

DIETARY INTAKE OF HIGH SCHOOL GIRLS AGED 15-18 YEARS IN NAKHON SI THAMMARAT PROVINCE, THAILAND

Manas Kotepui*, Orawan Sarakul, Kwuntida Uthaisar, Ranee Marasa, Wachaffiyah Thepwarin

Medical Technology Program, School of Allied Health Sciences and Public Health, Walailak University, Nakhon Si Thammarat, 80161, Thailand

ABSTRACT:

Background: Adequate dietary intake is a core lifestyle recommendation for the prevention of disease in adult and adolescent populations. In Thailand, about 10% of high school children aged 15-18 years are malnourished. This paper reports a study of inadequate dietary intake of high school girls aged 15-18 years.

Methods: This cross-sectional study was designed as a population-based survey of a sample group of high school girls. Surveys were conducted in 2013 (n=247) in Thasala Prasitsuksa School, Thasala District, Nakhon Si Thammarat Province, Thailand. Dietary intake of food was estimated from one 24-hour dietary recall. Demographic data such as age, body mass index (BMI), and religion were also collected.

Results: The mean habitual daily energy intake of the sample group was 1,470.6 kilocalories. The mean levels of protein, fat, carbohydrate, dietary fiber, cholesterol, vitamin A, carotene, vitamin B1, vitamin B2, vitamin C, sodium, potassium, calcium, phosphorous, iron, and zinc intake per day were 50.5 g, 34.3 g, 239.4 g, 2.8 g, 142.6 mg, 481.9 µg, 297.9 µg RAE, 0.7 mg, 1.50 mg, 19.9 mg, 644.0 mg, 274.2 mg, 465.8mg, 624.4 mg, 7.0 mg, and 1.1 mg, respectively.

Conclusions: Macronutrient and micronutrients intake were lower than the recommended range in the majority of the sample group, especially dietary fiber, which was low in 99% of the subjects. However, mean cholesterol intake was within the recommended range. Inadequate food intake in adolescent girls is a serious concern since they are the next generation of the Thai population. Implementation of government programs to ensure food intake that meets standard nutritional requirements is recommended.

Keywords: Diet, Adolescent, Nutritional status, High school girl, Thailand

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INTRODUCTION

Nutrition plays an important role among the environmental factors that impact the health of a nation. The health and nutritional status of adolescents is an index of national investment in the development of a country's future manpower [1]. Achievement of optimum growth during adolescence is of utmost importance in maintaining good health into adulthood. Poor nutrition leads to short stature and low lean body mass, which are associated with

many concurrent and future adverse health outcomes [2]. Food consumption needs in adults is different than in adolescents due to greater physiological need for food of high nutritional value[3]. For females, this is the period for preparation for motherhood. Thus, health and nutritional status of today's adolescent girls may have great impact on the quality of the next generations. Malnutrition of adolescence girls is associated with increased risk of adverse reproductive outcomes such as risks for low birth weight [4], cephalopelvic disproportion and caesarean section [5]. The risks are even higher if pregnancy occurs before physical growth and maturation have

* Correspondence to: Manas Kotepui
E-mail: manas.ko@wu.ac.th

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completed, which is common in the developing countries [6]. In Thailand, adolescents 15-17 years of age constitute 4.8% of the population [7]. According to a national nutrition survey of the Thai population living in cities by the Ministry of Public Health, about 10% of school children are malnourished of protein and energy consumption [8].

This study aims to investigate the prevalence of inadequate intake of macronutrients and micronutrients among high school girls. Early detection of nutritional insufficiency in this group of the population through regular surveys will help with prompt treatment and prevention of serious complications. The surveys used assessed food intake, which is become important in planning actions related to care for adolescents. Knowledge of the diet of this group of the population plays an important role in planning healthcare actions for monitoring of and intervention for diseases. Moreover, this study provides a background for establishing hypotheses about the relationship between diet and health. Habitual intake was compared to Thailand's recommended food intake guidelines [9].

METHODS

Assessment of dietary intake was performed in Thasala Prasitsuksa School, Thasala District, Nakhon Si Thammarat Province, Thailand from September to November 2013. The study protocol was approved by the Ethical Clearance Committee on Human Rights Related to Research Involving Human Subjects of Walailak University (EC13/029). Informed consent forms were signed by all study subjects before data collection. Interviewers who collected a 24-hour dietary recall data were trained by interviewing their colleagues before the data collection. During the interview process, pictures of food in established amounts and general household measurement tools such as tablespoons and measuring cups were used to assist in reporting portion size and method of preparation. After the interview process, data from the 24-hour dietary recall was entered into the Nutrisurvey Program [10] to calculate 24-hour nutrient intake. Nutrisurvey Program was validated in previous studies [11, 12]. The food code entered to Nutrisurvey Program was retrieved from Thailand food data base [13].

Out of 247 participants, 61 were excluded from the present analysis because they reported a total energy intake below the third percentile (805.8 kcal) and therefore were considered outliers due to possible dietary intake underreporting or incorrect collection of intake information. One additional participant was excluded because of an incomplete questionnaire. Data analysis was restricted to participants aged 15 to

18 years with a completed 24-hour dietary recall. Data from 184 participants were available for analysis. Analysis was conducted using the SAS software package (SAS Inc, Cary, NC). Body mass index (BMI) was used to characterize nutritional status and was calculated with self-reported measurements of height and weight. Initially, descriptive analysis was performed, and then the prevalence of inadequate nutrient intake was estimated by comparing the sample population's intake with dietary reference intake (DRI) reference values for energy, carbohydrates, fat, proteins, cholesterol, dietary fiber, vitamin A, carotene, vitamin B1, vitamin B2, calcium, sodium, potassium, phosphorous, iron, and zinc. Cholesterol and carotene intake recommendation ranges also followed these guidelines [14]. The adequacy of daily nutrient intake was estimated as the sum of percentages of the above intakes below the range of nutrient recommendations.

RESULTS

Of the 248 girls selected for this study, 184 girls completely participated in the 24-hour intake interviews, giving a response rate of 74.2%.

Socio-economic and anthropometric measurement

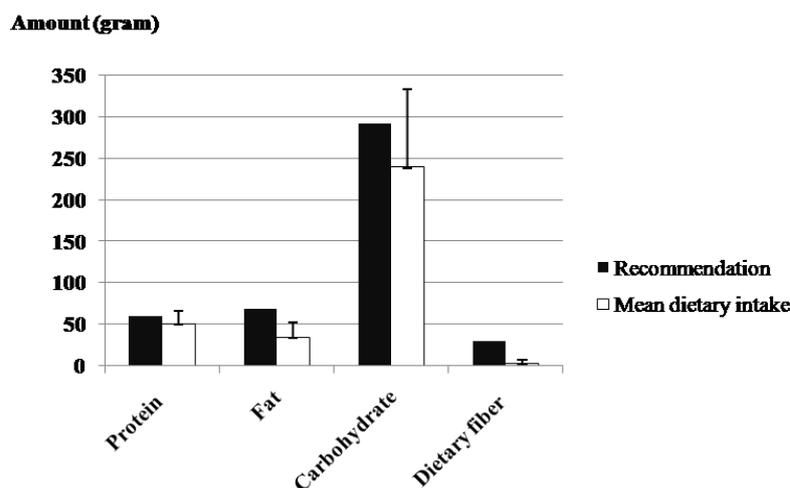
General demographic information was collected from participants (Table 1). All the participants were of Thai ethnicity. All participants were girls aged 15-18 years. Girls aged 17 comprised the majority of participants (38.6%), following by those aged 16 (35.3%), 18 (22.3%), and 15 (3.8%). More than 80% of participants were Buddhist, followed by Muslim (16.8%) and Christian (1.6%). For BMI, 56.5% of participants had a BMI index in the range of 18.5 to 24.9, indicating they were in the normal range and 35.3% of girls had a BMI index lower than 18.5, indicating they were underweight. The percentage of participants with a BMI index of more than 25 was 8.2%.

Table 1 Characterization of the studied population

Variables	Total (n%)
Age (years)	
15	7 (3.8)
16	65 (35.3)
17	71 (38.6)
18	41 (22.3)
Religion	
Buddhist	150 (81.5)
Muslim	31 (16.8)
Christian	3 (1.6)
Body mass index (kg/m²)	
< 18.5	65 (35.3)
18.5 to 24.99	104 (56.5)
≥25	15 (8.2)

Table 2 Mean food intake according to interviews and prevalence of food intake below the recommended levels

Nutrients (per day)	Mean intake (Mean \pm SD)	Intake below the recommendations n (%)
Energy (kcal)	1470.6 \pm 477.1	165 (89.7)
Protein (g)	50.5 \pm 15.5	95 (51.6)
Fat (g)	34.3 \pm 18.4	111 (60.3)
Carbohydrate (g)	239.4 \pm 93.0	107 (58.2)
Dietary fiber (g)	2.8 \pm 4.8	183 (99.5)
Cholesterol (mg)	142.6 \pm 166	43 (23.4)
Vitamin A (μ g)	481.9 \pm 1090.1	156 (84.8)
Carotene (μ g RAE)	297.9 \pm 444.1	156 (84.8)
Vitamin B1 (mg)	0.7 \pm 0.56	132 (71.7)
Vitamin B2 (mg)	1.50 \pm 0.9	90 (48.9)
Vitamin C (mg)	19.9 \pm 48.4	177 (96.2)
Sodium (mg)	644.0 \pm 1156.2	176 (95.7)
Potassium (mg)	274.2 \pm 231.1	175 (95.1)
Calcium (mg)	465.8 \pm 842.6	175 (95.1)
Phosphorous (mg)	624.4 \pm 295.6	182 (98.9)
Iron (mg)	7.0 \pm 4.0	175 (95.1)
Zinc (mg)	1.1 \pm 1.0	184 (100)

**Figure 1** Mean dietary intakes of protein, carbohydrate, fat, and dietary fiber intake in study population

Nutrients intake

Recommendations of nutrient levels for adolescents aged 15-18 years from Bureau of Nutrition, Department of Health, Ministry of Public Health, Thailand were used as guidelines. The mean habitual daily energy intake of the population was 1,470.6 kcal (Table 2). The mean protein, fat, carbohydrate, dietary fiber (Figure 1), vitamin A, carotene, vitamin B1, vitamin B2 (Figure 2), vitamin C, sodium, potassium, calcium, phosphorous (Figure 3), iron, and zinc daily intakes were 50.5 g, 34.3 g, 239.4 g, 2.8 g, 142.6 mg, 481.9 μ g, 297.9 μ g RAE, 0.7 mg, 1.50 mg, 19.9 mg, 644.0 mg, 274.2 mg, 465.8 mg, 624.4 mg, 7.0 mg, and 1.1 mg, respectively (Table 2). The percentages of individual participants with intakes lower than the recommended ranges are:

energy (89.7%), protein (51.6%), fat (60.3%), carbohydrate (58.2%), dietary fiber (99.5%), cholesterol (23.4%), vitamin A (84.8%), carotene (84.8%), vitamin B1 (71.7%), vitamin B2 (48.9%), vitamin C (96.2%), sodium (95.7%), potassium (95.1%), calcium (95.1%), phosphorous (98.9%), iron (95.1%), and zinc (100%) (Table 2).

DISCUSSION

This study examined the prevalence of inadequate food nutrient intake among high school girls living in Nakhon Si Thammarat, Thailand. Our aim was to obtain information not only on energy and macronutrient intake, which is already available in many previous surveys, but also on micronutrient intake.

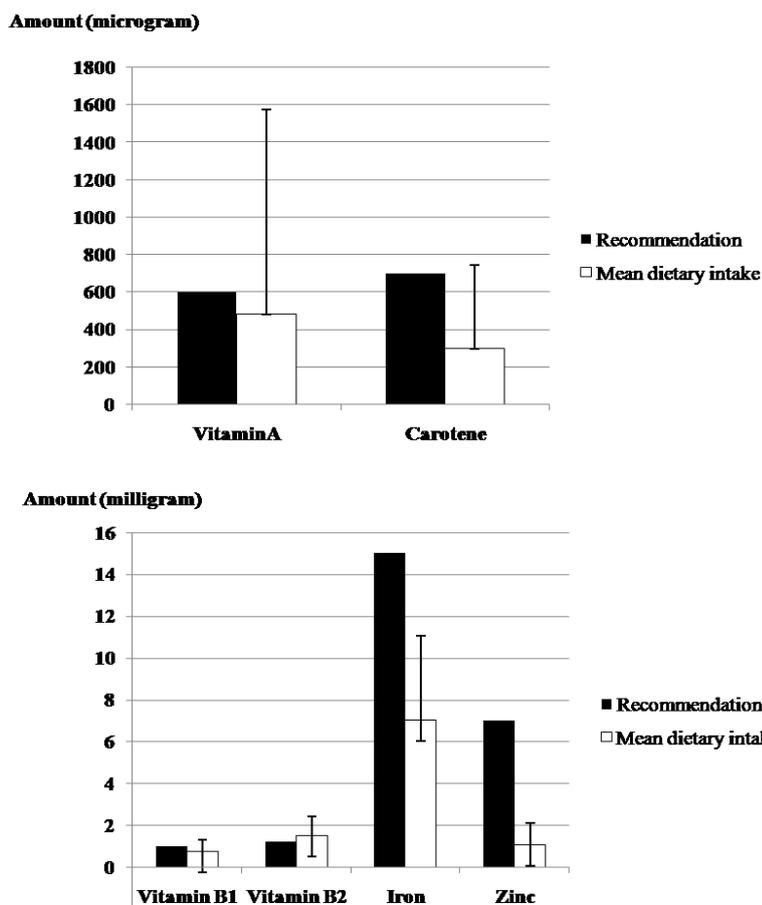


Figure 2 Mean dietary intakes of vitamin A, carotene, vitamin B1, vitamin B2, iron, and zinc in study population

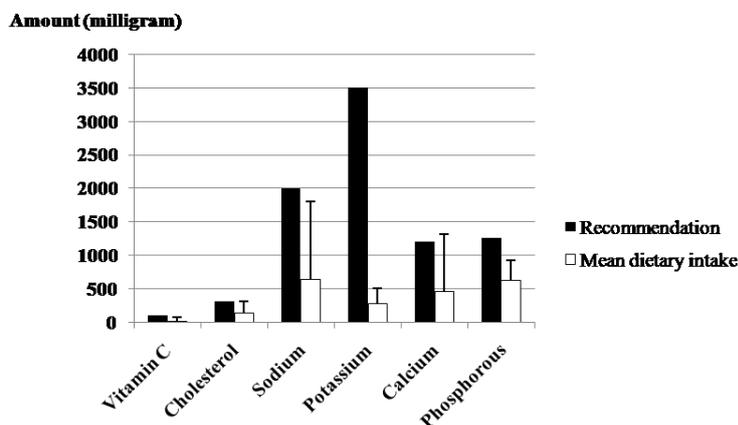


Figure 3 Mean dietary intakes of vitamin C, cholesterol, sodium, potassium, calcium, and phosphorous in study population

This study showed a general inadequate energy intake. Children experience a number of consequences from early malnutrition such as poor learning ability and increased susceptibility to diseases throughout their lives [15]. In Thailand, according to a national nutrition survey of the Thai population living in cities by the Ministry of Public Health, about 10% of school children are

malnourished of protein and energy [11]. In this study, cholesterol intake was within the recommended range, which is a good predictor for reduced risk of various diseases such as coronary artery disease (CAD), one of the major causes of death in later life [16]. A previous study showed that a high level of low-density lipoprotein (LDL), one type of cholesterol, was a cause of CAD [17], so

participants may have a lower risk of the disease. This study also uncovered that the fiber intake of participants was lower than the majority of the sample group, which can be explained by reduced consumption of fruit and vegetables. Fruit, vegetables, and grains are particularly implicated in decreased risk of diseases such as cancer, cardiovascular disease, and stroke [18]. Participants with low consumption of fruit and vegetables may have a greater risk of developing these diseases.

Analysis also reported inadequate intake of micronutrients including vitamin A, carotene, vitamin B1, vitamin B2, sodium, potassium, calcium, phosphorous, iron, and zinc. In southern Thailand, data about micronutrient intake (e.g. calcium, phosphorus, iron, vitamin A and zinc) is limited; however, previous studies in other parts of Thailand, particularly the Northeast, have reported lower micronutrient intake than those recommended for school-aged children [19-21]. Deficits in some of these micronutrients in school-aged children have been associated with reduced linear growth, impaired immune competence, cognition, and school performance [22-24]. If these micronutrient deficits persist, the likelihood of growth is diminished.

Participants had low vitamin A and carotene intake. Previous studies have shown that poor vitamin A intake can lead to vitamin A deficiency disorders (VADD), which are a public health nutrition problem among school-aged children worldwide and can cause xerophthalmia, blinding sequelae, increased severity of infection, anemia, poor growth, and mortality [25, 26]. Carotene or carotenoids in fruits and vegetables are thought to provide health benefits by decreasing the risk of various diseases, including cancers and eye diseases, due to their antioxidant activities [27]. Participants also had low vitamin B1 intake. Vitamin B1, also known as thiamine, is one of the essential B vitamins that help the body convert food into energy. This vitamin is vital for proper functioning of the central and peripheral nervous system [28]. Its deficiency can occur as a result of inadequate intake, increased requirements, excessive renal loss, and consumption of anti-thiamine factor [29]. A deficiency can lead to energy compromise and neuronal death in certain populations that have high metabolic requirements. In addition, participants had low vitamin B2 intake. Vitamin B2 or riboflavin, is a micronutrient that is necessary for maintaining human health and is essential for the proper functioning of the nervous, cardiovascular, immune, and endocrine systems [30]. Its deficiency can cause protein and DNA damage, which are accompanied by cell cycle arrest, cell stress, and increased apoptosis [31, 32]. This

study also revealed low vitamin C intake. Vitamin C, or ascorbic acid, plays an important role in many biological processes, particularly free radical scavenging, collagen and hormone synthesis, hemostasis, and protection of lipid membranes which might affect chronic disease risk [33].

For mineral analysis in this study, sodium and potassium intake was lower than the recommended range, which may be a good predictor for lowered risk of hypertension in early life. Evidence from randomized controlled trials has indicated a direct dose-response relation between sodium intake and blood pressure. In addition, potassium intake increases urinary excretion of sodium through action on the renal tubule [34]. Several systematic reviews of randomized controlled trials concluded that reducing sodium intake can decrease blood pressure in adults with or without hypertension [35, 36].

Participants also had calcium and phosphorous intake lower than the recommended range. Calcium and phosphorus are critical for numerous normal physiologic functions including mineral metabolism, skeletal development, energy transfer metabolism, cell signaling, and even platelet aggregation. The most specific symptom of calcium and phosphorous deficiency is perioral numbness and carpopedal spasms of the hands and feet, which may progress to tetany [37]. Low iron intake was also found in a majority of participants. This can cause iron deficiency and anemia, which is the world's most common nutritional deficiency and is associated with developmental delay, diminished intellectual performance, and decreased resistance to infection [38]. The most prevalent inadequate intake in this study was zinc. Zinc plays a regulatory role in various cellular processes including apoptosis, modulates cellular signal recognition, and plays a role in modulation of brain excitability. Zinc deficiency can cause nutritional growth-limiting in infants and young children [39, 40].

Of particular concern in this study are the risks of coexisting micronutrient deficits. Since such coexisting deficits were widespread, these findings explain why some interventions based on single micronutrients have had limited success in developing country settings [41]. This is especially of concern when the etiology for the primary outcome (e.g. anemia, impaired linear growth) is not specific to a single micronutrient deficiency, and the micronutrient supplied is not the first limiting micronutrient in the population under study [42]. Micronutrient deficiencies, either alone or coexisting, have been reported frequently among Thai school children [42]. Interestingly, obesity was not common among this study's participants, which

was a different result than in previous studies [43]. This may be because the participants consumed traditional food in their culture and the energy intake of the majority of participants was low compared with the estimated average recommendation. This finding seems to be correlated with the existing relatively low prevalence of overweight and obesity. However, bias towards underestimation of energy intake has been reported previously [44]. The present study indicates that more than 48% of participants had low intake of calcium, iron, zinc, phosphorus, vitamin A, carotene, vitamin B1, vitamin B2, and vitamin C. This finding is similar to the results from previous reports [45, 46]. In high school girls, low intake might be due to poor food quality. Food consumption patterns in childhood tend to be associated with subsequent risk of developing chronic diseases in adult life [47, 48]. These results suggest that this population has a low quality diet with low intake of nutrients.

LIMITATIONS

This study had many limitations. First, convenience sampling was employed, with participants drawn from a population based on their interest. Second, the method chosen for measuring food intake was a 24-hour food recall which depends on the interviewee's memory. Participants may also have listed their current diet, not their habitual diet. However, repeating the measurement on additional days will reduce variability between and within individuals, making it possible to improve the measurement accuracy in future studies. Third, data was collected only one time and ask participant to recall what they ate yesterday. It is necessary to collect data every day to gain more precise results.

CONCLUSION

Macronutrient and micronutrients intake in our study were lower than the recommended range for the majority of the sample group, especially dietary fiber, which was low in 99% of the subjects. However, mean cholesterol intake was within the recommended range. Inadequate food intake in adolescent girls is a serious concern since they are the next generation of the Thai population. Implementation of government programs such as designing public policies with the aim of improving and maintaining the quality of life of adolescent females to ensure food intake that meets standard nutritional requirement is recommended

CONFLICT OF INTEREST

The author declare that they have no conflict of interest

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