of physical activity. There was a non-significant decrease in PAL in the most obese men and women.

A study by Vethuis-te-wierik-EJ et al (53) studied the effect of a 10 week moderately energy-restricted diet (ER) on energy expenditure and body composition in 20 health non-obese men. Subjects were matched for age and body mass index and randomly assigned to a counted group ( $n = 8$ ) or an ER group ( $n = 16$ ). After a weight – maintaining run in period of 2 weeks, the ER group received a diet that contained 9.2 MJ/day on average, i.e. 80% of the energy of their habitual diet (estimated by means of a 7 – day dietary record, for the next ten weeks while the control group

received the weight –maintaining diet. The result showed that average daily metabolic rate (ADMR, i.e. total energy expenditure), measured with doubly labeled water in eight subject of the ER group, appeared to be 82.5% of reported energy intake resulting in actual level of energy restriction in these eight subjects of 33% on average. Subjects in the ER group lost  $7.4 \pm 1.7$  kg; 83% of the weight loss was fat mass, 17% was fat-free mass subjects in the control group lost some weight too ( $2.1 \pm 1.5$  kg) Resting metabolic rate (RMR) (MJ/day) decreased in the ER group ( $p < 0.001$ ).

A study by Seal and Rumble (54) compared estimates of daily energy expenditure TEE using energy intake from self reported diet records, metabolizable energy intake balance, doubly labeled water and room calorimetry . Nineteen health adult female (11) and male (8) subjects were recruited at the Beltsville Human Study Facility (BHSF) for 22 week. Subjects height, weight, body mass index were determined. Subject also completed questionnaires on alcohol consumption and physical activity during 12 – 14 weeks. Energy Intake was measured using seven-day self-reported diet records (EI), EE was measured using doubly labeled water (TEE) for 10 days period. The metabolizable energy intake balance (ME) was determined during week five of each eight-week diet phase. Subject were fed experimental diets at the BHSF. Total fecal and urine excretion and duplicate meals were analyzed. In addition, subject 24 hours EE was measured in a room calorimeter during a one-day period between day b0 and b1 of the study. The results showed that EI measured by self reported diet records was 22% less than ME intake balance, 23% less than TEE by doubly labeled water and 8% less than 24 EE by room calorimeter. 24 EE was 16% less than TEE and 16% less than ME. TEE was not significantly greater than ME (0.3%). While mean ME, TEE and 24 measurements were significantly lower in

female compared to male subjects. In conclusion, self-reported diet records and rooms calorimeter underestimate daily energy expenditure.

A study by Scale (55) studied energy expenditure (EE) measurement in relation to energy requirements. Two hundred sixty-six (203 males, 63 females) were same sample group at Beltsville Human Nutrition Research center. Dietary records were collected for > 7 day and analyzed for energy intake (EI). Comparison of EI with EI measured in 12 controlled feeding studies. Subjects were fed experimental diets for 45 days minimum. Seven daily duplicate food collections, and urine and fecal sample for each subject were analyzed. The results showed that diet records underestimate energy requirementally 18%. When comparison of EE measured in a room calorimeter and by DLW in nine subjects showed no significant different between methods within the calorimetry environment ( $1.6 \pm 2.6\%$ ) but free-living EE measured by DLW were significantly greater ( $13.2 \pm 7.1\%$ ). Comparison of Metabolizable Energy Intake (ME), DLW and direct or indirect calorimetry in four subjects indicated no different between ME and EE measured by DLW ( $-1.0 \pm 1.3\%$ ) between direct and indirect calorimetry.

A study by Haggarty et al. (56) investigated the influence of exercise on the energy requirement of adult males in the UK. Leisure activities of subject ranged from 'non-active' to 'very active'. Energy expenditure was measured over 10 days using DLW and activity diary method (AD) in summer and winter in subjects with "light" occupations. The BMR and the energy cost of activities were determined by indirect calorimetry. The results showed that the department of Health (1991) predicted BMR for the group ( $6.89 \pm 0.30$  MJ/d; n = 18) The range of DLW - derived Energy Expenditure within the group was BMR x 1.41 to 2.41. The largest seasonal

change within individuals was  $BMR \times 0.5$ . The Energy Expenditure of the group as a whole was lower in winter ( $BMR \times 1.88 \pm 0.30$ ;  $n = 9$ ) than summer ( $BMR \times 2.01 \pm 0.30$ ;  $n = 9$ ) though the difference; was not statistically significant. The average summer and winter DLW derived - energy expenditure was ( $BMR \times 1.96 \pm 0.31$ ;  $n = 17$ ). The activity diary estimate of energy expenditure was ( $BMR \times 1.79 \pm 0.32$ ;  $n = 17$ ). Subject were representative of the most active 26% of all adult males in the UK, the DLW- derived expenditure was  $BMR \times 2.08 \pm 0.24$ ;  $n = 11$ ). This is higher than the highest department of Health (1991) estimate of  $BMR \times 1.6$  for individuals in light occupations. The measured energy costs of low intensity activities were similar to those presented in the Department of Health (1991) report but the value determined for running ( $BMR \times 13.08 \pm 2.4$ ;  $n = 6$ ) was higher than the highest value in the report ( $BMR \times 6$  to 8).

A study by Rothenberg et al. (57) validated energy intake (EI) by a diet history (DH) against total energy expenditure (TEE) measure by DLW ( $n = 12$ ), used as reference, by heart rate monitoring (HR) and by an activity diary (AD). 20 healthy free-living elderly subjects (73 years) were interviewed about food consumption by nutritionist. Energy Intake were analyzed. Heart rate monitoring method determined BMR and energy for physical activity for four days. During the four days of HR, the individuals kept an AD including type of activity and time spent on different activities. Only 12 subjects were measured energy expenditure by DLW that urinary samples of subjects were than taken after 4, 8 and 12 hours as the first day and there after one sample per day on days 2, 3, 5, 10, 15, 19 and 20 about the same time each day. The results showed that mean value for EI was  $9.02 \pm 2.30$ , for TEE by HR was  $9.66 \pm 2.25$  MJ/d, and for TEE by HR was  $8.94 \pm 1.96$  MJ/d, and TEE by AD was  $9.24 \pm$

2.15 MJ/d. Mean difference between DH and DLW was  $1.28 \pm 2.17$  MJ(NS). In conclusion, the DH slightly underestimated EI compared to the HR, but was in concordance with the AD. Compare to DLW, DH underestimated EI by 12%

In conclusion, there were the studies on measurement of Energy Expenditure by several methods. A study of Energy Expenditure indicated that the activity diary with DLW method provided a close estimate of Energy Expenditure and Physical Activity Level in population groups. In addition, DLW is 2 newest method and provides validity. In consequence, the researcher used activity diary for estimating energy expenditure of the participants in this study. Moreover, Measurement of energy expenditure can evaluate energy requirement for recommendation in RDA.

## **CHAPTER III**

### **MATERIALS AND METHODS**

#### **Research design**

This study was an explanatory research which to assess energy and nutrient intake and energy expenditure of nursing students at Naval Nursing College.

#### **Population**

The population was 178 female nursing students (nursing science degree) in second, third and fourth-year of 1999 academic year at Naval Nursing College in Bangkok. Their ages were between 18-22 years old. All students were required to answer demographic questionnaire about inclusion criteria to be included in the population of this study. The inclusion criteria were as follows:

1. To participate voluntarily in this study.
2. Being between 18-22 years old .
3. Having constant body weight (within  $\pm 1$  kg) during 1-2 months.
4. Not an athlete of the college.
5. No chronic disease.
6. Not on diet or exercise for weight loss program.
7. Not under recuperating period after an sickness or operation during 1 month.
8. No ill from infectious diseases or thyroid gland disease.

The data of all 178 students were analyzed and there were 63 students who met the criteria.

### **General information of nursing students at Naval nursing College.**

#### **(Nursing science degree)**

Nursing study at Naval Nursing is a four- year program. The curriculum is divided into two parts, lecture and practice in various wards. The first-year study consisted only lecture, while second, third and fourth-year consisted of both lecture and practice. From the schedule of nursing training, in the first term second-year students have to be trained in nursing in the morning shift on Monday and Tuesday and on Saturday or Sunday in some weeks. In the second term they have to attend the afternoon and late night shifts as well. The third-year students have to be trained in the morning, afternoon or night shifts on Monday, Tuesday and Wednesday, in the morning of Saturdays and Sundays in some weeks. The fourth-year students have to be trained only in the morning shift, Monday through Thursday. They do not have shift on weekends. The rest of weekdays were lecture. All students have to stay in the college dormitory during weekdays, on the holidays they will be allowed to go home if they do not have to attend morning or night nursing training shifts. The canteen provides the students three meals a day. For additional food, the students can purchase from the shop inside the college or from the stores outside if they receive a permission to go out in the evening.

## **Instrument**

Instruments used in this study consisted of three parts (appendix):

1. Demographic questionnaire for all nursing students to provide the following information: name, age, academic year, height, weight during 1 - 2 months, athletic status, chronic diseases, sickness, weight loss, menstruation and exercise.

2. Food record for recording dietary intake including date, time, meals, place, menu, composition and quantity of food consumption. The record form was of tabular type consisted of instruction for recording and an example.

3. Activity diary was used for recording activities including date, time spent on each of the activities. The form includes types of activity: lying, sitting, standing relaxed and bath taking, standing at work, dressing and undressing, dishwashing and ironing, floor sweeping and mopping- cleaning bed and laundry, walking, walking rapidly, making bed, walking upstairs, walking downstairs, exercise and sleeping for a five minute interval record.

## **Instrument Development**

### **1. Demographic questionnaire**

After reviewing literatures about factors affecting Basal Metabolic Rate and by applying the selected questionnaire from the thesis of Onnipa Wongseelashote (58) on name, age, height, weight, weight loss and exercise, more questions on having constant weight ( $\pm$  within 1 kg) in 1 – 2 months, sickness and operation during one month and having regular menstruation ( $28 \pm 7$  days) were added.

## 2. Food record

Food record of Paradee Temcharoen (31) was applied. The researcher rewrite the instruction and example of the food intake record for clear and easy understanding for the participants.

## 3. Activity diary

The activity diary originally designed by Bratteby et al (50) was modified into three versions by the researcher. The first version was of 2 pages. The first page was the instruction to record codified activities and the second was a tabular form for recording time of activity. Types of activity were divided into 12 items including sitting, standing relaxed, standing at work, dressing and undressing, dishwashing and ironing, floor sweeping and mopping- cleaning bed and laundry, walking, making bed, walking upstairs, walking downstairs, exercise and note taking. Tabular forms of time were prepared into column and horizontal lines, i.e. 5 column lines with a 15 minute interval: 0-15, 16-30, 31-45, 46-60 and a footnote. Horizontal lines were designed for 24 hours record beginning at 06.00 to 05.00 the following day. The activities performed were recorded into the tabular form. The second version was of 1 page that consisted of column and horizontal line for recording activities and time of activities. Column line was of 12 columns for recording 12 types of activity the same as the first version. Horizontal line was of the same as the first form design. The data record was recorded in minute. The third version was of 1 page that consisted of columns of activity and horizontals of time. The column lines were to record 14 types of activity of which lying and walk were added. The horizontal lines were divided at five-minute interval. The data record was recorded using “✓” sign on the tabular form.

## **Validation of study instrument**

Before the data collection, demographic questionnaire was reviewed by thesis advisor for appropriateness, clarification, and modification.

One day food record was modified into a portable booklet and was pilot tested among 15 nursing students of the second, third and fourth year classes, 5 students from each class. The researcher explained the recording procedure of food consumption and demonstrated how to measure quantity of food. Cooked foods, measuring cup and spoon were used to estimate food intake. The actual size of foods such as pork, chicken, vegetables and fruits were provided so that the participants could estimate the foods consumed correctly. After the pilot study, the researcher checked the data collected. It showed that the students were able to record dietary intake information correctly.

Each activity diary was modified three times. The researcher tested the modified diary with 15 nursing students. The researcher explained the recording procedure to the students. After the researcher interviewed about their recording, it found that the first version was too difficult to fill each codified activity and took too much time. The second version was allowed the students to fill the time in minutes of each activity and it was found to be inconvenient to fill out. The third version allowed the students to tick each activity at a five-minute interval. It found that the third version was understandable and convenient. The modified activity diary then was transformed into a portable booklet and tested with 15 students.

## Data collection

In this research there were procedures for implementation of the research as follows:

### 1. Preparations

1.1 The researcher inquired permission letter from Faculty of Graduate Studies, Mahidol University to the director of Naval Nursing College for permission and cooperation of data collection.

1.2 The researcher met with the director of Naval Nursing College to inform and explain the research objectives and seeking cooperation.

1.3 A research assistant with a bachelor's degree in nursing was trained and assisted in weighing food.

### 2. Collection of data

Collection of data was carried out between August 26<sup>th</sup> 1999 to September 30<sup>th</sup> 1999 as follows:

2.1 The researcher informed 178 students in the second, third- and fourth-year classes the research objective. Each student received a questionnaire and was weighed in a uniform dress without belt and shoes using a beam balance scale in kilogram and 1/10 of kilogram. Height of the students without shoes was measured accurately with at least 0.1 cm validated by a measure tape attached in perpendicular line to the wall.

Sixty-three students were selected and divided into 2 age groups by the standard weight for height criteria. The younger group (18 – 19 age group) were evaluated using growth chart for female age between 10 – 20 years old, whereas the older group (20 – 22 age group) by WHO Body Mass Index (BMI) (10 ).

2.2 The data collection was done on Tuesday, Wednesday, Friday, and Saturday the same week.

### 2.2.1 Data on food consumption

The researcher explained how to record data on food consumption and demonstrated how to estimate the food quantity in detail. Raw food, measuring cups and spoons, and kitchen utensils were used to help in estimating. The participants were asked to record food consumed immediately after each meal for accuracy. During the data collection, the researcher monitored the participants everyday to confirm and motivate the participants to record the data continuously.

Since the nursing students have three meals a day at the canteen. So the foods provided were measured to assess food intake of the participants. This was done in two steps. First, 10 trays cooked foods to be served to participants were weighed and the average weight was used for determining the quantity of the foods of participants. Second, after the meal the leftovers were weighed and recorded for three meals throughout the period of data collection days. However, for the food consumed outside the canteen the participants would record food intake themselves. After the recording, the researcher would check and confirmed the data with each of the participants for accuracy.

### 2.2.2 Data of physical activities

The researcher explained how to record and choose activities in the activity diary. The participants were asked to record the activities every 15 minutes to minimize error from forgetfulness.

## Data Analysis

The data were analyzed using computer program.

1. Demographic Questionnaires were analyzed and presented as percentage, mean and standard deviation.

2. Four days food records and observed weighed records were evaluated for energy and nutrient intake and energy distribution. The data was converted to raw food in grams. The observed weighed records in term of weight in grams were averaged in 3 steps. First, the amounts of cooked food before serving for 10 trays was calculated by average. Second, the amounts of the leftover of each participant were substrate from the average cooked food before serving to yield actual quantity of food consumption. Third, The data of food record and observed weighed record were sum and were analyzed by nutrition calculates program, INMUCAL, of Institute of nutrition, Mahidol University. The average energy and nutrients intake in one day of the study population compared with Thai Recommended Daily Dietary Allowance (RDA) at the same age group by percent (%RDA). The percent of proportion of energy distribution from nutrients in one day were analyzed by average.

3. Energy Expenditure were analyzed into 3 parts:

3.1 Mean and standard deviation of Basal Metabolic Rate (BMR) by the FAO/WHO/UNU equations (46).

3.2 Energy for Physical Activity includes:

3.2.1 Calculation for time spent on each of the 14 types of activities.

3.2.2 Calculation for energy cost of activities in nursing applying referent data of cost of activities of Taylor and Mcleod. (appendix)

### 3.2.3 Calculation of mean and standard deviation of time and energy

#### Physical Activity.

3.3 Specific Dynamic Action would be calculated by 10% of the sum of averaging Basal Metabolic Rate and energy for Physical Activities of each participants and analyzed SDA of all participants by mean and standard deviation.

Mean and standard deviation of energy expenditure calculation would be derived by averaging the sum of Basal Metabolic Rate, energy for Physical Activities and Specific Dynamic Action of all participants.

Calculation of Energy Expenditure were presented in appendix.

4. Patterns of physical activity included lying, sitting, standing relaxed, standing at work, dressing and undressing, dishwashing and ironing, floor sweeping and mopping- cleaning bed and laundry, walking, walking rapidly, making bed, walking upstairs, walking downstairs, exercise and sleeping, the data of which would be analyzed for mean and standard deviation. The activities then were ranked in order of time used from most to least.

## CHAPTER IV

### RESULTS

The results of this study which to assess the energy and nutrient intake and energy expenditure of the nursing students at Naval Nursing College were presented in term of demographic information, weight status, energy and nutrient intake, and proportion of energy distribution, energy expenditure and patterns of physical activity of the participants.

#### Demographic information of the participants

The population participating in the study were 63 nursing students (nursing science degree) in second, third, and fourth year of 1999 academic year at Naval Nursing College. The mean age of the participants was  $20.3 \pm 1.1$  years. The majority of the participants were 21 years old (30.1%) followed by 27% each of 19 and 20 years old. There were 14.3% of the participants aged 22 years, about half of the 19 and 20 years old group. The least of the participants was of 18 years old (1.6%). Most of the participants were in the fourth year (39.7%), followed by 33.3% in second year and 27.0% in third year. The mean height was  $160.3 \pm 3.6$  cm. The percentage of the height of the participants in the range of between (155.1-160.0), (160.1-165.0) and (165.1-170.0) cm were 54.0%, 36.5%, and 9.5% respectively. The mean weight was  $51.7 \pm 5.0$  kg. The percentage of the participants body weight were 38.0% with 45-50 kg body weight, 27.0% with 50.1-55.0 kg, 22.0 % with 55.1-60.0 kg, 6.4 % with 40.1 – 45.0 kg and 6.4 % with 60.1 – 65.0 kg. The majority of the



participants had regular menstruation cycle (93.7%), and duration (96.8%). There were about three-fourths of all participants (74.6%) who exercised regularly as showed in Table 4.

**Table 4** Demographic information of the participants

Demographic information	n	%
<b>Age (Year)</b>		
18	1	1.6
19	17	27.0
20	17	27.0
21	19	30.1
22	9	14.3
$\bar{X} \pm SD$	20.3 ± 1.1	
<b>Academic year</b>		
2	21	33.0
3	17	27.0
4	25	39.7
<b>Height (cm)</b>		
155.1-160.0	34	54.0
160.1-165.0	23	36.5
165.1-170.0	6	9.5
$\bar{X} \pm SD$	160.3 ± 3.6	

**Table 4 (Continued)**

<b>Demographic information</b>	<b>n</b>	<b>%</b>
<b>Weight (kg)</b>		
40.1-45.0	4	6.4
45.1-50.0	24	38.0
50.1-55.0	17	27.0
55.1-60.0	14	22.2
60.1-65.0	4	6.4
$\bar{X} \pm SD$	51.7 $\pm$ 5.0	
<b>Cycle of menstruation</b>		
Regular (28 $\pm$ 7 days)	59	93.7
Irregular	4	6.3
<b>Duration of menstruation</b>		
Normal (3-7 days)	61	96.8
Abnormal	2	3.2
<b>Exercise</b>		
Not exercise	16	25.4
Exercise regularly	47	74.6
<b>Total</b>	<b>63</b>	<b>100.0</b>

## Weight status of the participants

Because the range of population age was from 18 to 22 years, it was necessary to use different criteria to determine the weight status. The weight status of the participants aged between 18 years to 19 years were evaluated by using the standard growth chart of female ages between 10-20 years old of the Department of Health, Ministry of Public Health, while the participants aged between 20 years to 22 years were evaluated by Body Mass Index of WHO as showed in Table 5. It was found that the majority of the participants had normal weight (85.7%), while there were 12.7 % underweight (BMI = 17.0 – 18.49 kg/s.q.m) in the 20-22 years age group. Moreover, the prevalence of underweight was medium. On the other hands there were only one overweight participant 1.6% who was in the 19 years age group with > 97 percentile.

**Table 5** Weight status of the participants

Weight status	n	%
Underweight	8	12.7
Normal weight	54	85.7
Overweight	1	1.6
Total	63	100.0

## **Energy, nutrient intake and proportion of energy distribution of the participants' food intake**

### **Energy and nutrient intake of the participants' food intake**

Four days observed weighed records and food records were analyzed and the results were showed in Table 6. The groups of the participants aged 18 – 19 and 20 – 22 years had almost the same energy intake ( $1471.9 \pm 268.5$  kcal and  $1441.8 \pm 263.5$ ) with 79.6% and 72.1% RDA respectively.

The amount of protein, carbohydrate and fat intakes of both groups were similar. As for other nutrient intakes it showed that calcium intakes were at lower level at 25.9% RDA for the 18 – 19 years old group and 32.7% for the 20 – 22 years old group. Vitamin B2 and Niacin intake of both age groups were equal. Vitamin A, B1 and C intake of the 20 – 22 years old group was higher than the 18 – 19 years old group. While iron intake in the 18-19 years old group was higher than the other group.

**Table 6** The mean energy and nutrient intake of the participants compared with Recommended Daily Dietary Allowance by percent (%RDA).

Energy and Nutrient	Age 18-19 years (n=18)		Age 20-22 years (n=45)	
	$\bar{X}\pm SD$	%RDA	$\bar{X}\pm SD$	%RDA
Energy (kcal)	1471.9±268.5	79.6±14.5	1441.8±263.5	72.1±3.2
Protein (g)	44.8±10.9	99.4±24.3	45.8±11.7	104.1±26.5
Carbohydrate (g)	225.7±42.0	-	218.3±47.6	-
Fat (g)	42.6±11.0	-	42.6±10.8	-
Calcium (mg)	310.4±228.0	25.9±19.0	261.2±85.0	32.7±10.6
Iron (mg)	11.4±3.3	75.7±21.9	10.5±2.8	69.7±18.4
Vitamin A (RE)	389.3±329.2	64.9±54.9	550.2±643.5	91.7±107.3
Vitamin B1 (mg)	0.9±0.6	79.1±57.3	0.9±0.7	93.0±70.0
Vitamin B2 (mg)	0.9±0.4	70.0±27.7	0.8±0.3	70.0±21.7
Niacin (mg)	9.6±2.5	68.3±18.0	9.6±2.8	68.3±19.8
Vitamin C (mg)	58.1±83.8	96.9±139.7	91.6±152.9	153.2±254.8

**Proportion of energy distribution of carbohydrate, protein, and fat of the participants' food intake**

The proportion of energy distribution from carbohydrate, protein, and fat of the 18 – 19 and the 20 – 22 years old group were almost the same at 60.9%, 12.6% and 26.5% respectively as showed in Table 7.

**Table 7** Average Percentage of energy distribution from nutrients of the participants' food intake

Nutrient	Age 18-19 years (n=18)	Age 20-22 years (n=45)	Total (n=63)
Carbohydrate	61.8	60.5	60.9
Protein	12.2	12.7	12.6
Fat	26.0	26.8	26.5
Total	100.0	100.0	100.0

### Energy Expenditure of the participants

Energy Expenditure was calculated from the sum of Basal Metabolic Rate, energy for Physical Activities and Specific Dynamic Action. The mean energy expenditure was  $2031.6 \pm 179.0$  kcal,  $2035.0 \pm 164.2$  kcal in 18 –19 years old group and  $2030.2 \pm 186.4$  kcal in the 20 - 22 years old group as shown in Table 8. The mean energy expenditure compared with energy intake of the participants by age group (18 – 19, 20 – 22) was 138.3% and 140.85 respectively. Compared with recommended energy allowances at the same age groups, they were 110.0 % and 101.5% respectively. Energy Expenditure of the participants was analyzed into three parts: Basal Metabolic Rate, energy for Physical Activities and Specific Dynamic Action as shown in Table 8. It showed that the mean Basal Metabolic Rate (BMR) of the participants was  $1219.1 \pm 72.6$  kcal, and were similar quantity in both groups that were  $1225.9 \pm 67.2$  kcal and  $1216.4 \pm 75.2$  kcal respectively. The mean energy for Physical Activities was  $627.7 \pm 116.4$  kcal. The mean energy for

Physical Activities of both age group were almost the same that were  $624.1 \pm 100.1$  kcal and  $629.2 \pm 123.3$  kcal respectively. Four days activities were analyzed, the mean time and energy for each Physical Activities were shown in Table 9. It showed that the highest mean of energy for walking was  $247.5 \pm 104.2$  kcal, and the least was  $0.6 \pm 1.9$  kcal for dishwashing and ironing. The mean Specific Dynamic Action (SDA) was  $184.7 \pm 16.3$  kcal. The SDA of 18 – 19 years old group was almost the same as that of the 20 – 22 years old group that was  $185.0 \pm 15.0$  kcal and  $184.5 \pm 17.0$  kcal respectively.

**Table 8** The mean energy expenditure of the participants

Energy Expenditure (kcal)	Age 18-20 years (n=18) $\bar{X} \pm SD$	Age 20-22 years (n=45) $\bar{X} \pm SD$	Total (n =63) $\bar{X} \pm SD$
Basal metabolic rate	1225.9±67.2	1216.4±75.2	1219.1±72.6
Energy for Physical Activities	624.1±100.1	629.2±123.3	627.8±116.4
Specific Dynamic Action	185.0±15.0	184.5±17.0	184.7±16.3
Energy Expenditure	2035.0±164.2	2030.2±186.4	2031.6±179.0

**Table 9** The mean time and energy for Physical Activities of the participants classified by type of activity

Type of activity	Time (minute) $\bar{X} \pm SD$ (n=63)	Energy (kcal) $\bar{X} \pm SD$ (n=63)
Sitting	534.3±125.5	185.3±44.3
Sleeping	427.2±70.6	-
Walking	146.9±60.6	247.5±104.2
Standing relaxed and bath taking	133.0±44.9	58.4±26.7
Standing at work	82.2±45.0	41.9±23.5
Lying	44.8±35.2	4.1±3.3
Dressing and undressing	29.3±12.7	18.0±7.8
Floor sweeping and moping, cleaning bed and laundry	13.2±24.9	15.0±23.4
Walking rapidly	7.7±7.9	21.4±23.1
Exercise	6.2±13.9	18.7 ±36.9
Making bed	3.1±3.4	7.7±9.1
Walking upstairs	1.5±1.1	7.2±5.8
Walking downstairs	1.4±1.1	2.7±2.4
Dishwashing and ironing	0.8±2.4	0.6±1.9
Total	1440.0	627.8±116.4

## **Patterns of physical activity of the participants**

The average time in minutes spent for each activity of the participants in one day were sitting  $534.3 \pm 125.5$ , sleeping  $427.2 \pm 70.6$ , walking  $146.9 \pm 60.6$ , standing relaxed and bath taking  $133.0 \pm 44.9$ , standing at work  $82.2 \pm 45.0$ , lying  $44.8 \pm 35.2$ , dressing and undressing  $29.3 \pm 12.7$ , floor sweeping and mopping - cleaning bed and laundry  $13.2 \pm 24.9$ , walking rapidly  $7.7 \pm 7.9$ , exercise  $6.2 \pm 13.9$ , making bed  $3.1 \pm 3.4$ , walking upstairs  $1.5 \pm 1.1$ , walking downstairs  $1.4 \pm 1.1$  and dishwashing and ironing  $0.8 \pm 2.4$  as showed in Table 9.

In conclusion, the time spent for each physical activity of the nursing students at Naval Nursing College in hours for one day were as follows: sitting including sitting quietly, sitting to work, eating, talking, writing and reading 6.8 – 11 hours, standing relaxed, bathing and standing at work 2.1 – 5.1 hours, walking 1.4 – 3.8 hours, walking upstairs and downstairs 0.0 – 0.1 hours, dressing, and undressing 0.3 – 0.7 hours, making bed, dishwashing and ironing, floor sweeping and mopping, cleaning bed and laundry 0.2 – 0.8 hours, exercise -0.1 – 0.3 hours, lying 0.2 – 1.3 hours and sleeping 5.9 – 8.3 hours.

## **CHAPTER V**

### **DISCUSSION**

This research was aimed to investigate energy and nutrient intake, proportion of energy distribution, energy expenditure of the nursing students. Sixty-three nursing students participated in the research were between 18-22 years old and were in second, third, and fourth year of 1999 academic year (nursing science degree) at Naval Nursing College. There were 3 important topics for discussion including energy and nutrient intake, energy expenditure, and patterns of physical activity in one day of the nursing students.

#### **Energy and nutrient intake of the participants.**

The mean energy intake of the 18 – 19 and the 20 – 22 years group of the nursing students when compared with Recommended Daily Dietary Allowances for Health Thais (RDA) using 67% as the cut off point, both groups had adequate energy intakes which were 79.6% and 72.1% respectively.

The recommended for proportion of energy distribution from nutrients – carbohydrate, protein, and fat for adolescents were 50 – 60 %, 10 – 15 % and 25 – 30% respectively. (26) This study showed the mean energy distributions from carbohydrate (60.9%) which was slightly higher than the recommended proportion while the mean energy distributions from protein (12.6%) and fat (26.5%) were about the same as the recommended proportion. Energy Intake from carbohydrate was high because the participants usually consumed snack foods and desserts.

The mean nutrient intake from both groups were analyzed by %RDA. It was shown iron intake of both groups was adequate at 75.7% and 69.7% respectively. However, calcium intake of both groups were inadequate at 25% (108.3 – 1151.2 mg) and 32.7% (119.3 – 478.0 mg) respectively.

Vitamins B1, B2, C, and niacin intake of both age groups were adequate at 79.1%, 70.0%, 96.9%, and 68.3% for the age group of 18 - 19 and 93.0%, 70.0, 96.9% and 68.3% for the 20 – 22 years group. In addition, vitamin A intake of the 20 – 22 years group was adequate at 91.7% (88.5 – 2630.8). In contrast, the 18 – 19 years group had an inadequate vitamin A intake (64.9%)(112.0 – 1260.5 RE).

Nutrient intake per day of the participants from cooked foods at canteen of Naval Nursing College were investigated. Because the nursing students have to eat three meals a day from the canteen, this has an important impact on nutrient intake of nursing students. If the food served contains adequate nutrients to meet body requirement, It can prevent undernutrition in nursing students. To study dietary intake of the participants, the quantity of foods at the canteen were collected and analyzed by observed weighed records (appendix ). One serving of the canteen's food and dessert, and 3 ladles of rice for each meal were analyzed for nutrients and energy by mean  $\pm$  standard deviation. The mean energy and nutrient intake were compared with Thai RDA of the age group of 18 – 19 years old and 20 – 22 years old as showed in the appendix. It was found that the inadequacy of nutrient intake from food at the canteen for the 18-19 years group were calcium, vitamin A, B1 and B2 at 23.1%, 43.4, 45.4% and 61.5% RDA respectively for 18 –19 years old group and at 34.6%, 43.4%, 50.0% and 61.7% respectively for 20 –22 years old group.

The study showed that calcium content from the canteen's foods was at inadequate level. Because milk or milk products that were high in calcium has not been served to the students. High calcium intake in some students was due to their own milk supplement. The researcher investigated milk consumption of the participants. It found that 6.3% drank milk everyday and 61.9 % drank milk someday. About one – third of the population group or 31.8% never had milk.

The results of the four days (12 meals) survey on foods at the canteen showed that the foods with high calcium served were eggs for four meals, small fish for one meals, Chinese kale for two meals, cucumber for two meals. Therefore, it is suggested that the canteen and the college' officers should realize this problem and plan to provide high calcium foods in the menu each day, e.g. small dried shrimps, small fish, dried peas, bean curd, green vegetables such as Chinese kale, water mimosa, Thai copper pod leaves, Tamlung (*Melothria heterophylla*) etc (46). Thai RDA recommends 1200 mg calcium intake for females aged 18 –19 years and 800 mg for females 20 – 22 years. (25) The growth of body skeleton and function of neurological system requires increase of calcium intake. During the period of the skeletal growth at 12-40 years of age, higher calcium and minerals intake are needed to increase bone mineralization up to the peak bone mass from food consumption, which is related directly to the calcium intake from food. During the period before 30 years old, the body accumulates calcium and minerals in bones more than dissolution from bones. Until after 30 years old the body has a process of calcium and mineral dissolution from bones more than the building and accumulation of minerals. Therefore, the bone mass is reduced, those who have insufficient calcium intake for a

long time, their bone density will be less than normal and causing osteoporosis which is found commonly in the menopause women and old age people (46).

The other nutrient intake that is inadequate was vitamin A. The foods served at the canteen provide inadequate vitamin A so the participants who consume food only at canteen can have insufficient vitamin A intake. Some students received higher vitamin A intake because they bought and consumed foods such as milk, liver and papaya – ripe to add to the food consumption from the canteen.

High vitamin A foods served at the canteen were egg for four meals, green vegetables for two meals and yellow vegetables for one meal. However, food such as liver had not been served even for one meal. It showed that egg had been served almost everyday but the vegetable was rarely served. Therefore, the canteen should plan a variety of menus that include liver and green leaves – high carotene alternately with eggs. This will increase vitamin A intake and make the food more attractive to eat. Besides, the canteen should concern that Thai RDA for vitamin A is 600 RE for female 18 – 22 years of age. Vitamin A is essential for growth development and maintenance of the vitreous membrane and skin. It is found in liver, egg yolk, milk, butter, green vegetables, yellow vegetables such as pumpkin, carrot, sweet potatoes etc (25).

Vitamin B1 intake of the participants was adequate because the majority of participants bought and consumed snacks consisting of flour, grilled pork and meatballs from the shop in the college. While vitamin B1 from foods at the canteen was inadequate.

The high vitamin B1 foods served at the canteen were eggs for 3 meals, pork for 4 meals and rice, which is a good source of vitamin B1 for every meal. Chicken was served for 6 meals while pork was served for 4 meals. Pork has higher vitamin B1 content than chicken, the canteen should serve pork more often. Besides, rice should not be consider the major source of vitamin B1 since the amount consumed by the participants was different. Furthermore, the canteen should serve vitamin B1 rich food to meet body requirement. Vitamin B1 requirement for adolescents was 1.1 mg for 18 – 19 years old and 1.0 mg for 20 – 22 years old. Vitamin B1 is essential for metabolism of energy from carbohydrate. Vitamin B1 deficiency may cause beriberi. Food with high vitamin B1 are pork, milk, eggs, rice-flour, etc. (25).

Although vitamin B2 content from the canteen's foods was inadequate but vitamin B2 intake of the participants was adequate due to milk consumption in addition to the canteen's foods, so the mean vitamin B2 intake of the participants was adequate.

The foods with high vitamin B2 served at the canteen were eggs for 4 meals, black beans for one meal and Chinese kale for two meals, there is in a month period no other items such as entrails: liver, heart etc. being served. It also found that eggs were served quite often while green leaves – high carotene was served only for 2 meals. Therefore, the canteen should add a variety of foods with high vitamin B2 such as entrails to the menu. Besides, if 100 g of green leaves is served, this will increase 0.30 mg of vitamin B2 intake (59). In addition, the menu should be prepared to meet vitamin B2 requirement for adolescents that was 1.3 mg for 18 –19 years old and 1.2 mg for 20 – 22 years old. Vitamin B2 is an co-enzyme in the metabolism of protein.

Vitamin B2 deficiency can cause angular stomatitis. High vitamin B2 food are cow milk, entrails, dried peas, eggs, green vegetables, etc (25).

Vitamin C intake of the participants was adequate but range of intake was at 7.6 – 385.4 mg for 18-19 year old and 8.19 – 798.9 mg for 20-22-years old. Some students had high quantity of vitamin C because they consumed fruits in additional to the foods served at the canteen. It found from the survey that 6.3% of the participants consumed fruit everyday but 33.2% did not consume fruit. The fruits consumed were pineapple, banana, guava, orange and papaya-ripe.

Vitamin C content from the canteen's foods was sufficient. It found that from fresh vegetable was served for one meal and cooked fruit as a dessert was also served; however, fresh fruits had not been served. Therefore, the canteen should add fresh vegetable and fruit to the menus because these foods are rich in vitamin C. Vitamin C and mineral intake will enhance calcium absorption in the body. Vitamin C is easily destroyed by heat. As for the balance menu 2 portions of fruits per day should be served. Vitamin C requirement for adolescents 18 – 22 years old is 60 mg vitamin C helps build collagen and tissue. Vitamin C deficiency can cause scurvy (26).

In conclusion, this research showed that the adequacy of nutrient intake of the nursing students depends on foods served at the canteen. If the canteen's foods have insufficient nutrient intake to meet body requirement, the students will receive inadequate quantity of nutrients. So the food menu prepared each day should comprise the basic five food groups in sufficient. The canteen's officers must prepare quantity of food to meet nutrients and energy requirement for adolescents. Moreover, the menu prepared should consist of a variety of food to avoid repetition and help

increase food consumption. Finally, the college should provide milk as a supplement food everyday so that the students would have adequate calcium and vitamin A intake.

### **Energy Expenditure of the participants**

Energy Expenditure consists of three parts: Basal Metabolic Rate, energy for Physical Activity and Specific Dynamic Action. It found that the mean energy expenditure of the nursing students was  $2031.6 \pm 179.0$  kcal,  $2035.0 \pm 164.2$  kcal for 18 – 19 old and  $2030.2 \pm 186.4$  kcal for the 20-22 years old. The mean weight of the age group of 18-19 years and 20-22 years was  $52.1 \pm 4.7$  kg and  $51.6 \pm 5.2$  kg respectively. The Energy Expenditure, which calculated from body weight, was 39.1 kcal/ kg/ day and 39.3 kcal/ kg /day for 18-19, and 20-22 age groups respectively as shown in Table 8.

Energy Expenditure compared to the percentage of energy intake of the 18-19 and 20-22 age group was 138.3% and 140.8% respectively. It found that energy expenditure was about 38.3% - 40.8% higher than energy intake.

Thai RDA for energy intake for female adolescent aged 18-19 years old is 1,850 kcal and aged 20-22 years is 2,000 kcal (25). When compared energy expenditure of the nursing students with energy requirement of Thai RDA for the same ages group, the energy expenditure of the age group of 18 –19 years was 110% of Thai RDA. As for the age group of 20 – 22 years, the energy expenditure was about the same as Thai RDA. The energy expenditure of the 18 – 19 years old group was higher than other female adolescents of the same ages. However, if energy requirement calculated by multiply body weight with BMR factor (1.64), the energy requirement was close to the energy expenditure of 18 – 19 years of age group. In 20 – 22 years age group, it found

that, by using BMR factor of 1.64, the energy expenditure was close to the energy requirement. So it can conclude that the energy expenditure of the participants is suitable for medium activity, thus the participants need 2,000 Kcal per day.

The Energy Expenditure was analyzed into 3 parts as followed: First, Basal Metabolic Rate of both age groups was the same that was  $1225.9 \pm 67.2$  kcal and  $1216.4 \pm 75.2$  kcal respectively. Second, energy for Physical Activities of both age groups was close that was  $624.1 \pm 100.1$  kcal and  $629.2 \pm 123.3$  kcal respectively. The mean energy for physical activity classified by type of activities showed that the highest energy expenditure was for walking that was  $247.5 \pm 104.2$  kcal. The energy expenditure for walking activity was high because the nursing students had to walk a lot e.g. walking upstairs to wards, walking during nursing practice, walking to the canteen, walking to the classroom etc. As for energy expenditure for sitting activities, that was lower than that of walking activity at  $185.3 \pm 44.3$  kcal, because the students usually spent time sitting at leisuring, writing, reading, eating, talking and working. These combine activities make the energy expenditure so high. Though the time spent for sitting activities was higher than that of walking activities but they required lower energy than walking activities. So the mean energy expenditure for the sitting activities was lower than that of walking. As for the exercise the energy expenditure was minimal because most of the third year students only exercised once a week in physical education class.

The lowest energy expenditure was for dishwashing and ironing at  $0.6 \pm 1.9$  kcal because the students were restricted by the rules of the college to have meals at the canteen and not washing their clothes by themselves. As for energy needed for

metabolism, it found that the energy expenditure of the two groups of participants were similar due to the basic need of the energy requirement of the two groups were close.

### **Patterns of physical activity of the participants**

To study the patterns of daily activities the time spent for physical activities in one week classified by types was investigated. The mean time spent on each activity then was calculated (Table 9). It was found that  $534.3 \pm 125.2$  minutes was spent on sitting activities i.e. working, eating, talking, writing, reading, leisuring sitting, followed by sleeping at  $427.2 + 70.6$  minutes or  $7.1 \pm 1.2$  hour. Normally, people should sleep at least 8 hours a day, but as the nursing students had to take afternoon and night work shifts on the wards. The normal sleeping period was interrupted. Besides, the students had to review their education lessons, preparing reports eventually their sleeping period was lower. As for exercising activities, it found that the mean time spent was minimal at  $6.2 \pm 13.9$  minutes. Only 38.1% of the participants mostly third year students exercised at the physical education class.

The time spent for activity of walking upstairs or downstairs was minimal at  $1.5 \pm 1.1$  minutes and  $1.4 \pm 1.1$  minutes respectively due to the elevator had been used mostly by the participants. The least time spent was for dishwashing and ironing at  $0.8 + 2.4$  minutes. The students did not perform these activities themselves, so they did not spend time on the activities except when they used their personal utensils for eating at the boarding house.

## CHAPTER VI

### CONCLUSION AND RECOMMENDATIONS

#### Conclusion

The objectives of the research were to study energy and nutrient intake and energy expenditure of the nursing students ( nursing science degree) aged 18-22 years who were studying in second, third and fourth year of 1999 academic year at Naval Nursing College. All students were asked to answer a questionnaire. Those who met the inclusion criteria were included in the study. Sixty-three students were selected. The students have been asked to record their food intake and the activities performed for 4 days. The results of the study can be summarized as follows: the mean energy intake of the 18-19 and 20-22 years old was  $1471 \pm 268.3$  kcal and  $1441.8 \pm 262.5$  kcal respectively. When compared with Thai RDA, it found that the energy intake per day of the students was adequate. The energy distribution per day was 12.6% from protein, 26.5% from fat which was acceptable but 60.9% from carbohydrate which was slightly higher than the acceptable level. As for nutrient intake when compare with Thai RDA, it found that the intake of carbohydrate, protein, fat, iron, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin C and niacin was adequate but intake of calcium and vitamin A was inadequate at 25.9% and 64.9% in the 18-19 years group. Only calcium intake was inadequate at 32.7% in the 20-22 years group. Normally, nursing students consume three meals a day at the canteen of the college, so the nutrient intake from food served at the canteen was investigated. It found that calcium and

vitamin A content in foods served were inadequate thus causing insufficient calcium and vitamin A intake of the nursing students. In addition, the students did not consume milk regularly since they had to buy milk for consumption themselves, and the college did not provide milk for students' to consume.

The energy expenditure of the 18-19 years group was higher than the energy requirement of the same age group of adolescents that was  $2035.0 \pm 164.2$  kcal. As for the group of 20-22 years of age the energy expenditure was  $2030.2 \pm 186.4$  kcal which was the same rate of energy expenditure recommended for the same age adolescents. When compare the mean energy expenditure with the mean energy intake, it found that the energy expenditure was higher than the energy intake (38.3 - 40.8%). The highest energy expenditure was for walking followed by (sitting activities: leisuring, writing, reading, eating, talking and working), standing relaxed and bath taking, standing at work, walking rapidly, exercise, dressing and undressing, floor sweeping and moping-cleaning and laundry, making bed, walking upstairs, walking downstairs.). Least energy expenditure was for dishwashing and ironing. In conclusion, the work that the nursing students performed was classified as medium activity that required 2,000 kcal. From one day study of the pattern of activity performance, it showed that the nursing students spent most time performing sitting activities followed by sleeping, walking, standing relaxed and bath taking, standing at work, lying, dressing and undressing, floor sweeping and moping- cleaning bed and laundry, walking rapidly, exercise, making bed, walking upstairs and walking downstairs, respectively. The least time spent was for dishwashing and ironing.

## **Recommendations**

1. Because of low energy intake than energy expenditure, food provided should meet energy requirement of the nursing student at 2000 kcal per day. The canteen should plan menus that provide adequate energy and nutrient intake. Nutrient content of foods to be served should be calculated each day particularly, the nutrients that were inadequate content including calcium, vitamin A, vitamin B1 and vitamin B2. In addition, the food to be served should look attractive and palatable. Since the nursing students have to work both in lecture and practice they might be tired and loss their appetites so attractive and palatable food might entice them to consume more food. Besides, fruits should be served instead of desserts to increase vitamin C intake and to build a healthy practice of food consumption by having fruits after meals.

2. Two cartons of milk (500 ml) should be served by the college to resolve the inadequacy of calcium and vitamin A in the nursing students as milk is calcium and vitamin A rich food.

3. Nutrition education should be provided and reinforce so that the students will understand and practice consumption of adequate energy and nutrients to meet the body need as well as to solve the problems of undernutrition and overnutrition, and dental problems.

4. Nutritional status of the nursing students should be assessed annually to monitor growth, development and malnutrition situation.

### **Recommendations for further study**

1. Nutritive value of foods to be served at the canteen should be investigated.
2. Opinion of the students on food served at the canteen should be surveyed.
3. Factors affecting food consumption of nursing students should be examined.
4. Energy Expenditure of the nursing students by both direct and indirect measurement should be studied.
5. Study of efficiency of supplement program such as milk consumption and continuity of nutrition implementation on nutrition situation of nursing students should be conducted.
6. Comparative study of nutrition situation and awareness of body figure of nursing students should be performed.
7. Patterns of food consumption of the nursing students should be investigated.

## REFERENCES

1. วลัย อินทร์มพรรย์. อาหารสำหรับบุคคลในภาวะการเปลี่ยนแปลง. เอกสารการสอนชุดวิชา โภชนาการกับชีวิตมนุษย์ หน่วยที่ 8 - 15 พิมพ์ครั้งที่ 12. กรุงเทพมหานคร: สำนักพิมพ์ มหาวิทยาลัยสุโขทัยธรรมาธิราช; 2539.
2. ประยูรศรี มณีสร. จิตวิทยาวัยรุ่น. กรุงเทพมหานคร. ภาควิชาจิตวิทยาและการแนะแนว คณะครู ศาสตร์ มหาวิทยาลัยรัตนโกสินทร์ วิทยาลัยครูจันทระเกษม; 2532.
3. กนกรัตน์ สุขะตุงคะ. คู่มือจิตวิทยาคลินิก. กรุงเทพมหานคร. สำนักพิมพ์เมดิคัลมิเดีย; 2540
4. คณะอนุกรรมการจัดทำแผนโภชนาการในคณะกรรมการโภชนาการแห่งชาติ. แผนอาหารและ โภชนาการแห่งชาติ ตามแผนพัฒนาเศรษฐกิจและสังคมแห่งชาติ ฉบับที่ 8 (พ.ศ. 2540- 2544). ม.ป.ท.; 2540.
5. เทวี โพธิผล. อาหารควบคุมน้ำหนัก. เอกสารการสอนชุดวิชาอาหารบำบัดโรค (ฉบับปรับปรุง) กรุงเทพมหานคร: สำนักพิมพ์สุโขทัยธรรมาธิราช; 2538.
6. Christian JL, Greger JL. Nutrition for living. Redwood City (CA): The Benjamin / Cummings Publishing; 1994.
7. วิชัย ตันไพจิตร. ผลงานที่รับประทานและสัดส่วนของพลังงานต่อสุขภาพ. วารสาร โภชน- ศาสตร์คลินิก 2539; 3: 49-56.
8. ประสงค์ เทียนบุญ. การศึกษาการบริโภคอาหาร โดยวิธีการจดบันทึกและภาวะ โภชนาการของ นักศึกษาแพทย์ปีที่ 4 มหาวิทยาลัยเชียงใหม่. วารสาร โภชนาการสาร 2539; 19(2):84-102.

9. Somjai Wichaidit, Siriphan Srisuwan. Body mass index of Thai college students and adult population. *J Nutr Assoc Thailand* 1990; 24(4): 167 -70.
10. Report of a WHO Expert Committee. Physical status: The use and interpretation of anthropometry. Geneva: World Health Organization; 1995. (WHO Tech Rep Ser no. 854).
11. Hurlock EB. Adolescent development. 3<sup>rd</sup> ed. New York: Mc Graw - Hill; 1969.
12. Mahan LK, Rees JM. Nutrition in adolescence. St.Louis: Times mirror / Mosby college Publishing; 1984
13. Furnharn A, Gunter B. The anatomy of adolescence. London: Routledge; 1989.
14. Twiford R, Carson P. The adolescent passage. New Jersey: Prentice-Hall ; 1980:
15. Steinberg L. Adolescence. 2<sup>nd</sup> ed. Newyork: Mc Graw - Hill; 1989.
16. Coolier Sn, Stalling SF, Wolman Pg, Collen Rw. Assessment of attitudes about weight and dieting among college-aged individuals. *J Am Diet Assoc* 1990; 90: 276 - 8.
17. Ensminger AH, Ensminger ME, Konlande JE, Robson Rk. The concise encyclopedia of foods and nutrition. Boca Raton (FLA): CRC Press; 1995.
18. Poleman CM, Capra CL. Nutrition essentials and diet therapy. 5<sup>th</sup>ed. Philadelphia: W.B. Saunders; 1984.

19. Anderson L, Dibble MV, Torkki PR, Milchell HS, Rynbergen HJ. Nutrition in health and disease. 17<sup>th</sup> ed. Philadelphia: J.B. Lippincott; 1982.
20. Mathan LK, Arlin MT. Krause's food nutrition and diet therapy. 8<sup>th</sup> ed. Philadelphia: W.B. Saunders; 1992.
21. Lewis CM. Nutrition therapy in nursing. East Norwalk (CT): Printice - Hall; 1986.
22. คณะทำงานจัดทำมาตรฐานน้ำหนัก ส่วนสูง และเครื่องชี้วัดภาวะโภชนาการอื่นๆ ของประชาชนไทย. มาตรฐานน้ำหนัก ส่วนสูง และเครื่องชี้วัดภาวะโภชนาการของประชาชนไทย อายุ 1 วัน- 19 ปี. กรมอนามัย กระทรวงสาธารณสุข; 2537.
23. Sziainer DN, Story M, Resnick MD, Blum RW. Lessons learned about adolesnutrition from the Minnesota adolescent health survey. J Am Diet Assoc 1998; 98: 1449-1546.
24. เสาวนีย์ จักรพิทักษ์. โภชนาการสำหรับครอบครัวและผู้ป่วย. พิมพ์ครั้งที่ 4. กรุงเทพมหานคร: ไทยวัฒนาพานิช จำกัด; 2534.
25. กองโภชนาการ กรมอนามัย กระทรวงสาธารณสุข. ข้อกำหนดสารอาหารที่ควรได้รับประจำวัน และแนวทางการบริโภคอาหารสำหรับคนไทย. กรุงเทพมหานคร: โรงพิมพ์องค์การสงเคราะห์ทหารผ่านศึก; 2532.
26. รัตนาภรณ์ เจริญพงศ์. เอกสารคำสอนเรื่องอาหารครบมาตรฐาน. มหาวิทยาลัยมหิดล. เอกสารโรเนียว.
27. สิริพันธุ์ จุลกรังคะ. โภชนศาสตร์เบื้องต้น. กรุงเทพมหานคร: มหาวิทยาลัยเกษตรศาสตร์; 2541.
28. Lutz AC. Nutrition and diet therapy. Philadelphia: F.A. Davis Company; 1994.

29. Guthrie HA, Picciano MF. Human nutrition. St. Louis: Mosby year Book; 1995.
30. Thompson FE, Byers T. Dietary assessment resource manual. J Nutr. 1994; 124 (Suppl): 224s - 317s.
31. ภารดี เต็มเจริญ. เอกสารคำสอนเรื่องการสำรวจอาหารบริโภค. มหาวิทยาลัยมหิดล. เอกสารโรเนียว.
32. Bingham Sa, Nelson M, Paul AA, Haraldsdottir I, Loken EB, Van Staveren Wa. Methods for data collection at an individual level. In: Cameron ME, Van Staveren Wa, Editors. Manual on methodology for food consumption studies: New York: Oxford University Press; 1988.
33. Gibson RS. Principles of Nutritional Assessment. New York: Oxford University Press; 1990.
34. ประณีต ผ่องแผ้ว. โภชนศาสตร์ชุมชน. กรุงเทพมหานคร: กิฟวิ้งทราฟานส์มีเดีย จำกัด; 2539
35. Brevard PB, Ricketts Cd. Residence of college students affects dietary intake, physical activity, and serum lipid levels. J Am Diet Assoc 1996; 96: 35 -8.
36. Ortega Anta RM. The Food Habits and energy and nutrient intake in overweight adolescents compared to those with normal weight. Anales Espanoles de Pediatria 1996; 44(3): 203-8.
37. Koszewski WM. Factors that influence the food consumption behavior and nutritional adequacy of college women. J Am Diet Assoc 1996; 96: 1286-8.

38. Hurson M, Colish C. Evaluation of lifestyle, food consumption and nutrient intake patterns among Irish teenagers. *Irish Journal of Medical Science* 1997 ; 166 (4): 225 - 30.
39. ปาริชาติ กาญจนะ. อาหารบริโภคและระดับไขมันในเลือดของวัยรุ่นเพศชาย กรณีศึกษาโรงเรียนโยธินบูรณะ กรุงเทพมหานคร (วิทยานิพนธ์ปริญญาวิทยาศาสตรมหาบัณฑิต สาขาวิชาโภชนาวิทยา). กรุงเทพมหานคร: บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล; 2539.
40. Worawan Faikratok. Body weight perception and food consumption patterns of female adolescent. (M.Sc.Thesis in nutrition). Bangkok: Faculty of Graduate Studies, Mahidol University; 1990
41. ชไมพร ชนัตนิยม. คุณค่าทางโภชนาการของอาหารบริโภคของนักเรียนชั้นมัธยมศึกษาตอนปลายที่บริโภคอาหารจานด่วน (วิทยานิพนธ์ปริญญาวิทยาศาสตรมหาบัณฑิต สาขาวิชาโภชนาวิทยา). กรุงเทพมหานคร: บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล; 2539.
42. Wardlaw GM, Insel PM. *Perspectives in nutrition*. 3<sup>rd</sup> ed. St. Louis: Mosby; 1996.
43. Mahan LK, Arlin M. *Food, nutrition and diet therapy*. 8<sup>th</sup> ed. Philadelphia: W.B. saunders company; 1992.
44. Pelto GH, Pelto PJ, Messer E. *Research methods in nutrition anthropology*. Hong Kong: The United Nations University; 1989.
45. Fidanza F. *Nutrition status assessment: A manual for population studies*. London: Chapman&Hall; 1991.

46. ทศนีวรรณ ภู่อารีย์. โภชนาการมนุษย์. กรุงเทพมหานคร. ภาควิชาคหกรรมศาสตร์ คณะวิทยา  
ศาสตร์ มหาวิทยาลัยศรีนครินทรวิโรฒ ประสานมิตร; 2537.
47. Food and nutrition Board subcommittee on the tenth edition of the RDAs.  
Recommended Dietary Allowances. 10<sup>th</sup> ed. Washington: National  
Academy Press; 1989: 25.
48. Scheider WL. Nutrition: basic concepts and applications. New York; 1983.
49. Bratteby LE, Sandhagen Bo, Lotborn M, Samuelson G. Daily energy expenditure  
and physical activity assessed by an activity diary in 374 randomly selected  
15 -year old adolescents. Eur J Clin Nutr 1997; 51: 592-600.
50. Bratteby LE, Sandhagen Bo. A 7 -day activity diary for assessment of daily energy  
expenditure validated by the doubly labelled water method in adolescents.  
Eur J Clin Nutr 1997; 51: 585-91.
51. Davies PSW, Gregory J, White A. Energy expenditure in children aged 1.5 to 4.5  
years: a comparison with current recommendations for energy intake. Eur J  
Clin Nutr 1995; 49: 360 - 4.
52. Prentice AM, Black AE, Coward WA, Cole TJ. Energy expenditure in  
overweight and obese adult in affluent societies: an analysis of 319 doubly  
labelled water measurements. Eur J Clin Nutr 1996; 50: 93-7.
53. Velthuis-te Wierik-EJ, Westerterp KR, Van-den-Berg H. Impact of a moderately  
energy – restricted diet on energy metabolism and body composition in non

- obese men. *Int J obes Relat Metab Disord* 1995; 19(5): 318 - 24.
54. Seale JL, Rumpler WV. Comparison of energy expenditure measurements by diet records, energy intake balance, doubly labelled water and room calorimeter. *Eur J Clin Nutr* 1997; 51: 856-63.
55. Seale JL. Energy expenditure measurements in relation to energy requirements. *Am J Clin Nutr* 1995; 62 (Suppl): 104s-6s.
56. Haggarty P, Mc Neill G, Manneh MK, Davidson L, Miine E, Duncan G, et al. The influence of exercise on the energy requirements of adult males in the UK. *Br J Nutr* 1994; 72 (6): 799-813.
57. Rothenberg E, Bosaews I, Lernfelt B, Landahl S, Steen B. Energy intake and expenditure: validation of a diet history by heart rate monitoring, activity diary and doubly labeled Water. *Eur J clin Nutri* 1998; 52: 832-838
58. Onnipa wongserachote. Energy balance in Thai woman comparison between obese and normal woman. (M.Sc.Thesis in nutrition). Bangkok: Faculty of Graduate Studies, Mahidol University; 1994.
59. กองโภชนาการ กรมอนามัย กระทรวงสาธารณสุข. ตารางแสดงคุณค่าอาหารไทยในส่วนที่กินได้ 100 กรัม; 2530.
60. Report of a Joint FAO/ WHO/ UNU Expert Consultation. Energy and protein requirement. Geneva: World Health Organization; 1985. (WHO Tech Rep Serial no. 724).





ตัวอย่างการประมาณค่า BMR ด้วยวิธีต่าง ๆ ในผู้หญิงอายุ 30 ปี น้ำหนัก 52 กิโลกรัม ส่วนสูง 164 เซนติเมตร ดังแสดงในตารางที่ 1

ตารางที่ 10 การเปรียบเทียบค่า BMR จาก 5 วิธี

วิธีการ	ค่า BMR (กิโลแคลอรี/วัน)
1. น้ำหนักตัว 0.9 กิโลแคลอรี / กิโลกรัม / ชั่วโมง	1123
2. Harris-Benedict Equation (สำหรับผู้หญิง) $655.0 + (9.6 \times \text{น้ำหนักตัวเป็นกิโลกรัม}) + (1.9 \times \text{ส่วนสูงเป็นเซนติเมตร}) - (4.7 \times \text{อายุเป็นปี})$	1325
3. Metabolic Body Size $70 \times \text{น้ำหนัก (กิโลกรัม)}^{3/4}$	1356
4. ความสัมพันธ์กับพื้นที่ผิวของร่างกาย $\text{พื้นที่ผิว(ตารางเมตร)} \times 24 (\text{ชั่วโมง}) \times \text{BMR}$	1302
5. สมการ FAO/WHO/UNU (สำหรับผู้หญิง 18 – 30 ปี) $(14.7 \times \text{น้ำหนักตัวเป็นกิโลกรัม}) + 496$	1260

จะเห็นได้ว่าค่า BMR จากวิธีที่ 1 จะได้ค่าที่ต่ำที่สุด และเป็นค่าที่แตกต่างจากค่าอื่น ๆ ส่วนค่าที่ได้จากวิธีที่ 2, 3, 4 และ 5 จะใกล้เคียงกัน ( $\pm$  ไม่เกิน 100 กิโลแคลอรี) จากการคำนวณค่าเฉลี่ยของ BMR ที่ได้จาก 5 วิธี จะเท่ากับ 1,273 กิโลแคลอรี ซึ่งค่า BMR จากวิธีที่ 5 มีค่าใกล้เคียงกับค่าเฉลี่ยของ BMR ที่ได้จาก 5 วิธี นอกจากนี้ค่า BMR จากวิธีที่ 5 ของ FAO/WHO/UNU เป็นค่าที่ได้จากการปรับปรุงสูตรสมการบนพื้นฐานการวัดค่า BMR จากการวิจัย 11,000 วิจัย ในกลุ่มตัวอย่างทั้งสองเพศในทุกช่วงอายุ (60) ผู้วิจัยจึงให้ความเชื่อถือ วิธีที่ 5 และใช้เป็นวิธีการประเมินค่า BMR ในการศึกษาวิจัยนี้

ภาควิชาโภชนวิทยา  
คณะสาธารณสุขศาสตร์  
มหาวิทยาลัยมหิดล

วันที่ 26 สิงหาคม พ.ศ. 2542

เรื่อง ขอความร่วมมือในการตอบแบบสอบถาม  
เรียน นักเรียนพยาบาลทุกท่าน

ข้าพเจ้า เรือเอกหญิงพัลลภา สันถวไมตรี นักศึกษาปริญญาโท สาขาโภชนวิทยา มหาวิทยาลัยมหิดล กำลังวิทยานิพนธ์ เรื่องการได้รับพลังงานจากอาหารบริโภคและการใช้พลังงานเพื่อการทำงานของร่างกายในนักเรียนพยาบาล วิทยาลัยพยาบาลกองทัพเรือ

ข้าพเจ้าได้รับอนุญาตให้ติดต่อนักเรียนพยาบาลเพื่อร่วมในการทำวิจัย ซึ่งนักเรียนพยาบาลมีส่วนร่วมโดยตอบแบบสอบถามข้อมูลส่วนบุคคล และบันทึกการบริโภคอาหารและการทำกิจกรรมเป็นเวลา 4 วัน การตอบแบบสอบถามแบบการบันทึกข้อมูลดังกล่าวจะไม่มีถูกไม่มีผิด และขอรับรองว่าข้อมูลของนักเรียนพยาบาลทุกท่านจะได้รับการเก็บเป็นความลับ และไม่มีผลต่อการเรียนหรือผลใดๆต่อนักเรียนพยาบาล

ข้าพเจ้าหวังเป็นอย่างยิ่งว่าจะได้รับความร่วมมือในการตอบแบบสอบถามและการบันทึกข้อมูลดังกล่าว และขอขอบคุณในความร่วมมือของนักเรียนพยาบาลเป็นอย่างมาก

ขอขอบคุณ

(พัลลภา สันถวไมตรี)  
ผู้วิจัย

### แบบสอบถามข้อมูลส่วนบุคคล

**คำชี้แจง** จงเติมข้อมูลหรือทำเครื่องหมาย ✓ ลงในช่องว่างให้สมบูรณ์

1. ชื่อ..... นามสกุล.....
2. อายุ.....วันเดือนปีเกิด.....
3. กำลังศึกษาในชั้นปีที่.....
4. ส่วนสูง.....เซนติเมตร
5. น้ำหนัก.....กิโลกรัม
6. ภายใน 1-2 เดือนที่ผ่านมาท่านมีน้ำหนักตัวคงที่ ( $\pm$  ไม่เกิน 1 กิโลกรัม) หรือไม่  
 ไม่คงที่       คงที่  
 ถ้าน้ำหนักตัวไม่คงที่ ท่านมีน้ำหนักตัวมากขึ้นหรือลดลงเท่าไร.....
7. ท่านเป็นนักกีฬาประจำของวิทยาลัยหรือไม่  
 เป็น       ไม่เป็น  
 ถ้านักกีฬาประจำของวิทยาลัย ให้ระบุชื่อกีฬาที่เล่น.....
8. ท่านมีโรคประจำตัวหรือไม่  
 มี       ไม่มี  
 ถ้ามีโรคประจำตัวให้ระบุ 8.1) ชื่อโรค.....  
 8.2) ผู้วินิจฉัยโรค.....  
 8.3) การรักษา.....
9. ปัจจุบันท่านป่วยเป็นโรคจากการติดเชื้อหรือโรคที่เกิดจากความผิดปกติของต่อมไทรอยด์หรือไม่  
 เป็น       ไม่เป็น  
 ถ้าเป็น ให้ระบุ 9.1) ชื่อโรค.....  
 9.2) ผู้วินิจฉัยโรค.....  
 9.3) การรักษา.....

10. ภายใน 1 เดือนที่ผ่านมา ท่านมีอาการเจ็บป่วยหรือได้รับการผ่าตัดหรือไม่

( ) มี ( ) ไม่มี

ถ้ามีให้ระบุ 10.1) ชื่อโรค.....

10.2) วันเดือนปีที่เจ็บป่วยหรือได้รับการผ่าตัด.....

10.3) การรักษา.....

11. ปัจจุบันท่านกำลังลดน้ำหนักหรือไม่

( ) ลด ( ) ไม่ลด

ถ้าลดน้ำหนักให้ระบุวิธีการลดน้ำหนัก.....

12. ท่านมีประจำเดือนสม่ำเสมอทุกเดือน ( $28 \pm 7$  วัน) หรือไม่

( ) สม่ำเสมอทุกเดือน ( ) ไม่สม่ำเสมอ

ถ้าประจำเดือนของท่านมาไม่สม่ำเสมอ ให้ระบุระยะเวลาของรอบประจำเดือนต่อครั้ง.....วัน

13. โดยทั่วไปในแต่ละเดือน ท่านมีประจำเดือนทั้งหมด.....วัน

ประจำเดือนครั้งสุดท้ายเมื่อไร.....ทั้งหมด.....วัน

14. โดยทั่วไป ท่านออกกำลังกายหรือไม่

( ) ออกกำลังกาย ( ) ไม่ออกกำลังกาย

ถ้าท่านออกกำลังกาย ให้ระบุ 14.1) ชนิดของการออกกำลังกาย.....

14.2) จำนวนครั้ง/สัปดาห์.....ครั้งละ...../นาที

**แบบบันทึกการบริโภคอาหารและการทำงาน**

เลขที่.....

ชื่อ.....นามสกุล.....อายุ.....ปี

ตั้งแต่ 06.00 น. ของวันที่.....เดือน.....พ.ศ.....

ถึง 06.00 น. ของวันที่.....เดือน.....พ.ศ.....

### คำแนะนำในการบันทึกการบริโภคอาหาร

1. ให้บันทึกอาหารทุกชนิดที่รับประทานทันทีภายหลังจากรับประทานอาหารเสร็จในแต่ละมื้อ หรือแต่ละครั้งของการรับประทาน เพื่อป้องกันการลืม
2. การบันทึกรายการอาหารที่บริโภคแต่ละมื้อหรือแต่ละครั้ง ขอให้บันทึกโดยละเอียด เช่น ข้าว ผักใส่ไข่
3. การบันทึกชนิดของอาหารที่เป็นส่วนประกอบของอาหารแต่ละรายการ ให้บันทึกรายละเอียดเกี่ยวกับลักษณะของอาหารชนิดนั้นให้ชัดเจนและมากที่สุดเท่าที่จะทำได้

#### ตัวอย่าง

- 1). ผัก ให้ระบุว่าเป็นส่วน หัว ลำต้น ดอก หรือใบ เช่น ต้นหอม หอมหัวใหญ่ เป็นต้น
  - 2). ผลไม้ ให้ระบุว่าสุกหรือดิบ และชื่อพันธุ์ในกรณีที่มีหลายพันธุ์ เช่น มะม่วง ทุเรียน
  - 3). เนื้อสัตว์ เช่น เนื้อหมูให้ระบุว่า เนื้อแดง เนื้อติดมัน หรือหมูสามชั้น
  - 4). ไขมัน ให้ระบุว่า น้ำมันพืช หรือน้ำมันสัตว์ น้ำมันพืชให้ระบุว่าเป็นน้ำมันอะไร เช่น น้ำมันถั่วเหลือง
  - 5). กะทิ ให้ระบุว่า หัวกะทิ หรือหางกะทิ กะทิข้น หรือใส
  - 6). ขนมหรืออาหารสำเร็จรูป ให้ระบุยี่ห้อด้วย เช่น ถั่วโกโก้ โยเกิร์ตรสส้มตราเมจิ
  - 7). เครื่องปรุงรส ให้บันทึกเฉพาะน้ำตาล และน้ำมันกระเทียมเจียวเท่านั้น ส่วนน้ำปลา พริกไทย พริกแห้งป่น น้ำส้ม ไม่ต้องบันทึก
4. การบันทึกปริมาณอาหารแต่ละชนิดที่รับประทาน ให้บันทึกเฉพาะส่วนที่รับประทานได้ และส่วนที่รับประทานจริง
- \* ถ้าเป็นรายการอาหารที่ท่านทราบน้ำหนัก ให้บันทึกน้ำหนักเป็นกรัม เช่นนมพ่องมันเนยตราไฟโรมอสต์ ขนาด 240 ซีซี, มันฝรั่งทอดยี่ห้อ 1 ซอง (30 กรัม)
  - \* ในกรณีที่ไมทราบน้ำหนัก ให้ท่านใช้ถ้วยตวง และช้อนตวง ในการกะปริมาณอาหาร เช่น ข้าวสวย 2 ถ้วยตวง , หัวกะทิ ใส่ขนม 2 ช้อนชา หรืออาจจะระบุเป็นขนาดและจำนวนที่ชัดเจน เช่น ส้มเขียวหวานขนาดกลาง 1 ผล ขนมจีน 2 จับใหญ่
5. ให้ระบุมื้ออาหาร เวลา และสถานที่ในการบันทึกอาหารแต่ละครั้ง

## ตัวอย่าง การบันทึกการบริโภคอาหาร

บันทึกอาหารประจำวันที่ 1 เดือน กันยายน พ.ศ. 2542

มื้ออาหาร และเวลา	สถานที่	รายการอาหาร	ส่วนประกอบอาหาร	ปริมาณ อาหาร		
เช้า 08.00	หอพัก	1. กาแฟร้อน	- ผงกาแฟ	1 ช้อนชา		
			- น้ำตาล	2 ช้อนชา		
			- คอฟฟี่เมท	2 ช้อนชา		
				2. ขนมปังทาแยม	- ขนมปังฟาร์มเฮาส์	1 แผ่น
- แยมสับปะรด	2 ช้อนชา					
เที่ยง 12.00	โรงครัว	1. ข้าวผัดกุ้ง (ใส่ไข่)	- ข้าวสวย	1 ถ้วยตวง		
			- กุ้ง	5 ตัว		
			- ผักคะน้า	1/2 ถ้วยตวง		
			- น้ำมันพืช	3 ช้อนโต๊ะ		
			- ไข่ไก่	1 ฟอง		
			2. แองจิตผักกาดขาว	- เนื้อหมูติดมัน	1 ช้อนชา	
				ใส่หมูบะซ่อ	- ผักกาดขาว	1/2 ถ้วยตวง
					- กระเทียมเจียว	1 ช้อนชา
					3. ส้ม	- ส้มเขียวหวานขนาดกลาง
ว่างบ่าย 14.00	ร้านค้าใน หอ	1. น้ำอัดลม	- โค้ก	1 ขวด 325 ซีซี		
			เย็น 18.00	ร้านบำรุง	1. ก๋วยเตี๋ยวน้ำไก่ตุ๋น (ไม่ใส่ถั่วงอก)	- ก๋วยเตี๋ยวเส้นใหญ่
- น่องไก่	1 ชิ้นขนาด กว้าง 3 ซม. ยาว 5 ซม.					
					- น้ำมันกระเทียมเจียว	1 ช้อนชา
					- น้ำตาล	1 ช้อนชา
ก่อนนอน 23.00	หอพัก	1. นมพร้อมมันเนย	- นมพร้อมมันเนยตรา โฟโมสต์	1 กล่อง 240 ซีซี		



### คำแนะนำในการบันทึกกิจกรรม

1. ขอให้สังเกตการทำกิจกรรมของตนเองอย่างต่อเนื่อง เพื่อการลงบันทึกกิจกรรมอย่างถูกต้อง และควรบันทึกอย่างต่อเนื่องทุก 15 นาที เพื่อป้องกันการลืม
2. โปรดใส่เครื่องหมาย ✓ ในช่องกิจกรรมที่ตรงกับกิจกรรมที่ทำจริงตามเวลาที่ทำกิจกรรมนั้น
3. ในกรณีที่ไม่ว่างที่จะลงช่องกิจกรรมใดให้ตัดสินใจว่าใกล้เคียงกับกิจกรรมใดมากที่สุด แล้วใส่เครื่องหมาย \* พร้อมทั้งเขียนชื่อกิจกรรมนั้นไว้ในช่องหมายเหตุด้วย
4. ในกรณีที่นอนหลับ ให้บันทึกลงในช่องหมายเหตุ โดยเขียนว่า “นอนหลับ” ในช่องเวลาที่เริ่มต้นและเวลาที่สิ้นสุดของการนอนหลับ
5. ในกรณีเล่นกีฬาหรือทำกิจกรรมอื่นๆที่นอกเหนือจากที่ตารางได้ระบุไว้ ให้เขียนชื่อกิจกรรมในช่องหมายเหตุตามเวลาที่ทำกิจกรรมนั้น
6. ในกรณีที่ขึ้น - ลงบันได ให้ระบุขึ้นบันไดไว้ในช่องกิจกรรมขึ้นหรือลงบันไดด้วย

### การจัดกิจกรรมประเภทกิจกรรมการพยาบาล

1. ประเภท นั่งทำงาน ได้แก่ นั่งรับเวร, นั่งป้อนนมเด็ก, นั่งพับ Gauze, นั่งจัดยา, นั่งซักประวัติ, นั่งวัดปรอท วัดความดัน จับชีพจร-การหายใจ
2. ประเภท ยืนทำงาน ได้แก่ ยืนรับเวร, ยืนวัดปรอท วัดความดัน จับชีพจร- การหายใจ, ยืนเตรียมอาหาร, ยืนเตรียมยา, ยืนป้อนเด็ก, ยืนป้อนอาหารทางปากและ Feed อาหารทางสายยาง, ยืนเจาะปอดหรือดูดเสมหะ, ยืนจับผู้ป่วยพลิกตะแคงตัว, ยืน Suction, ยืนเปลี่ยนผ้าอ้อม, ยืนช่วยแพทย์ตรวจ, ยืนส่งเครื่องมือแพทย์, ยืนซักประวัติผู้ป่วย, ยืนห่อของSterile, ยืนฉีดยา, ยืนให้น้ำเกลือ
3. ประเภทยืนและเดิน ได้แก่ เดินแจกยา, เดินแจกน้ำหรืออาหาร, เดินแจกเสื้อผ้าผู้ป่วย, เดินบันทึกการขับถ่ายปัสสาวะ- อุจจาระ ในกรณีนี้ให้ประเมินว่าเดินกึ่งนาทีและยืนทำงานกึ่งนาทีแล้วแยกบันทึกลงในช่องกิจกรรมทั้งสองประเภท



### การคำนวณค่าพลังงานที่ใช้

#### 1. การคำนวณหาค่าพลังงานที่ต้องการขั้นพื้นฐาน (BMR)

ผู้หญิงอายุ 22 ปี น้ำหนักตัว 60.3 กิโลกรัม คำนวณจากสมการ WHO ดังนี้

$$(14.7 \times \text{น.น. เป็นกก.}) + 496 \text{ จะได้ค่า BMR} = 1382.41 \text{ หรือ } 57.60 \text{ กิโลแคลอรี / ชั่วโมง}$$

$$\text{เนื่องจากจำนวนชั่วโมงที่นอนหลับ} = 7.53 \text{ ชั่วโมง}$$

$$\text{ดังนั้นค่า BMR ที่ลดลงขณะหลับ} = 10 \% \times 57.60 \times 7.53 = 43.37 \text{ กิโลแคลอรี}$$

$$\text{ดังนั้น BMR เมื่อหักลบจากที่ลดลงขณะหลับแล้ว} = 1339.04 \text{ กิโลแคลอรี / วัน}$$

$$\text{ดังนั้นเมื่อรวมพลังงานที่ต้องการขั้นพื้นฐาน (BMR) กับพลังงานที่ใช้ในการทำกิจกรรม (PA)}$$

$$= 1339.04 + 843 = 2182.04 \text{ กิโลแคลอรี}$$

#### 2. การคำนวณหาค่าพลังงานที่ใช้ในการทำกิจกรรมต่างๆ (PA)

ประเภทกิจกรรม	เวลาที่ใช้ (นาที)	เวลา (ชั่วโมง)	พลังงานที่ใช้ในการทำกิจกรรม	
			กิโลแคลอรี / กก./ ชม.	กิโลแคลอรี / นน.ตัว
1. นอนหลับ	430	7.17	-	-
2. นอนเล่น	15	0.25	0.10	1.81
3. นั่ง	470	7.83	0.40	188.74
4. ยืนตามสบาย	235	3.92	0.50	118.18
5. ยืนทำงาน	40	0.67	0.40	24.12
6. แต่งตัวและผลัดเสื้อผ้า	15	0.25	0.70	10.86
7. เดินตามปกติ	215	3.58	2.00	431.75
8. เดินเร็ว	20	0.33	3.40	67.54

\* รวมพลังงานที่ใช้ในการทำกิจกรรม = 843 กิโลแคลอรี / วัน

#### 3. การคำนวณหาค่าพลังงานที่ใช้เพื่อการเปลี่ยนแปลงอาหารภายในร่างกาย (SDA)

$$\text{SDA ประมาณร้อยละ 10 ของค่า BMR + PA} = 10 \% \times 2182.04 = 218.20 \text{ กิโลแคลอรี / วัน}$$

$$\text{รวมพลังงานที่ใช้ใน 1 วัน} = (1 + 2 + 3) = 2400.24 \text{ กิโลแคลอรี}$$

ตารางที่ 11 ค่าการใช้พลังงานในกิจกรรมการพยาบาลขณะฝึกปฏิบัติการพยาบาลบนหอผู้ป่วย

กิจกรรม การพยาบาล	กริยาอาการ	จัดเข้าประเภท กิจกรรม	กิโกลแคลอรี/ กก. /ชม.
นั่งรับเวร หรือ ส่งเวร	นั่ง, ฟัง, พุด, หรือเขียนหนังสือ	นั่งเขียนหนังสือ	0.4
นั่งป้อนนมเด็ก	นั่ง, อุ้มเด็กทารก และป้อนนม	นั่งรับประทานอาหาร	0.4
นั่งพันผ้า Gauze	นั่ง, พันผ้า Gauze	นั่งเย็บผ้าด้วยมือ	0.4
นั่งซักยา	นั่ง, ซักยา	นั่งเย็บผ้าด้วยมือ	0.4
นั่งซักประวัติ	นั่ง, ฟัง, พุด หรือเขียนหนังสือ	นั่งเขียนหนังสือ	0.4
นั่งวัด Vital sign	นั่ง, วัดปรอท- ความดันโลหิต- จับชีพจร และหายใจ	นั่งเขียนหนังสือ	0.4
ยืนรับเวร หรือ ส่งเวร	ยืน, ฟัง, พุด หรือเขียนหนังสือ	ยืนระวังตรง	0.6
ยืนวัด vital sign	ยืน, วัดปรอท- ความดันโลหิต- จับชีพจร และหายใจ	ยืนระวังตรง	0.6
ยืนซักยา	ยืน, ซักยา	ยืนระวังตรง	0.6
ยืนเตรียมยา	ยืน, เตรียมยาฉีดหรือน้ำเกลือ	ยืนระวังตรง	0.6
ยืนเตรียมอาหาร	ยืน, เตรียมอาหารสำหรับ Feed	ยืนระวังตรง	0.6
ยืนป้อนนมเด็ก	ยืน, ป้อนนมขวด	ยืนระวังตรง	0.6
ยืน feed อาหาร	ยืนให้อาหารทางสายยาง	ยืนระวังตรง	0.6
ยืนเคาะปอด-ดูดเสมหะ	ยืน, ให้การพยาบาล	ยืนระวังตรง	0.6
ยืนเปลี่ยนผ้าอ้อม	ยืน, เปลี่ยนผ้าอ้อมเด็ก	ยืนระวังตรง	0.6
ยืนช่วยแพทย์ตรวจ	ยืน, ส่งเครื่องมือให้แพทย์	ยืนระวังตรง	0.6
ยืนพลิกตัวผู้ป่วย	ยืน, จับผู้ป่วยเปลี่ยนท่านอน	ยืนระวังตรง	0.6
ยืนซักประวัติผู้ป่วย	ยืน, ฟัง, พุด หรือเขียนหนังสือ	ยืนระวังตรง	0.6
ยืนห่อของ sterile	ยืน, ห่อ set ของเครื่องใช้	ยืนระวังตรง	0.6
ยืนฉีดยา, ให้น้ำเกลือ	ยืน, ฉีดยาหรือให้น้ำเกลือ	ยืนระวังตรง	0.6
เปลี่ยนเสื้อผ้าให้ผู้ป่วย	เปลี่ยนเสื้อผ้าให้ผู้ป่วย	แต่งตัวและผลัดเสื้อผ้า	0.7
กวาดถูพื้น เช็ดเตียง, อาบนํ้าเด็ก, เช็ดตัวPt.	ยืนทำความสะอาด	กวาดพื้นห้อง	1.4
เก็บที่นอนและปูเตียง	ยืนจัดเก็บที่นอนและปูเตียง	ด้วยไม้กวาด	3.0

## ตารางที่ 12 รายการอาหารที่จัดเสิร์ฟจากโรงครัว

วันที่	เช้า	กลางวัน	เย็น
14 กย. 42	แกงจืดวุ้นเส้น, ข้าวสวย	ข้าวผัดกระเพราไก่, ซูปฟัก, ไข่ดาว, เผือกแกงบัวค	น้ำพริกปลาผัดจิ้ม, แกงจืดผัดกาดขาว, ข้าวสวย
15 กย. 42	ต้มยำไก่, ข้าวสวย	ข้าวมันไก่ทอด, ซูปฟัก, กล้วยบวชชี	ผัดคะน้าปลาเค็ม, ปลาทูจู้, ข้าวสวย
17 กย. 42	ซูปแซกไก่, ข้าวสวย	ผัดซีอิ้วใส่ไข่, ข้าวเหนียวถั่วดำ	ปลาใส่ต้นหอม, แกงเทโพหมู, ข้าวสวย
18 กย. 42	ไข่ลูกเขย, ข้าวสวย	ข้าวผัดอเมริกัน, ไข่ดาว, ซูปฟัก, ฟักทองแกงบัวค	ต้มยำไก่ใส่เห็ดนางฟ้า, ผัดบวบใส่หมู, ข้าวสวย

ตารางที่ 13 ค่าเฉลี่ยของพลังงานและสารอาหารจากอาหารหลัก 3 มื้อที่จัดเสิร์ฟจากโรงครัวของ  
วิทยาลัยพยาบาลกองทัพเรือ

สารอาหาร	$\bar{X} \pm SD$	%RDAของ	
		อายุ 18 - 19 ปี	อายุ 20 - 22 ปี
พลังงาน(กิโลแคลอรี)	1689 ± 163.7	91.34 ± 9.1	84.49 ± 8.9
คาร์โบไฮเดรต(กรัม)	278.7 ± 12.2	-	-
โปรตีน(กรัม)	44.9 ± 5.4	-	-
ไขมัน (กรัม)	41.8 ± 19.6	-	-
แคลเซียม (มิลลิกรัม)	276.8 ± 72.4	23.1 ± 6.1	34.6 ± 9.05
เหล็ก (มิลลิกรัม)	12.5 ± 4.7	83.3 ± 31.3	83.3 ± 31.3
วิตามินเอ (อาร์อี)	260.3 ± 134.4	43.4 ± 22.4	43.4 ± 22.4
วิตามินบี 1 (มิลลิกรัม)	0.5 ± 0.1	45.5 ± 9.1	50.0 ± 10.0
วิตามินบี 2 (มิลลิกรัม)	0.8 ± 0.3	61.5 ± 23.1	6.7 ± 25.0
ไนอาซิน (มิลลิกรัม)	9.9 ± 4.5	70.7 ± 32.1	70.7 ± 32.1
วิตามินซี (มิลลิกรัม)	56.1 ± 32.6	93.5 ± 54.3	3.5 ± 4.3

**Table 14** Demographic information of the population

Demographic information	n	%
<b>Total</b>	<b>178</b>	<b>100.0</b>
<b>Age (years )</b>		
18	2	1.1
19	44	24.7
20	51	28.7
21	58	32.6
22	18	10.1
23	5	2.8
$\bar{X} \pm SD$	20.3 $\pm$ 1.1	
<b>Academic year</b>		
2	60	33.7
3	61	34.3
4	57	32.0
<b>Height (cm)</b>		
155 – 160	93	52.2
160 – 165	64	36.0
165 – 170	20	11.2
170 – 175	1	0.6
$\bar{X} \pm SD$	160.5 $\pm$ 3.9	

Table 14 (continued)

Demographic information	n	%
<b>Weight (kg)</b>		
40 – 45	8	4.5
45 – 50	44	24.7
50 – 55	67	37.6
55 – 60	42	23.6
60 – 65	15	8.4
65 – 70	2	1.1
$\bar{X} \pm SD$	53.1 $\pm$ 5.1	
<b>Changes of Body Weight</b>		
Constant ( $\pm$ 1 kg)	41	79.2
Not constant ( $\pm$ over 1 kg)	37	20.8
<b>Athlete of the college</b>		
Athlete	62	34.8
Non athlete	116	65.2
<b>Chronic disease</b>		
No Chronic disease	155	87.1
Having chronic disease	23	12.9
The circulatory of vascular system	2	8.7
Respiratory system	13	56.5
Digestive or alimentary system	3	13.0
The regulation of the temperature	1	4.4

**Table 14 (continued)**

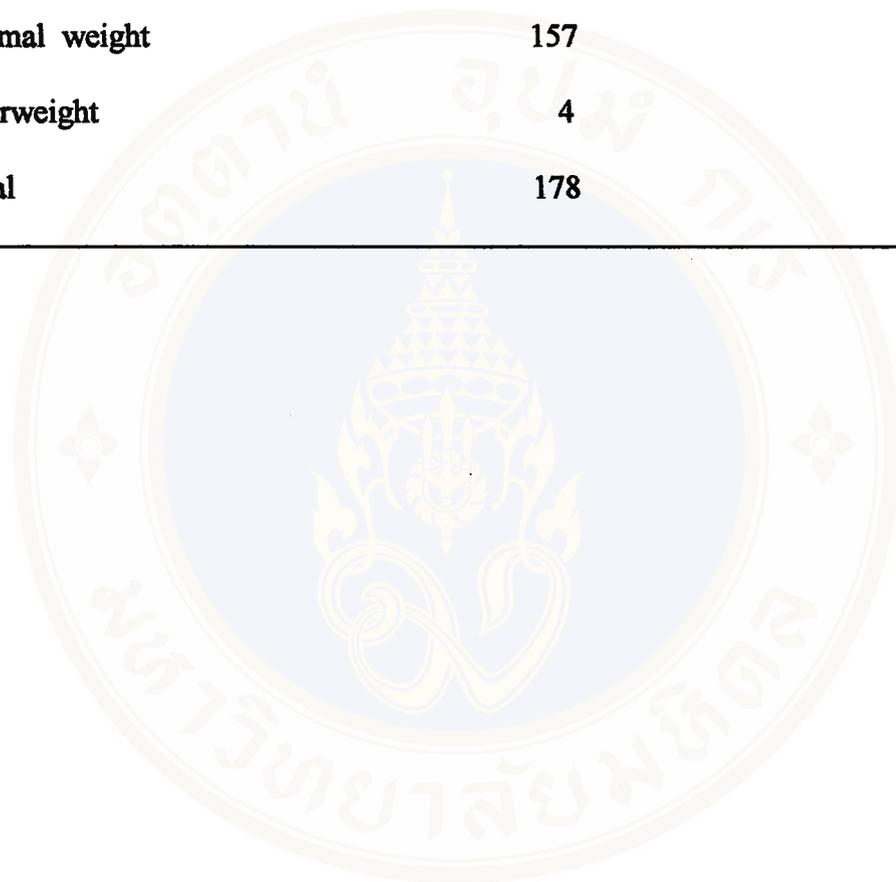
Demographic information	n	%
Nervous system	3	13.0
Sense	1	4.4
<b>Infectious disease or thyroid disease</b>		
Yes	177	99.4
No	1	0.6
<b>Illness or operation</b>		
Yes	157	88.2
No	21	11.8
The circulatory of vascular system	2	9.5
Respiratory system	7	33.3
Digestive or alimentary system	9	42.9
Reproductive system	2	9.5
Sense	1	4.8
<b>Dieting</b>		
None dieting	137	77.0
Dieting	41	23.0
Exercise	7	17.1
Control diet	16	39.0
Exercise and control diet	17	41.5
Diet pills	1	2.4

Table 14 (continued.)

Demographic information	n	%
<b>Cycles of menstruation</b>		
Regular (28 ± 7 days)	156	87.6
Irregular	22	12.4
< 21 days /cycle	9	40.9
> 35 days /cycle	13	59.1
<b>Duration of menstruation</b>		
Normal (3 – 7 days )	172	96.6
Abnormal	6	3.4
< 3 days	1	16.7
> 7 days	5	83.3
<b>Exercise</b>		
Not exercise	28	15.7
Exercise regularly	150	84.3
< 3 times / week	96	64.0
3 – 5 times / week	47	31.3
> 5 times / week	7	4.7

**Table 15** Weight status of the population

Weight status	N	%
Underweight	17	9.6
Normal weight	157	88.2
Overweight	4	2.2
Total	178	100.0



## BIOGRAPHY

<b>NAME</b>	Lieutenant Panlapa Santavamaitree
<b>DATE OF BIRTH</b>	29 October 1968
<b>PLACE OF BIRTH</b>	Bangkok, Thailand
<b>INSTITUTIONS ATTENDED</b>	Naval Nursing College, 1986 – 1990 : Bachelor Science of Nurse Sukhothai Thammathirat University, 1996 – 1998 : Bachelor of Home Economics Mahidol University, 1998 – 2000 : Master of Science ( Public Health )
<b>POSITION &amp; OFFICE</b>	1990 – Present, Somdejphapinklao Hospital, Bangkok, Thailand. Position : Professional nurse

