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**THESIS FOR THE DEGREE OF
MASTER OF SCIENCE IN FOOD AND NUTRITION**

**Characteristics and dietary intake of
Korean adolescents from food insecure
households**

한국 청소년의 식품불안정성에 따른
특성 및 식이섭취

August, 2017

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Abstract

Characteristics and dietary intake of Korean adolescents from food insecure households

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Adolescents are among the individuals who are most susceptible to the nutritional consequences of food insecurity. The purpose of this study was to identify adolescents from food insecure households in Korea and assess their characteristics, dietary intake and habits, in comparison to adolescents from food secure households. This study used the 6th KNHANES data for the period of 2013-2015. Food security status was determined using the 18-item questionnaire. In order to evaluate dietary intake, several methods of assessing nutrient and food intake were used. Macronutrient contribution to energy, nutrient density, nutrient adequacy ratios (NARs), prevalence of insufficient or excessive intake of selected nutrients and meeting acceptable macronutrient distribution ranges (AMDRs) were used to examine nutrient intake. Food intake was evaluated using food group servings and dietary diversity score (DDS). Dietary habits including several snacking characteristics (frequency of snacking, total calories from snacks and food group servings consumed as snacks),

as well as frequency of eating out, and frequency of meal skipping were analysed. Multiple logistic regression was used to examine the association between food insecurity and household characteristics. ANCOVA was used to compare the means of food secure and food insecure groups in case of continuous variables with food security status as the binary independent variable and age and sex as covariates. Chi-square test and multiple logistic regression models adjusted by age and sex were used in case of categorical variables to compare food secure and food insecure groups. Among the 1,453 adolescents included in the study, 695 were middle school-aged (12-14 years old) and 758 were high school-aged (15-18 years old). About 11.1% of middle school-aged adolescents and 16.8% of high school-aged adolescents were identified as being food insecure. Factors associated with the risk of food insecurity included reception of basic livelihood security, household income level, and age and education level of the house head. Middle school-aged food insecure adolescents consumed a higher percentage of energy from carbohydrate ($p=0.006$), but lower percentage of energy from fat ($p=0.010$) and saturated fatty acids ($p=0.005$) than food secure adolescents in spite of the average intake of both groups being within the recommended AMDR for these nutrients. Results from NAR show that high school-aged food insecure adolescents had a higher risk of vitamin A deficiency compared to food secure high school-aged adolescents ($p=0.038$). Both food secure and food insecure adolescents demonstrated a risk of vitamin A, vitamin C and calcium deficiencies. In addition, adolescents exhibited high prevalence of excessive intake of sodium and low prevalence of meeting AMDRs for carbohydrate and sugar. Consumption of vegetable, fruits and dairy was low in both food secure and food insecure groups. The percentage of adolescents who had skipped breakfast was

higher among food insecure adolescents compared with food secure adolescents. A lower percentage of high school-aged food insecure adolescents was associated with frequently eating out compared to food secure high school-aged adolescents ($p=0.047$). There were only a few differences between food secure and food insecure adolescents regarding dietary intake. However, food insecure adolescents came from socio-economically disadvantaged households and skipped breakfast frequently. Also, in the case of high school-aged adolescents, food insecure adolescents had a higher risk of vitamin A deficiency compared with food secure high school-aged adolescents. Therefore, there is need to continue monitoring and make efforts to improve the dietary intake and habits of food insecure adolescents in Korea.

Keywords: food supply, adolescent, diet, feeding behavior, nutrition surveys

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I. INTRODUCTION

1. Background

Attainment of adequate nutritional status across the lifecycle among all populations continues to be of global concern. Nutrition is intricately linked to the second sustainable development goal that aims at ending hunger, achieving food security and improving nutrition (United Nations, 2016). Food security is attained when one has constant access to nutritious food in adequate amounts at all times. It is often used as an indicator of accessibility, availability and utilization of enough food and nutrients in terms of both quantity and variety (Food and Agriculture Organisation, International Fund for Agricultural Development, & World Food Programme, 2014).

Although it may appear that the developing parts of the world are the only ones affected by the problem of hunger and food insecurity, cases of food insecurity continue to exist in economically advanced countries. In Canada, from 2007 to 2012 about 4.9% of children and 8.2% of adults were reported to live in food insecure households (Roshanafshar & Hawkins, 2015). In the US, 12.7% of the population was food insecure at some point in 2015 (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016). Korea is no exception. In 2015, Kim and Oh reported national household food insecurity prevalence at 11.3% for the year 2012.

Several factors have been shown to be in association with food insecurity most of which are connected to financial constrain. In Korea, fast economic advancement has seen the rate of poverty and hunger decline over the years. However, the

economic advancement has occurred concurrently with a shift to a technology based economy away from an agricultural economy. This has continuously affected national food sufficiency rates and the cost of food (Park, Kang, Lim & Moon, 2011). Furthermore, the cost of raising children in Korea is expensive making the rate of food insecurity higher in households with children. As a matter of fact, while the overall rate of food insecurity was 11.3% in 2012, it was higher (13.2%) in households with children compared to households without children (10.3%) (Kim & Oh, 2015). Unfortunately, in such households, children aged 5-18 years were affected more because the younger children are naturally given priority access to food in periods of shortage.

Childhood is an important part of development. Adolescents in particular require proper nourishment to satisfy the needs of their fast changing bodies (Brown et al., 2011). Besides the importance of this stage to general growth and development, it is also very crucial in the progression of metabolic diseases and conditions. Dietary habits and nourishment of adolescents have been associated with diseases in adulthood such as hypertension, obesity and cancer. Therefore, guidance in terms of dietary intake and habits at this stage is especially important.

Korean adolescents in particular have been shown to exhibit poor dietary habits such as meal skipping (Hong, Bae, Kim, & Park, 2014), unhealthy snacking (Kim et al., 2010), and consumption of energy dense food items (Jo et al., 2013). Most of the times, these problems are thought of as problems of food choice. However, for adolescents from food insecure households, such unhealthy dietary habits may be the only option. This makes research dedicated to identifying, defining, characterizing and understanding this particular group of people and their nutritional

and dietary needs important in efforts to improve their health and overall life quality.

There has generally been little research dealing with food insecurity in Korea. Some of the existing studies providing a general insight into food insecurity in Korea have hinted on the vulnerability of adolescents (Kim & Oh, 2015). Nonetheless, a lot of the studies concerning individuals affected by food insecurity have preferentially targeted the elderly and adult populations. In addition, some of the previous studies employed brief instruments to assess food insecurity. Such abridged instruments are limited to detecting a few elements of food insecurity and, in some cases, had not been validated. The Korea National Health and Nutrition Examination Survey, KNHANES, also only recently broadened its food security status instrument to capture a broader aspect of food insecurity.

2. Purpose of the study

The purpose of this study was to identify Korean adolescents from food insecure households and assess their characteristics, dietary intake and habits, in comparison to adolescents from food secure households.

The specific objectives of this study were as follows:

1. To estimate the prevalence of food insecurity among Korean adolescents
2. To examine the characteristics of adolescents from food insecure households
3. To estimate dietary intake of Korean adolescents from food insecure households
4. To evaluate the compliance of dietary intake with the current dietary

reference intake guidelines among Korean adolescents from food insecure households

5. To examine the dietary habits associated with Korean adolescents from food insecure households
6. To compare the household characteristics, dietary intake and habits of Korean adolescents from food insecure households to those of adolescents from food secure households

II. LITERATURE REVIEW

1. Definition and prevalence of food insecurity

The concept of food security is defined differently depending on the conditions of the population to which it is being applied. There is currently a few tools that have been developed for the assessment of food security status. The following section introduces the concept of food security, compares the tools available for its assessment and then presents the current trend of food insecurity in economically advanced countries highlighting Korea.

1) Definition and assessment of food insecurity

Food security, at household level, is achieved when all individual members of a given household have access to quality food in adequate amounts all the time. The Food and Agriculture Organization (FAO) proposes availability, accessibility, stability and utilization as the four dimensions of food insecurity (Food and Agriculture Organisation of the United Nations et al., 2014). Availability deals with existence or having a constant supply of a variety of foods in plenty. Accessibility, on the other hand, deals with ability to obtain this food in terms of economic or physical capacity. Stability focuses on factors that may expose individuals or households to food security risk such as political strife. Lastly, utilization deals with the capacity of the body to efficiently use the nutrients as may be evidenced by

absence of diet-related ailments.

However, given that the tools FAO proposed were intended for developing countries, economically advanced countries choose only those concepts relevant to their context (Food and Agriculture Organisation of the United Nations et al., 2014). Most of the economically advanced countries seem to stress physical and economic accessibility to adequate amounts of nutritious food over other concepts identified in the FAO report. Kim and Oh (2015) adopted a definition that leans towards the definition of the concept in the UK (Lambi-Mumford, Crossley, Jensen, Verbeke, & Dowler, 2014) which emphasizes availability alongside accessibility. The stress on accessibility is because for most of these countries food insecurity is associated with low economic status. The reason the UK report and Korean study adopted a definition that also considers availability is probably because unlike US and Canada, Korea and UK import a significant amount of their food.

Several tools have been used in the assessment of food insecurity. Previously the Korea National Health and Nutrition Examination Survey, KNHANES, used to employ a single question to assess this condition. Kim, Kim, Shin and Lee (2011) also employed a brief six-item food insecurity questionnaire in their 2010 study. Whilst using the shorter tools, the prevalence of food insecurity in Korea by KNHANES has been estimated at rates less than 8% since 2010. Specifically in 2015, 2014, 2013, and 2012, the prevalence of food insecurity was 6.5 %, 6.2 %, 6.5% and 7.8 %, respectively (Ministry of Health and Welfare & Korea Centers for Disease Control and Prevention, 2016, 2015, 2014). Using the six-item questionnaire, Kim and colleagues reported the prevalence of food insecurity at 5.3%.

Korea National Health and Nutrition Examination Survey recently adopt a new

longer tool for detecting food insecurity and incorporated it in its survey in 2012. Results from the short tools used previously have been questioned with the argument that they only detect food insecurity accrued from poverty. This assessment seems valid given that while Kim and Oh (2015) reported prevalence of food insecurity at 11.3% in 2012, the report from KNHANES indicated a lower estimate of 7.8% (Ministry of Health and Welfare & Korea Centers for Disease Control and Prevention, 2014) for the same data. The only difference being that while Kim and Oh based their assessment on the then new tool containing 18 items, the KNHANES report relied on the single-item questionnaire.

Korea Centres for Disease Control and Prevention adopted the 18-item food security assessment tool from US Household Food Security Survey Module (HFSSM) for use in the KNHANES. It contains three questions about household food conditions, seven questions for adults and an additional eight questions in case of households with children. It was validated for the Korean population and showed good internal consistency and construct validity. Using this tool, a score of 1 is awarded for each response that indicates food insecure conditions or 0 for any other response. Classification by food security status is then based on the total score with a score of 2 or less being food secure and a total score of 3 or more indicating food insecurity (Kim & Oh, 2015).

2) Prevalence of food insecurity and its related factors

Conventionally, food insecurity and hunger are considered to be largely problems of developing countries. However, due to socio-economic inequalities, this problem

is apparent even in other countries. In Canada, about 4.9% children and 8.2% adults were reported to have lived in food insecure households from 2007 to 2012 (Roshanafshar & Hawkins, 2015). The latest report from the US indicates a persistent albeit declining rate of food insecurity reaching 12.7% in 2015 (Coleman-Jensen et al., 2016). Kim and Oh (2015) estimated overall food insecurity in Korea at 11.3% for the year 2012.

The prevalence of food insecurity among children is lower than the overall rate for Canada (Roshanafshar & Hawkins, 2015) and the US (Coleman-Jensen et al., 2016) with the rates of food insecurity in children estimated at 7.3% (in contrast to 12.7% for the entire population) and 4.9% for Canada. Regardless, for both these countries and Korea, the rate of food insecurity among households with children is higher than households without children. Canada reported 10.3% of households with children as experiencing food insecurity versus 7.5% of households without children. About 16.6% of US households with children were food insecure in 2015. In Korea, 13.2% of households with children were food insecure compared to 10.3% of households without children (Kim & Oh, 2015).

Usually, parents tend to shield children from negative consequences of food insecurity by compromising their own diet (Matheson, Varady, Varady, & Killen, 2002). However, given the results of the study by Kim and Oh (2015), less priority is given to older children and, the report from Canada suggests that this effect is less significant in households with more than one child (Roshanafshar & Hawkins, 2015).

Food insecurity in Korea has mostly been shown to be associated with poverty and low socio-economic status. In their study, Kim et al. (2011) indicated that household factors such as low-economic status, living alone, low household income,

living in a leased or rented home, and participation in food assistance programs were related with food insecurity. In addition to these and as mentioned earlier, households with children are affected more than those without (Kim & Oh, 2015). These factors are consistent with those suggested by reports from Canada and the US (Coleman-Jensen et al., 2016; Roshanafshar & Hawkins, 2015).

2. Dietary intake and habits of food insecure adolescents

Existing literature shows that food insecurity is more prominent in households with children compared to those without children. This result has been consistent in reports from Canada (Roshanafshar & Hawkins, 2015), and the US (Coleman-Jensen et al., 2016), and a Korean study (Kim & Oh, 2015). Generally, parents tend to make efforts to protect their children from the effects of food insecurity by compromising their own diet (Matheson et al., 2002). However, this phenomenon is less evident in households with more than one child and decreases as the child's age increases. Among children, the effects of food insecurity exist mostly in the adolescent population. Food insecurity constrains food availability and accessibility thereby hampering liberal food choice and selection. The following section maneuvers the literature available discussing the effects of food insecurity with particular interest in the adolescent population.

1) Dietary intake of food insecure adolescents

There have been a number of studies discussing the effect of food insecurity on nutrient intake but only a few have discussed it among adolescents. Kim and Oh (2015), in a previous study, identified significantly lower intakes of protein, fat, calcium, phosphorous and potassium among food insecure children aged 5-18 years in comparison to food secure children of the same age in 2012. Similarly, Kirkpatrick and Tarasuk (2008) showed that there was a higher prevalence of nutrient inadequacy among Canadian food insecure adolescents compared to food secure adolescents of the same age. However, the nutrients of concern varied slightly. While in Korea fat, calcium and potassium were of concern, they were not in Canada. The Canadian study showed inadequate intake of vitamins A, B2, B6 and folate as well as minerals including magnesium, phosphorous and zinc among food insecure adolescents. The difference could be attributed to the differences in national feeding patterns.

Even though there were limited studies highlighting nutrient intake among Korean food insecure adolescents, a couple of studies were found that describe nutrient inadequacies among the Korean older adult population affected by food insecurity. One of these, by Lee (2015), found a higher risk of lower energy, calcium, iron, potassium, riboflavin, and niacin intakes associated with food insecure Korean adults compared to food secure Korean adults. Yang (2015), on the other hand, reported significantly lower intakes of only calcium, riboflavin and potassium among food insecure individuals compared to food secure individuals, while the fat intake increased with increasing food insecurity. It should be noted that Yang and Lee dealt with datasets of different years and that while Lee used the 18-item questionnaire to assess food insecurity, Yang used the single-item questionnaire. The

differences in the method used to assess food security and the study period may have in part contributed to the differences observed.

Food insecurity limits food choice and selection thereby influencing the type of foods commonly consumed by the affected individuals. Presently, no studies were found that describe food consumption patterns for food insecure adolescents in Korea. Nonetheless, Kirkpatrick and Tarasuk (2008), reported lower intakes of fruit and vegetables among food insecure Canadian adolescents, particularly males aged 14-18 years compared to food secure adolescents in the same age group. On the contrary, a study by Widome, Neumark-Sztainer, Hannan, Haines, and Story (2009) demonstrated that food insecure adolescents in the US were more likely to meet the national vegetable intake guidelines than did food secure adolescents. They went on to state that this observation might have been due to provisions from food assistance programs that food insecure individuals benefit from.

Despite having no literature describing food intake patterns for food insecure adolescents, variation of food intake with food security status has been reported in other Korean populations. Kim and Oh (2015) indicated lower intakes of fruits, vegetables, nuts, milk and milk products in adults. Within the elderly population, food insecure individuals have also been reported to have lower intakes of soy, soy-bean products, mushrooms, fruits, vegetable oils, meats, eggs, sea food and dairy products (Yang, 2015) than food secure older adults. The common foods of concern for both age groups include fruit, vegetables and dairy products. Similarly, the food insecure Canadian adult population was reported to have lower consumption of fruits and vegetables and milk products compared to food insecure adults in most of the age and sex categories studied. In addition, fewer servings of meat and its

alternatives as well as grain products were observed among food insecure Canadians in some age and sex groups in comparison to food secure individuals (Kirkpatrick & Tarasuk, 2008).

2) Dietary habits of food insecure adolescents

Recent information concerning dietary habits of food insecure adolescents is still rare especially in the Korean context. However, there are a few characteristics that have been shown to correspond with food insecurity. Literature discussing dietary habits including meal skipping and eating out in relation to food insecurity in Korea is presented here.

(1) Meal skipping

Meal skipping is almost unanimous with adolescents given the high rates of meal skipping reported among all adolescents. When it comes to food insecurity, however, only a few studies have dealt with the subject. One study assessed variation of meal skipping among Korean adolescents of low socio-economic status (Hong et al., 2014). They found overall prevalence of skipping breakfast among male and female adolescents of low socio-economic status in 2012 to be 34.7% and 34.3%, respectively. In case of other meals, the rate of skipping lunch was 13.4% and 8.8% among male and female adolescents, respectively. The rates of skipping dinner were reported to be 13.9% and 12.4% among males and females, respectively, in the same year. They also drew a conclusion that meal skipping was positively associated with being of low socio-economic status.

The other study was about the prevalence of meal skipping among poor children

benefitting from public meal service in Jeonju (Rho & Lee, 2012). The percentage of children who skipped breakfast was 7.2% while 16.8% of children skipped dinner for reasons of food shortage. In comparison to the general rates of meal skipping established by Hong et al. (2014), the meal skipping rates reported in this study were lower for breakfast but higher for dinner. The lower prevalence of skipping breakfast is evidence of the contribution of free public meals towards alleviating the problems of food insecurity. Through such interventions, households are able to reallocate resources from one meal towards another. However, meal skipping was still persistent and rather high for dinner. This observation indicates the need of multiple rather than single intervention strategies for food insecure individuals.

It is important to state that the past two studies concerning meal skipping do not encompass food insecurity precisely. The first one associates meal skipping with low socio-economic status. Low socio-economic status, in spite of being highly associated with food insecurity, is not synonymous with food insecurity. The second study, only deals with individuals benefitting from public meal service. Individuals entitled to this free meal are mostly those from poor households. As established earlier, food insecurity is broader than that and this paper thus only provides information regarding food insecurity resulting from poverty. Further, neither of the two studies assessed the food security status of the subjects. Therefore, conclusions from these studies cannot be assumed to be the same as one would obtain when analyzing food insecurity in the broader context. Regardless, they provide an idea of the possible relationship between meal skipping and food insecurity among adolescents in Korea.

Meal skipping is also a problem among other food insecure age groups in Korea.

Kim and Oh (2015) reported the prevalence of skipping breakfast for two consecutive days at 13.2% among food insecure children aged 1-18 years, a rate higher than that for food secure children of the same age. Furthermore, a higher percentage of food insecure children and adults skipped three or more meals than food secure individuals during the span of the two days for which meal intake was recorded.

(2) Eating out

Adolescents tend to spend more time away from home and as such tend to eat away from home more frequently. Only a single study showing an association between frequency of eating out among Korean adolescents and their food security status was found. In this study, the frequency of eating out was negatively associated with food insecurity among severely food insecure individuals (Kwon, Hong, & Ju, 2016). Simply put, severely food insecure individuals were less likely to eat out.

(3) Other dietary habits

Most of the other dietary habits have not been discussed in literature with respect to food insecurity among adolescents or any other Korean population. Habits such as snacking frequency and added sugar intake have been shown to be associated with food insecurity in other areas. For example, Kral, Chittams, and Moore (2017) found that children from food insecure households were more likely to consume more than three snacks per day. There is need to study the relationship between food insecurity and some of these habits to fill this gap in knowledge.

III. METHODS

1. Secondary data

This study used nationwide cross-sectional data of the 6th (2013-2015) KNHANES. KNHANES was initiated in 1998 and aims to examine the health and nutritional status of the general Korean population excluding institutionalized individuals. This survey was reviewed by the Institutional Review Board of the Korea Centers for Disease Control and Prevention (2013-07CON-03-4C, 2013-12EXP-03-5C) for the years 2013 and 2014. In 2015, KNHANES was exempted from review by the Bioethics and Safety Act.

The survey employs a stratified and multi-stage clustered probability sampling. Of the 1,855 adolescent aged 12-18 years who participated in the survey for the target time period, 183 were from households that did not respond to the 18-item food security status assessment questionnaire. There were also 188 individuals with non-positive weights with respect to the variables of interest and an additional 31 individuals who reported energy intakes less than 500 kcal or greater than 5000 kcal. Adolescents who had missing values for food security status, non-positive weights and extreme values of total energy intake were excluded. The final sample consisted of 1,453 adolescents, of whom 695 were middle school-aged (12-14 years old), and 758 were high school-aged (15-18 years old). The process summarizing the flow of this process is shown in Figure 1 below.

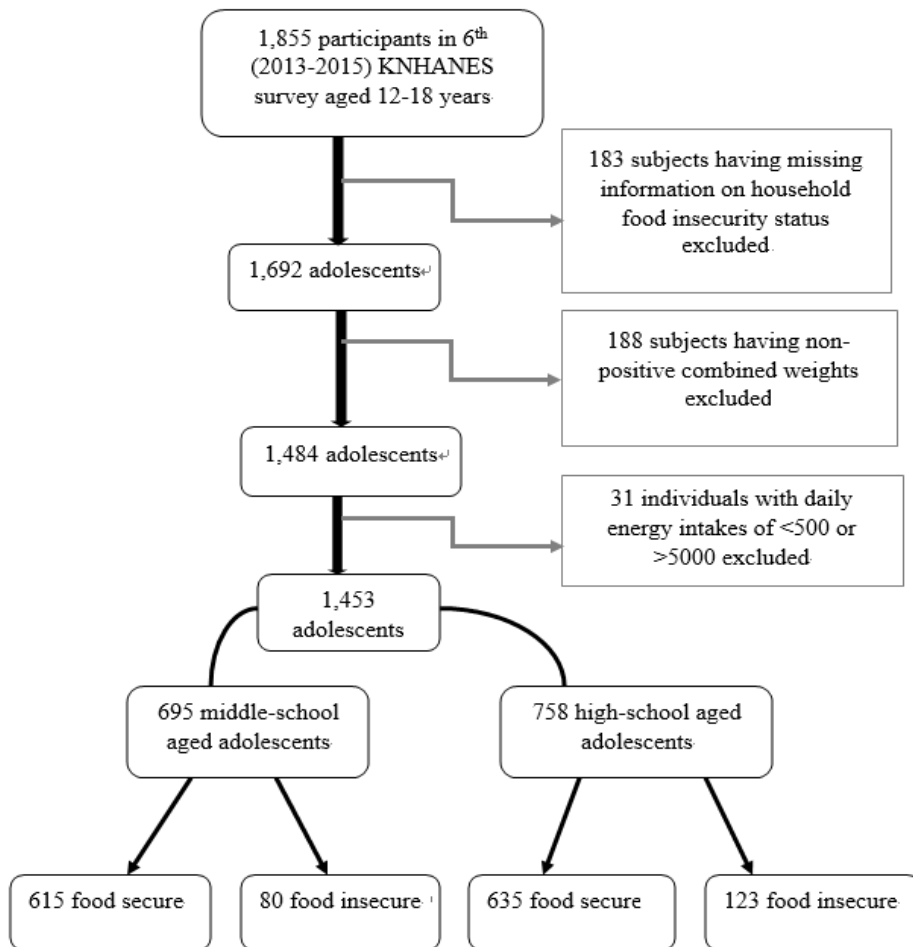


Figure 1. Flow diagram of sample selection process

2. Data analysis

1) Assessment of food security status

Food security was graded using the 18-item tool that was adopted by KNHANES in 2012 from US Household Food Security Survey Module, HFSSM

(Kim & Oh, 2015). The tool contains 18 questions in total for households that consist of children. Each question awards a score of 1 for an affirmative answer such as ‘yes’, ‘often’, ‘sometimes’, ‘almost every month’, ‘sometimes but not every month’, but 0 for any other responses. A household scoring a total of 2 or less was considered food secure while one that scored a total greater than 2 was categorized as food insecure. Individuals were assigned the scores and food security status of their respective households. As a result, adolescents living in food insecure households were placed in food insecure groups and those from food secure households were placed in food secure groups. The frequency distribution of food security scores among the subjects is shown in Figure 2.

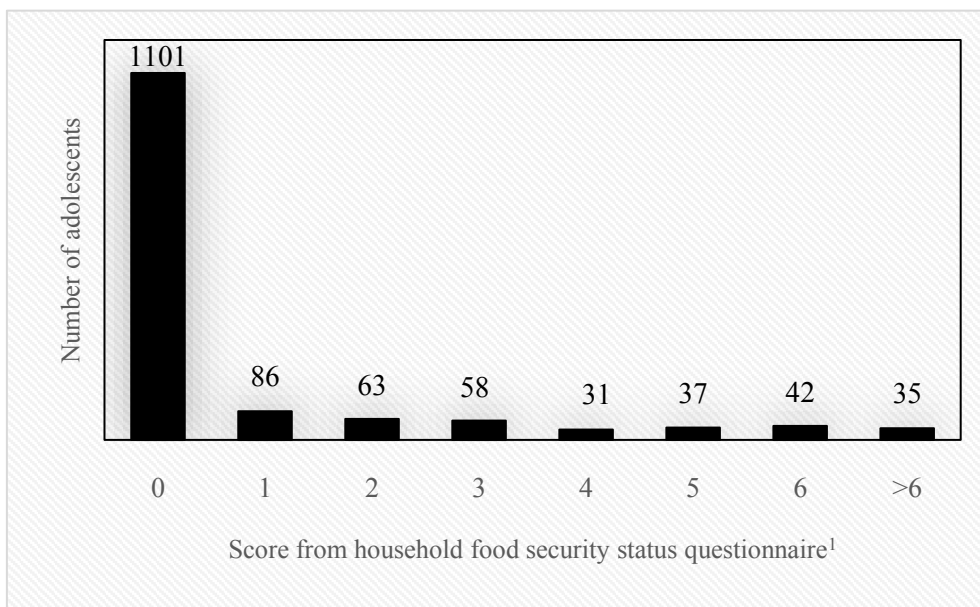


Figure 2. Frequency distribution of household food security scores among Korean adolescents

¹ Score may range from 0-18. Adolescents with a score less than or equal to 2 were considered food secure. Adolescents with a score greater than 2 were considered food insecure.

2) Socio-demographic and health-related characteristics

KNHANES contains several sections among which the health interview and examination gives details on household characteristics, individual socio-demographic characteristics and health-related characteristics. It is from here that data concerning age, sex, area of residence, reception of basic livelihood security, household income, family size, householder's sex, householder's age, householder's education level and householder's occupation were obtained.

Health-related characteristics such as smoking, alcohol consumption, weight status, and body image perception were also assessed. An individual was considered a smoker as long as they had smoked before, regardless of their current smoking status. Similarly, categorization concerning alcohol consumption was based on whether or not an individual had drunk alcohol before.

Regarding weight status, analysis was based on body mass index (BMI). Adolescents were allocated to BMI groups using cut off points defined in the 2007 Korean National Growth Charts (Moon et al., 2008). The Korean National Growth charts group individuals based on sex and age into different anthropometric percentiles. Accordingly, individuals of BMI equal to the 5th percentile and above but below the 85th percentile were grouped as 'normal'. On the other hand, individuals of BMI below the 5th percentile were grouped as 'underweight'. Adolescents whose BMI was within the 85th percentile and over but below the 95th percentile were grouped as 'overweight'. Lastly, adolescents with BMI equal to or above the 95th percentile were grouped as 'obese'. In this study, the groups of overweight and obese were combined to make a single group.

3) Analysis of dietary intake

Data on dietary intake and diet-related habits were extracted from the nutrition survey section of the KNHANES. It consisted of a 24-hour dietary recall, which provided information about all food items consumed on the previous day, and a dietary lifestyle questionnaire. In order to evaluate dietary intake, several methods of analysing nutrient intake and food intake were used. Nutrient intake and food intake were analysed using the following criteria.

(1) Analysis of nutrient intake

Several nutrient intake assessments were done in this study. Energy intake and percentage energy contribution from carbohydrate, sugar, protein, fat and saturated fatty acids were analysed. Percentage energy contribution from these nutrients was calculated as their caloric content expressed as a percentage of total energy intake. The nutrient density of the diet was estimated as nutrient intake per 1,000 kcal for vitamin A, thiamin, riboflavin, niacin, vitamin C, potassium, calcium, phosphorous, iron, and sodium.

Additionally, insufficient intake of protein, vitamin A, thiamin, riboflavin, niacin, vitamin C, calcium, phosphorous and iron, and excessive sodium intake were also assessed. Insufficient intake referred to intake less than the Estimated Average Requirement (EAR) for a particular nutrient. Excessive sodium intake referred to intake in excess of its intake goal of 2,000 mg/day (Ministry of Health and Welfare and Korean Nutrition Society, 2016). Nutrient adequacy ratios were also derived for protein, vitamin A, thiamin, riboflavin, vitamin C, calcium, phosphorous, and iron as the ratio of nutrient intake of each nutrient to its recommended nutrient intake.

Further, the prevalence of intake of carbohydrate, sugar, protein, fat, and saturated fatty acids within the recommended ranges was also evaluated. The recommended ranges were based on the acceptable macronutrient distribution ranges as such: 55-65% of energy intake for carbohydrates, 10-20% of energy intake for sugar, 7-20% of energy intake for protein, 15-30% of energy intake for fat, and energy intake < 8% for saturated fatty acids (Ministry of Health and Welfare and Korean Nutrition Society, 2016).

Reference values for all nutrient analyses were obtained from the 2015 version of Dietary Reference Intakes for Koreans (Ministry of Health and Welfare and Korean Nutrition Society, 2016) with the exception of vitamin A. In 2015, the guideline changed the units for vitamin A from $\mu\text{g RE}$ to $\mu\text{g RAE}$. However, KNHANES still uses $\mu\text{g RE}$ as the standard units for vitamin A composition. Therefore, reference values in the 2010 version (Korean Nutrition Society, 2010) were used in evaluations concerning vitamin A.

KNHANES did not provide information on sugar intake for the target period. Therefore, total sugar intake had to be derived separately. A sugar database developed by Korea Health Industry Development Institute was used with permission. This database was developed for use with KNHANES data. The details concerning its development have been provided elsewhere (Lee, et al. 2014).

(2) Analysis of food intake

Food intake was evaluated using food group servings and dietary diversity scores (DDS). Food group servings were evaluated following the guidelines provided in the

2015 Dietary Reference Intakes for Koreans (Ministry of Health and Welfare and Korean Nutrition Society, 2016). The foods were separated into six groups as such: grains; meat, fish, eggs, and legumes; vegetables; fruits; milk and dairy products; and oils and sweets. The servings from each of these food groups were derived as total calories obtained from a food divided by calories equivalent to a serving for its food group. A serving was estimated by the amount of calories contained in representative items of each food group. In this regard, a serving of grains contained 300 kcal, while that of the meat, fish, eggs, and legumes group contained 100 kcal. A serving of vegetables contained 15 kcal while that of fruits contained 50 kcal. A serving of milk and dairy contained 125 kcal while that of oils and sweets contained 45 kcal.

DDS were obtained following the procedure developed by Kant, Block, Schatzkin, Ziegler and Nestle (1991) and its modification by Um, Park and Chung (2006) for the Korean population. The foods consumed were divided into five groups; grain, meat, vegetable, fruit, and dairy. The grain group consisted of all cereals and cereal products except cakes, pies, pastries, cookies, and other confectionaries. The meat group contained all protein rich foods such as meats, eggs, legumes, fish, and poultry, and their products. The vegetable group comprised all cooked, frozen, and canned vegetables. With the exception of fruit drinks, all fruit juices and frozen, dried, and canned fruits were included in the fruit group. The dairy group consisted of milk and milk products other than cream and butter. The foods were further subdivided into solids and beverages. Beverages included yogurt, milk, soy-milk, cereal-based drinks, and vegetable and fruit juices. A point was only awarded if the amount consumed was equal to or greater than the minimum amount of the food group. The

minimum amounts for the grain and dairy groups were 15 g and 30 g for solid dishes and beverages, respectively. While the minimum amounts for all other groups were 30 g and 60 g for solid dishes and beverages, respectively.

4) Analysis of dietary habits

Besides daily nutrient intake, snacking characteristics were also examined. Snacking frequency was determined by summing up the number of times an individual snacked on the day for which the 24-hour recall was generated. The total caloric intake from snacks on this day was also calculated along with the number of food group servings consumed as snacks. The food group servings were calculated following the same criterion which was described earlier under food intake.

The frequency of skipping was also evaluated. A questions concerning meal frequency was included in the dietary lifestyle questionnaire. Individuals were asked how often they had consumed a particular meal on a weekly basis over the past 12 months. Meal skipping was defined as not consuming a given meal on 5 or more days of the week for the past year. Individuals were categorized as ‘consumers’ if they said that they had eaten a particular meal on several days of the week (≥ 3 days/week) for the past year. Those who ate a given meal on only two occasions or less each week were categorized as ‘skippers’.

The frequency of eating out was also evaluated. In the dietary questionnaire, individuals were also asked about how often they ate away from home during the past 12 months. The variable of eating out was re-grouped into two levels depending on whether or not an individual reported eating out at least once daily during the past year. Resultantly adolescents who reported eating out at least once a day were

considered to have been eating out frequently while those who did not were considered to have been eating out occasionally.

5) Statistical analysis

Statistical analyses were performed with SAS 9.4 (SAS Institute Inc., Cary, NC, USA) using ‘proc survey’ procedures for complex sample survey data. Sampling weights assigned to individual participants were applied in all cases to generate parameters that represent Korean adolescents.

A logistic regression model was used to examine the association between food insecurity and household characteristics. Food security status was the binary dependent variable and reception of basic livelihood security, household income (four categories), householder’s sex, householder’s age and householder’s education level were the independent variables.

Analyses for age groups (middle school-aged and high school-aged) were performed separately and comparisons were made between their respective food secure and food insecure subgroups. ANCOVA was used to compare means of food secure and food insecure groups in case of continuous variables with food security status as the binary independent variable and age and sex as covariates. Nutrient intakes were log transformed before ANCOVA to improve the normality of the distributions (Kim & Oh, 2015). Comparison between food secure and food insecure groups in case of categorical variables was done using chi-square test and multiple logistic regression models adjusted by age and sex.

IV. RESULTS AND DISCUSSION

1. Prevalence of food insecurity among Korean adolescents

The prevalence of food insecurity among Korean adolescents at individual and household level is shown in Figure 3. Overall, about 11.1% of middle school-aged adolescents and 16.8% of high school-aged adolescents were found to be living in households which experienced food insecurity within the period of 2013-2015. Therefore, the prevalence of food insecurity was estimated at 11.1% among middle school-aged adolescents and 16.8% among high school-aged adolescents. Food insecure households made up 14.3% of households consisting of adolescents. The current study estimates food insecurity for households consisting of adolescents at a percentage slightly higher than that previously reported for households with children in 2012 (Kim & Oh, 2015). In addition, a higher percentage of high school-aged adolescents than middle school-aged adolescents were exposed to food insecurity. This observation implies that Korean adolescents, particularly high school-aged adolescents, were highly susceptible to food insecurity during the target time period.

2. General characteristics of study subjects

The general characteristics of study subjects by food security status are presented in Table 1. Generally, there was a higher percentage of food insecure adolescents from households that were past or current recipients of basic livelihood security than

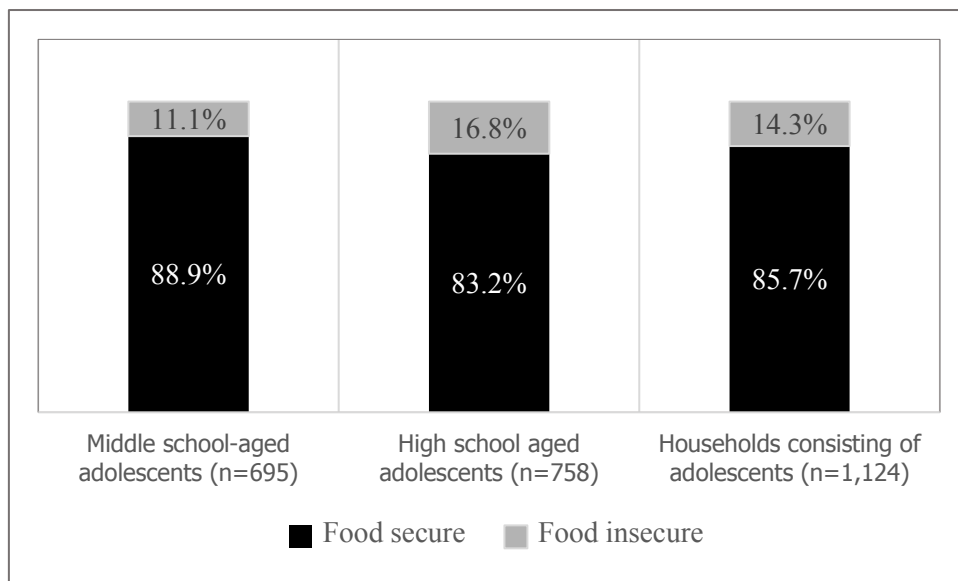


Figure 3. Prevalence of food insecurity among Korean adolescents and households consisting of adolescents

food secure adolescents. Among middle school-aged adolescents, 30% of food insecure adolescents were from households that were past or current recipients of basic livelihood security compared to 5% of food secure adolescents ($p < 0.001$). In the high school-aged group, 40% of food insecure adolescents were from households that were past or current recipients of basic livelihood security compared to 7% of food secure adolescents ($p < 0.001$).

In addition, the percentages of adolescents from households of low income level were higher among food insecure adolescents than food secure adolescents. Among middle school-aged adolescents, 24% of food insecure adolescents compared to 5% of food secure adolescents were from households of low income ($p < 0.001$). In the

Table 1. General characteristics of study subjects by food security status

Characteristics	Middle school-aged adolescents		P	High school-aged adolescents		p
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	%			%		
Sex						
male	50.7	48.1	0.703 ²	52.3	57.5	0.331 ²
Area of residence						
urban	85.0	85.9	0.889 ³	84.2	87.2	0.561 ³
Reception of basic livelihood security ⁴ (n=1,452)						
past/current	4.6	30.4	<0.001 ³	7.0	40.0	<0.001 ³
Household income level ⁵ (n=1,444)						
Q1	5.0	24.3	<0.001 ³	9.2	42.4	<0.001 ³
Family size						
1-2	3.2	5.9	0.955 ³	4.2	8.1	0.514 ³
Householder's sex (n=1,356)						
female	26.6	45.5	0.007 ³	28.5	57.6	<0.001 ³
Householder's age (n=1,356)						
≥65	5.6	12.0	0.060 ³	5.1	7.5	0.351 ³
Householder's education level (n=1,157)						
≤middle school	11.9	23.7	<0.001 ³	13.7	36.5	<0.001 ³
Householder's occupation (n=1,156)						
unemployed	14.2	32.1	0.001 ³	14.3	33.7	<0.001 ³

Data were analysed using complex sample module.

¹ Food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² By chi-square test

³ By multiple logistic regression adjusted by age (years) and sex

⁴ Includes livelihood benefits, housing benefits, education benefits, etc. from government

⁵ Household income subdivided into four quartiles with Q1 being the lowest and Q4 being the highest

high school-aged group, 42% of food insecure adolescents compared to 9% food secure adolescents were from households of low income ($p<0.001$). These results concur with those of earlier studies (Kim & Oh, 2015; Kim et al., 2011).

In terms of householder's sex, regardless of age group, there were significantly more of food insecure adolescents from households with female house heads. In the middle school-aged group, the percentage of adolescents from female headed households reached 46% among food insecure adolescents compared to 27% among food secure adolescents ($p=0.007$). In the high school-aged group, 58% of food insecure adolescents came from households with female householders compared to 29% of food secure adolescents ($p<0.001$).

More of food insecure adolescents also came from households with house heads who had obtained a maximum of middle school education. Among the middle school-aged, the percentage of adolescents whose householders had obtained middle school education at most was 24% in the food insecure group compared to 12% in the food secure group ($p<0.001$). Among the high school-aged, the percentage of adolescents whose householders had obtained middle school education at most was 14% in the food secure group compared to 37% in the food insecure group ($p<0.001$).

Further, the percentage of adolescents whose householders were unemployed was higher in the food insecure groups than the food secure groups. Among the middle school-aged adolescents, 32% of food insecure adolescents came from households with unemployed householders compared to 14% of food secure adolescents ($p=0.001$). Among the high school-aged adolescents, 34% of food insecure adolescents came from households with unemployed householders compared to 14% of food secure adolescents ($p<0.001$).

3. Health-related characteristics of adolescents by food security status

Table 2 shows health-related characteristics of adolescents by food security status. Adolescents did not show any differences in health-related characteristics such as smoking, alcohol consumption (drinking), weight status (BMI) and body image perception with regards to food security status. Previous studies have demonstrated a relationship between smoking (Kirkpatrick & Tarasuk, 2008) and alcohol consumption (Yang, 2015) and food security status among adult and elderly populations. These differences may have been less distinct because the current study only dealt with the adolescent population within which such habits may not be as prevalent.

4. Relationship between food insecurity and household characteristics

Table 3 shows the variables included in the logistic regression model describing the relationship between several household characteristics and household food insecurity among adolescents. The results from this model are presented in Table 4. The trend was generally similar in both age groups. Reception of basic livelihood security was associated with close to a fourfold increase in the risk of food insecurity in both age groups. Being from a household of low income was associated with five times and thirteen times more chances of being food insecure among middle and high school-aged adolescents, respectively. These two factors are representative of

Table 2. Health-related characteristics of middle and high school-aged adolescents by food security status

Characteristics	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	%			%		
Smoking (n=1,425)						
non-smoker	96.2	92.9	0.214	76.6	70.1	0.274
smoker	3.4	7.1		23.4	29.9	
Drinking (n=1,426)						
never before	87.7	81.8	0.159	52.4	49.4	0.995
has drank before	12.3	18.2		47.6	50.6	
BMI						
underweight	3.7	5.1	0.331	6.5	10.2	0.414
normal	78.3	69.7		72.1	69.7	
overweight/obese	18.0	25.2		21.4	20.1	
Body image (n=1,425)						
thin	25.0	30.0	0.285	21.6	25.6	0.653
normal	45.8	36.9		44.4	38.8	
fat	29.2	33.1		34.0	35.6	

Data were analysed using complex sample module.

¹ Food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² By multiple logistic regression adjusted by age (years) and sex

the economic status of a household and thus demonstrate the close association between economic status and food insecurity.

Several characteristics of the householder were also associated with food insecurity. Middle and high school-aged adolescents from households having householders with high school education rather than college education were twice and thrice more likely to be food insecure, respectively. Having a householder with middle school education or less rather than college education was associated with a fourfold increase in the likelihood of being food insecure among high school-aged adolescents. In the same age group, elder-headed households, compared to those with

Table 3. Variables included in the logistic regression model examining the relationship between food insecurity and household characteristics of middle and high school-aged adolescents

Variable	Middle school-aged adolescents		High school-aged adolescents	
	Food secure (n=538)	Food insecure ¹ (n=64)	Food secure (n=538)	Food insecure ¹ (n=64)
	n (%)		n (%)	
Reception of basic livelihood security ²				
past/current	28 (6.8)	18 (33.3)	26 (5.9)	39 (41.2)
non-recipient	446 (93.2)	46 (66.7)	484 (94.1)	67 (58.8)
Household income level ³				
Q1	31 (6.6)	22 (29.9)	38 (8.1)	47 (45.0)
Q2	111 (23.1)	26 (44.8)	130 (26.5)	44 (42.1)
Q3+Q4	332 (70.3)	16 (25.3)	342 (65.4)	15 (12.8)
Householder's sex				
female	140 (30.1)	34 (53.2)	160 (30.1)	58 (56.8)
male	334 (69.9)	30 (46.8)	350 (69.9)	48 (43.2)
Householder's age				
≥65 years	31 (6.6)	11 (14.0)	29 (5.1)	10 (8.0)
<65 years	443 (93.4)	53 (86.0)	481 (94.9)	96 (92.0)
Householder's education level				
≤ middle school	56 (12.3)	17 (23.5)	73 (13.5)	40 (36.8)
high school graduate	181 (37.6)	39 (64.5)	215 (45.0)	55 (52.6)
≥ college graduate	237 (50.1)	8 (12.0)	222 (41.6)	11 (10.6)

¹ Food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² Includes livelihood benefits, housing benefits, education benefits, etc. from government

³ Household income subdivided into four quartiles with Q1 being the lowest and Q4 being the highest

Table 4. Relationship between food insecurity and household characteristics of middle and high school-aged adolescents¹

Variable	Middle school-aged adolescents (n=535)	P	High school-aged adolescents (n=616)	p
	OR (95% CI) ²		OR(95% CI) ²	
Reception of basic livelihood security ³				
Past/current	3.54 (1.13-11.12)	0.030	3.65 (1.65-8.09)	0.002
Non-recipient	1.00 (ref.) ²		1.00 (ref.)	
Household income level ⁴				
Q1	5.27 (1.48-18.82)	0.018	13.44 (4.82-37.51)	<0.001
Q2	3.11 (1.21-7.95)	0.011	5.63 (2.39-13.28)	<0.001
Q3+Q4	1.00 (ref.)		1.00 (ref.)	
Householder's sex				
female	1.59 (0.76-3.30)	0.216	1.48 (0.74-2.96)	0.267
male	1.00 (ref.)		1.00 (ref.)	
Householder's age				
≥65 years	0.71 (0.18-2.70)	0.610	0.25 (0.09-0.73)	0.011
<65 years	1.00 (ref.)		1.00 (ref.)	
Householder's education level				
≤ middle school	3.39 (0.80-14.04)	0.098	4.35 (1.72-10.98)	0.045
high school graduate	4.44 (1.76-11.22)	0.002	2.38 (1.02-5.55)	0.002
≥ college graduate	1.00 (ref.)		1.00 (ref.)	

Data were analysed using complex sample module.

¹ Result of logistic regression with food security status as the dichotomous dependent variable; max-rescaled R²=0.28 (middle school-aged), 0.41 (high school-aged); food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² OR: odds ratio, CI: confidence interval, ref.:reference

³ Includes livelihood benefits, housing benefits, education benefits, etc. from government

⁴ Household income subdivided into four quartiles with Q1 being the lowest and Q4 being the highest

younger householders, were associated with a 75% reduced risk of being food insecure.

The present study agrees with results from a previous study that suggested a negative association between having elder house heads and food insecurity. The association could be owed to the benefits unique to the elderly population as suggested by Kim et al. (2011). However, while Kim and colleagues reported that the effect of householder's age became non-significant after adjusting for economic status, in the current study this factor was significant for high school-aged adolescents after accounting for factors related to economic status. This indicates that the relationship between householder's age and food insecurity among adolescents may be independent of economic status. This observation could be attributed to the fact that elders, most of whom are likely to be retired, have more time to participate in meal planning and preparation activities more actively than younger householders. However, further research is necessary to validate this result and provide a deeper understanding of this observation.

Additionally, unlike results from Kim et al. (2011), the current study showed a significant association between food insecurity and reception of social benefits. Kim et al. purported that their study design weakened the effect of the social programs hence the weak non-significant outcome. Therefore, the conflicting results may be because the model used in the current study offered robustness to this particular factor.

Regardless, basic livelihood security is intended to protect from problems of social inequality. Food insecurity was shown to be in close association with factors of socio-economic inequality in this study, an observation which is supported by the

US national report on food insecurity (Coleman et al, 2016) and previous studies (Kim & Oh, 2015; Kim et al, 2010). Therefore, programs like basic livelihood security that are aimed at alleviating socio-economic inequality should also include strategies for improving food security. It is possible that most of the people who were affected by food insecurity were past and not current beneficiaries. This would imply a need to include more capacity building approaches besides financial support in efforts to address socio-economic inequality. Capacity building ensures that past beneficiaries are left with relevant skills and knowledge to independently support themselves and their families beyond the assistance period. However, other studies are still required to verify this assumption and perform a more thorough investigation that would yield more robust solutions.

5. Dietary intakes of adolescents by food security status

1) Nutrient intake

The result of analysis of amount of energy and nutrient density of Korean adolescents' diet by food security status is shown in Table 5. Among middle school-aged adolescents, food insecure individuals exhibited higher intake of percentage energy from carbohydrate ($p=0.006$) but lower intake of percentage energy from fat ($p=0.010$), and saturated fatty acids ($p=0.005$) than did food secure middle school-aged adolescents. Among high school-aged adolescents, there was no significant difference between nutrient intake of food secure and insecure adolescents following these criteria.

Table 5. Amount of energy and nutrient density of the diet among middle and high school-aged Korean adolescents by food security status

Nutrient	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	mean (SE)			mean (SE)		
Energy (kcal)	2,043.1 (34.7)	1,970.6 (89.9)	0.322	1,973.8 (36.8)	1,937.3 (78.4)	0.314
Percentage energy from:						
Carbohydrates (%)	60.2 (0.5)	63.1 (1.3)	0.006	59.0 (0.5)	58.9 (1.2)	0.911
Sugar (%)	12.4 (0.0)	11.5 (1.0)	0.489	12.3 (0.4)	11.0 (0.8)	0.257
Protein (%)	13.4 (0.2)	13.0 (0.5)	0.244	13.7 (0.2)	13.5 (0.4)	0.398
Fat (%)	22.7 (0.4)	20.1 (1.0)	0.010	22.4 (0.4)	22.9 (1.0)	0.691
Saturated fatty acids (%)	7.3 (0.1)	6.1 (0.4)	0.005	6.9 (0.1)	6.9 (0.3)	0.751
Vitamin A (µg RE/1,000 kcal)	223.2 (7.9)	227.8 (19.4)	0.949	223.9 (0.8)	209.5 (11.6)	0.208
Thiamin (mg/1,000 kcal)	0.9 (0.1)	0.9 (0.1)	0.504	0.9 (0.1)	0.9 (0.1)	0.262
Riboflavin (mg/1,000 kcal)	0.6 (0.5)	0.6 (0.5)	0.875	0.6 (0.6)	0.6 (0.5)	0.298
Niacin (mg/1,000 kcal)	6.8 (0.1)	6.4 (0.3)	0.323	7.0 (0.1)	6.5 (0.3)	0.186
Vitamin C (mg/1,000 kcal)	21.5 (1.1)	21.5 (3.6)	0.998	20.4 (0.9)	19.5 (1.8)	0.936
Potassium (mg/1,000 kcal)	1,146.0 (20.2)	1,178.4 (50.8)	0.718	1,145.2 (16.7)	1,146.0 (33.9)	0.886
Calcium (mg/1,000 kcal)	209.3 (4.6)	206.4 (11.9)	0.802	192.0 (5.0)	198.2 (10.7)	0.500
Phosphorous (mg/1,000 kcal)	498.9 (5.7)	479.1 (13.8)	0.133	484.3 (6.0)	482.5 (11.7)	0.892
Iron (mg/1,000 kcal)	6.4 (0.1)	6.3 (0.3)	0.473	6.6 (0.1)	6.8 (0.4)	0.957
Sodium (mg/1,000 kcal)	1,434.8 (25.6)	1,467.2 (80.2)	0.865	1,490.7 (32.0)	1,482.9 (61.0)	0.740

Data were analyzed using complex sample module.

Energy contribution of macronutrients was obtained by expressing energy from a macronutrient as percentage of total energy intake.

Nutrient intake data was log transformed before ANCOVA to obtain distributions that proximate to normal distribution.

¹ Food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² By ANCOVA with age and sex as covariates

The nutrient adequacy ratios, as shown in Table 6, were generally similar, regardless of food security status. While the NARs for most nutrients were high, the NARs of vitamin A, vitamin C and calcium were all below 0.7 for all age and food security status groups. However, food insecure high school-aged adolescents had a lower NAR for vitamin A compared to food secure high school-aged adolescents ($p=0.0382$).

Table 7 shows the prevalence of insufficient and excessive nutrient intake among adolescents according to food security status and age. Overall, there was no significant difference in prevalence of insufficient or excessive intake between food security status groups. However, the percentages of individuals who consumed less than the EAR of vitamin A, vitamin C and calcium were above 50% in most cases, and only middle school-aged food insecure adolescents were below the 50% mark for vitamin A. In addition, the prevalence of sodium intake in excess of the intake goal was above 70% regardless of food security status.

Table 8 shows the prevalence of meeting AMDRs among adolescents by food security status. Regardless of food security status, less than 50% of adolescents met the AMDRs for carbohydrate and sugar. Among middle school-aged adolescents, 40% of food secure adolescents and 34% of food insecure adolescents met the AMDR for carbohydrate, while among high school-aged adolescents this percentage was 42% for food secure adolescents and 40% for food insecure adolescents. Regarding sugar, 49% of food secure adolescents and 45% of food insecure adolescents met the AMDR among middle school-aged adolescents. Among the high school-aged adolescents, 44% of food secure adolescents and 39% of food insecure adolescents met the AMDR for sugar.

Table 6. Nutrient adequacy ratio among middle and high school-aged adolescents by food security status

Nutrient	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	mean (SE)			mean (SE)		
Protein	0.94 (0.006)	0.92 (0.019)	0.171	0.91 (0.007)	0.88 (0.011)	0.299
Vitamin A	0.66 (0.013)	0.69 (0.035)	0.405	0.65 (0.014)	0.59 (0.028)	0.038
Thiamin	0.97 (0.004)	0.97 (0.010)	0.354	0.93 (0.007)	0.94 (0.013)	0.396
Riboflavin	0.84 (0.011)	0.82 (0.025)	0.300	0.78 (0.012)	0.78 (0.024)	0.751
Niacin	0.83 (0.010)	0.80 (0.030)	0.174	0.80 (0.012)	0.77 (0.025)	0.169
Vitamin C	0.54 (0.016)	0.55 (0.047)	0.848	0.49 (0.016)	0.47 (0.032)	0.652
Calcium	0.51 (0.011)	0.48 (0.030)	0.409	0.51 (0.013)	0.52 (0.028)	0.915
Phosphorous	0.81 (0.010)	0.77 (0.027)	0.073	0.77 (0.011)	0.75 (0.023)	0.274
Iron	0.80 (0.010)	0.78 (0.031)	0.377	0.81 (0.011)	0.80 (0.023)	0.495

Data were analysed using complex sample module.

Nutrient adequacy ratio was calculated as ratio of nutrient intake of a nutrient to its recommended nutrient intake as presented in 2015 version of Reference Intake Guidelines for Koreans and its 2010 version for vitamin A.

¹ Food insecurity defined as a score of >2 according to the 18-item household food security assessment questionnaire

² By ANCOVA with age and sex as covariates

Table 7. Prevalence of insufficient or excessive nutrient intake among middle and high school-aged adolescents by food security status

Nutrient ²	Middle school aged adolescents		p ³	High-school aged adolescents		p ³
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
<i>Insufficient intake</i>						
	%			%		
Protein	12.5	15.6	0.272	19.5	22.3	0.476
Vitamin A	56.2	47.3	0.154	54.4	62.1	0.079
Vitamin B1	6.3	10.5	0.108	15.8	13.4	0.458
Vitamin B2	34.4	37.0	0.290	45.8	45.8	0.641
Niacin	29.0	34.9	0.253	36.8	40.0	0.362
Vitamin C	66.6	66.8	0.981	70.8	74.4	0.439
Calcium	85.7	89.1	0.223	82.3	82.1	0.783
Phosphorous	45.7	51.7	0.269	52.2	51.8	0.672
Iron	42.0	47.3	0.261	36.3	38.4	0.346
<i>Excessive intake</i>						
	%			%		
Sodium	77.6	78.8	0.819	72.9	73.9	0.598

Data were analysed using complex sample module.

Insufficient intake defined as intake less than the stipulated Estimated Adequate Requirement (EAR) for a particular nutrient

Excessive intake defined as intake higher than the intake goal

¹ Food insecurity defined as a score of >2 according to the 18-item food security assessment questionnaire

³ By multiple logistic regression adjusted by age (years) and sex

Table 8. Prevalence of meeting acceptable macronutrient distribution ranges (AMDRs) among middle and high school-aged adolescents by food security status

Nutrient	Middle-school aged adolescents		p ²	High-school aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	%			%		
Carbohydrate	39.6	34.4	0.412	42.1	40.1	0.499
Sugar	49.1	45.1	0.706	44.8	38.7	0.285
Protein	92.5	90.1	0.692	89.8	89.1	0.827
Fat	66.9	71.4	0.301	63.8	63.3	0.902
Saturated fatty acids	55.7	68.8	0.088	59.6	61.5	0.696

Data were analysed using complex sample module.

Acceptable macronutrient distribution ranges: 55-65% of energy intake for carbohydrate; 10-20% of energy intake for sugar; 7-20% of energy intake for protein; 15-30% of energy intake for fat; energy intake < 8% for saturated fatty acids

¹ Food insecurity defined as a score of >2 according to the 18-item food security assessment questionnaire

² By multiple logistic regression adjusted by age (years) and sex

This study showed a few differences in nutrient intake between food secure and insecure middle school-aged adolescents regarding percentage energy intake from carbohydrate, fat and saturated fatty acids. However, although these differences were significant, the average intakes were within the recommended AMDRs among both food secure and food insecure adolescents. Therefore, the results do not reflect an increased nutritional risk in any one group in comparison to the other.

The results for fat align well with the result of a previous study which also found lower intake of fat among food insecure children aged 5-18 years compared to food secure children (Kim & Oh, 2015). The trend is similar to that observed among middle school-aged children from low income households (Shim, Yoon, Lee & Kwon, 2009). As observed with demographic characteristics, there were more of

food insecure adolescents associated with low household income.

On the contrary, unlike the current study, Kim and Oh (2015) further observed differences in intake of protein, calcium and phosphorous between food secure and food insecure children aged 5-18 years. The conflict in results may have been due to the age of the subjects. Age greatly influences dietary intake. Another study, by Kirkpatrick and Tarasuk (2008), observed significantly intakes of vitamins A and C to be lower among food insecure Canadian males aged 14-18 years than food secure Canadian males of the same age. However, given that this was a foreign study, it could be argued that the conflicting result was due to differences in conditions surrounding food insecure adolescents between the two countries.

Besides the differences observed in the middle school-aged group, the nutrient adequacy ratio for vitamin A among food insecure high school-aged adolescents was significantly lower than that observed among food secure high school-aged adolescents. This indicates a higher risk of vitamin A deficiency among food insecure adolescents within this age group. This result is unique since there are currently no reports of an increased nutritional risk regarding vitamin A among food insecure individuals of any age in Korea.

Overall, adolescents exhibited low intake of vitamin A, vitamin C and calcium, regardless of their food security status as evidenced by the high percentage of individuals failing to meet EAR and comparatively low NARs for these nutrients. There is therefore need to reinforce ongoing programs and strategies that aim at improving intake of these nutrients among adolescents or set up new ones. However, food insecure adolescents are associated with vulnerable socio-demographic

backgrounds as indicated in the current study and as such may require more specialized approaches than food secure adolescents. These characteristics could be a barrier to access of nutritional information and desirable changes in behavior (Laraia, Leak, Tester and Leung, 2017; US Department of Health and Human Services and US Department of Agriculture, 2015). Programs that reach food insecure adolescents should consider emphasizing cheaper, and more accessible alternatives for the diet. These include common vegetables like Korean radish, red pepper, pumpkin, and sweet potato for vitamin A, and anchovies and sesame seeds for calcium.

Besides the high risk of micronutrient deficiency, the current study observed high rates of inappropriate intake of carbohydrate, sugar and sodium, regardless of food security status. Sodium hyper nutrition is hence still of concern among Korean adolescents. Therefore, intervention programs for reducing dietary sodium should be reinforced and food insecure adolescents should also be provided access to them.

In terms of sugar, Korea does not currently have a free access sugar database. This limits studies with the objective of providing information concerning dietary sugar intake. A sugar database would also be useful in interventions aimed at improving dietary sugar intake. Further, besides total sugar intake, databases for free and added sugars may be relevant particularly for adolescents. This is because the main source of sugar among Korean adolescents is processed foods which are high in added sugars (Lee et al., 2014).

2) Food intake

Table 9 shows results of the comparison of food group serving intake among Korean adolescents according to food security status. There was generally no significant difference in food group intake among food secure and food insecure adolescents in both age groups. Regardless of food security status, adolescents from both age groups ate about 4 servings of vegetable. The intakes of fruits and milk and dairy products were also less than 2 servings for all groups except fruit intake among food insecure middle school-aged adolescents.

The results of DDS are shown in Table 10. All adolescents scored an average of 3 points regardless of food security status. The average score was about 3.5 among both food secure and food insecure middle school-aged adolescents. Among high school-aged adolescents, the average DDS was 3.4 and 3.3 for food secure and food insecure adolescents, respectively.

Regardless of food security status, the percentages of adolescents that obtained a DDS point for the groups of grain, meat and vegetable were above 97%, 88% and 76%, respectively. In contrast, it was only in the food secure middle school-aged group that more than 50% of individuals obtained a point for the fruit group. In all other groups, less than 50% of individuals obtained a DDS point for this food group. Furthermore, less than 35% of individuals, regardless of food security status obtained a point for the dairy group.

Table 9. Number of food group servings consumed by middle and high school-aged adolescents by food security status

Food group	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	mean (SE)			mean (SE)		
Grains	4.04 (0.09)	4.06 (0.25)	0.898	3.83 (0.08)	3.79 (0.19)	0.550
Meat, fish, eggs and legumes	4.08 (0.13)	3.55 (0.35)	0.100	4.31 (0.15)	4.50 (0.35)	0.862
Vegetables	4.23 (0.21)	4.42 (0.43)	0.574	4.62 (0.19)	4.88 (0.36)	0.777
Fruits	1.51 (0.10)	2.16 (0.50)	0.202	1.31 (0.10)	1.01 (0.19)	0.191
Milk and dairy products	1.28 (0.06)	1.07 (0.15)	0.118	1.01 (0.07)	1.02 (0.16)	0.980
Oils and sweets	2.85 (0.15)	2.51 (0.21)	0.158	3.12 (0.19)	3.00 (0.35)	0.819

Data were analysed using complex sample module.

Number of servings = total calories from food / calories in 1 serving

Calories in 1 serving: 300 kcal for grain; 100 kcal for meat, fish, eggs and legumes; 15 kcal for vegetables; 50 kcal for fruits; 125kcal for milk and dairy products; 45 kcal for oils and sweets

¹ Food insecurity defined as a score of >2 according to the 18-item household food security assessment questionnaire

² By ANCOVA with age and sex as covariates

Table 10. Dietary diversity score (DDS) of middle and high school-aged adolescents' diet by food security status

Variables	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	mean (SE)			mean (SE)		
DDS	3.50 (0.04)	3.45 (0.12)	0.320	3.38 (0.04)	3.29 (0.08)	0.325
	<i>Percentage of adolescents who obtained a score</i>					
	%			%		
Grain	99.9	100.0	n/a ³	98.6	100.0	n/a ³
Meat	88.9	88.9	0.613	89.7	91.6	0.942
Vegetable	76.2	79.1	0.739	81.5	80.5	0.731
Fruit	53.4	48.9	0.354	43.3	34.5	0.118
Dairy	31.9	28.1	0.370	25.2	23.0	0.909

Data were analysed using complex sample module.

Minimum amounts: 15g for solid dishes and 30g for beverages in case of grain and dairy; 30g for solid dishes and 60g for beverages in case of meat, vegetable and fruit

¹ Food insecurity defined as a score of > 2 according to the 18-item household food security assessment questionnaire

² By ANCOVA with age and sex as covariates or multiple logistic regression adjusted by age (years) and sex

³ Not applicable

Results from the current study indicate a low intake of vegetables, fruits and milk and dairy products among all adolescents, regardless of food security status. The average number of vegetable servings ranged from 4.2-4.9 which is less than the recommended intake of 8 and 7 servings for males and females, respectively, in the 12-18-year-old age group (Ministry of Health and Welfare and Korean Nutrition Society, 2016). In addition, very few individuals obtained a point for the consumption of fruit and dairy groups in the DDS. Vegetables and fruits are important sources of vitamins and dairy is a good source of calcium. These results therefore corroborate those of nutrient intake results presented earlier which demonstrated general concern for vitamin A, vitamin C and calcium intake.

The results from food intake also suggest that the reason for an increased risk of vitamin A deficiency observed among food insecure high school-aged adolescents compared to food secure adolescents was most likely due to the difference in fruit intake. The main sources of vitamin A in the Korean adolescent diet include vegetables, dairy, meat and fruit (Ministry of Health and Welfare and Korean Nutrition Society, 2016). Of all these, it is only in the fruit group where the difference in intake is most noticeable even though it is not significant. Food insecure high school-aged adolescents consumed fewer servings from fruit than food secure high school-aged adolescents did. Furthermore, a lower percentage of food insecure high school-aged adolescents obtained a score in DDS from the fruit group compared to food secure high school-aged adolescents. Therefore, efforts to increase fruit intake among food insecure adolescents should emphasize fruits high in vitamin A including persimmons, tangerines and watermelon.

Kirkpatrick and Tarasuk (2008) reported lower intake of fruit and vegetables among food insecure Canadian males aged 14-18 years compared to their food secure adolescents of the same age. The disagreement in results particularly for vegetables may be due to the differences in the food environment between the two countries. In Korea, vegetables are relatively cheap, widely available and an important part of the traditional diet.

Overall, dietary intake was not different between food secure and food insecure adolescents in the current study and all adolescents exhibited similar diet-related problems. This observation may have been due to a number of reasons. Firstly, there is several food service programs that may have contributed to the dietary intake of food insecure adolescents. One among them is the school

lunch program which supports over 70% of all school going children (Ministry of Education, 2016). This program means a homogeneous diet for most adolescents at lunch time. Other programs that provide food for households and individuals who may suffer from food insecurity also exist (Moon, Yoo and Lee, 2015). Secondly, parents have been shown to protect their children from problems of food insecurity (Matheson et al., 2002). Lastly, regardless of food security status, it is common for adolescents to make poor food choices and choose foods of low nutritional quality. These three factors may have in combination offset the effect of food insecurity on dietary intake hence the homogeneous dietary intake of adolescents observed in the current study.

6. Dietary habits of adolescents by food security status

Table 11 shows snacking frequency, energy obtained from snacks and number food groups servings from the snacks consumed according to food security status among adolescents in Korea. Overall, on average all adolescents regardless of food security status ate snacks about twice a day. The caloric intake from snacks did not vary with food security status either.

Food group intake in terms of snacking was not different among adolescents with respect to food security status. The trend is similar in all groups but food insecure middle school-aged adolescents. Among all the other groups, the most number of food group servings were from oils and sweets while the fewest number of servings were from the vegetable group. On the contrary, the most number of servings consumed by food insecure middle-school aged adolescents

Table 11. Frequency of snacking, total calories from snacks and food group servings from snacking among middle and high school-aged adolescents by food security status

Characteristic	Middle school-aged adolescents		p ²	High school-aged adolescents		p ²
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	mean (SE)			mean (SE)		
Snacking frequency	2.4 (0.1)	2.4 (0.2)	0.558	1.9 (0.1)	2.2 (0.2)	0.140
Total calories from snacks	613.5 (24.5)	588.4 (60.4)	0.671	531.4 (23.4)	557.6 (54.9)	0.712
	<i>Number of food group servings consumed as snack³</i>					
Food group	mean (SE)			mean (SE)		
Grains	0.96 (0.06)	0.89 (0.14)	0.827	0.75 (0.05)	0.72 (0.11)	0.691
Meat, fish, eggs and legumes	0.53 (0.07)	0.50 (0.15)	0.375	0.54 (0.06)	0.62 (0.15)	0.607
Vegetables	0.32 (0.04)	0.53 (0.15)	0.135	0.39 (0.08)	0.48 (0.13)	0.637
Fruits	0.98 (0.08)	1.51 (0.41)	0.186	0.88 (0.09)	0.73 (0.17)	0.371
Milk and dairy products	0.97 (0.05)	0.88 (0.14)	0.476	0.65 (0.05)	0.85 (0.15)	0.257
Oils and sweets	1.18 (0.12)	0.88 (0.17)	0.101	1.22 (0.16)	1.24 (0.25)	0.725

Data were analysed using complex sample module.

Results obtained from analysis of 24-hour recalls

¹ Food insecurity defined as a score of >2 according to the 18-item food security assessment questionnaire

² By ANCOVA with age and sex as covariates

³ Number of servings = total calories from food / calories in 1 serving

Calories in 1 serving: 300 kcal for grain; 100 kcal for meat, fish, eggs and legumes; 15 kcal for vegetables; 50 kcal for fruits; 125kcal for milk and dairy products; 45 kcal for oils and sweets

were from fruit and the fewest number of servings were from meat, fish, eggs and legumes group.

The oils and sweets group includes foods of low nutritional quality. Therefore, there is need for interventions to alter this behavior. It also presents an opportunity to improve intake of nutrients and foods for which there was low intake. Education programs that encourage adolescents to choose fruit, vegetable or dairy alternatives over oils and sweets would be necessary. These interventions should make efforts to increase access to these items for food insecure adolescents. For example, given that fruits are seasonal, including simple skills of home-based fruit preservation methods in such programs may be useful.

Table 12 shows the prevalence of meal skipping and eating out among middle and high school-aged adolescents by food security status. A higher percentage of food insecure adolescents skipped at least a meal in both the middle and high school-aged groups. In the middle school-aged group, 38% of food insecure adolescents skipped at least a meal compared to 17% of food secure adolescents ($p<0.001$). In the high school-aged group, the percentage of food secure adolescents who skipped at least a meal was 40% compared to 26% among food secure adolescents ($p=0.028$).

Meal skipping appears to be associated more with breakfast than other meals. Similar to overall skipping (at least one meal), the prevalence of skipping breakfast was higher among food insecure adolescents than food secure adolescents. In the middle school-aged group, 37% of food insecure adolescents skipped breakfast compared to 16% of food secure adolescents ($p<0.001$). In the high school-aged group, the percentage of adolescents who skipped breakfast in the food insecure group was 40% compared to 25% of adolescents in the food secure group ($p=0.013$).

Table 12. Prevalence of meal skipping and eating out among middle and high school-aged adolescents by food security status

Characteristic ²	Middle school-aged adolescents		p ³	High school-aged adolescents		p ³
	Food secure (n=615)	Food insecure ¹ (n=80)		Food secure (n=635)	Food insecure ¹ (n=123)	
	%			%		
Meal skipping						
≥1 meal skipper ¹	16.7	38.4	<0.001	26.4	40.2	0.028
consumer	84.3	61.6		73.6	59.8	
Breakfast skipper ¹	16.1	36.7	<0.001	24.6	39.6	0.013
consumer	83.9	63.3		75.4	60.4	
Lunch skipper ¹	1.3	0.0	n/a ⁴	1.4	0.7	0.467
consumer	98.7	100.0		98.6	99.3	
Supper skipper ¹	0.5	1.7	0.428	1.7	0.5	0.233
consumer	99.5	98.3		98.3	95.5	
Eating out frequency						
Frequent	31.7	38.7	0.248	59.0	50.5	0.047
Occasional	68.3	61.3		41.0	49.5	

Data were analysed using complex sample module.

¹ Food insecurity defined as a score of >2 according to the 18-item food security assessment questionnaire

² A skipper ate a given meal on only 2 occasions or less each week

³ By multiple logistic regression adjusted by age (years) and sex

⁴ Not applicable

Hong et al. (2014) reported the prevalence of breakfast skipping at 34.2% among Korean adolescents of low socio-economic status which is slightly lower than the result of the current study. The difference could be interpreted as evidence that food insecurity is not limited to low socio-economic status. It does not always follow that individuals of low socio-economic status are food insecure. While Hong and colleagues reported high rates of skipping for other meals besides breakfast, the current study found meal skipping for other meals almost inexistent within the entire population. This observation is quite peculiar to the current study and may require

further investigation to validate.

Although previous studies had established an association between breakfast skipping and socio-economic factors among Korean adolescents, to the best of our knowledge, this study is the first to demonstrate the association between breakfast skipping and food insecurity. This association had earlier been established in other countries such as the US (Potamites & Gordon, 2016).

The association between food insecurity and breakfast skipping implies that food insecure adolescents have limited access to breakfast at home. A plausible solution for this would be the establishment of school breakfast feeding programs. It has been supposed in this study that the homogenous dietary intake was partly due to the school lunch program. Therefore, school breakfast programs are also likely to successfully create equal access to breakfast among adolescents and thus improve the quality of life of food insecure adolescents. In the US, the school breakfast program is faced with the challenge of balancing the needs of food insecure adolescents and controlling obesity (Potamites & Gordon, 2016). However, this will not be a problem in Korea since results from the current study indicate common nutritional needs and health-related characteristics among food secure and food insecure adolescents.

Generally, eating out was more common among high school-aged adolescents than middle school-aged adolescents. About 32% of food secure and 39% of food insecure adolescents in the middle school-aged group ate away from home frequently. Among high school-aged adolescents, eating out was more prevalent with about 59% of food secure and 51% of food insecure adolescents reporting to eat away from home frequently. The difference was significant in the high school-aged group

($p=0.047$).

Kwon et al. (2016) similarly reported a high prevalence of eating away from home especially among children aged 16-18 years old (52.7%) during the period of 2010-2012. About 25.1% of children aged 13-15 years old ate out in the same period. The results for the high school-aged adolescents in the current study are somewhat comparable with the results reported for the 16-18 age category in the study by Kwon and colleagues. The variation in results could be partly attributed to the fact that individuals were further subdivided by food security status in the current study and the difference in the target time period.

A generally high prevalence of eating out among the high school-aged adolescent population demonstrates how significant the contribution of away-from-home setting is to their dietary intake. This observation presents an opportunity to alter adolescent behavior using interventions targeting away-from-home settings. The school setting and retail establishments are of particular importance among adolescents. Therefore, intervention programs should be organized at school level for effectiveness. Additionally, the food retail industry should provide healthy food choices at cheap prices to increase access to these items among food insecure adolescents. Lastly, food service programs that benefit food insecure adolescents require support from the community and government.

The current study found that among high school-aged adolescents, food insecure adolescents were less likely to eat out compared to food secure adolescents. Kwon et al. (2016) showed a negative association between eating out and being severely food insecure. However, the current study demonstrates that among the high school-aged adolescents, the relationship between food security status and eating out exists

regardless of the severity of food insecurity.

Since food insecure adolescents have limited access to food at home, away-from-home settings become a major source of food for these individuals. Food insecure high school-aged adolescents being less likely to eat out indicates that they have limited access to alternative sources of food outside the home. Therefore, the food industry, as mentioned earlier, should provide cheap healthy food options that food insecure individuals, too, can afford. Furthermore, community based food service programs should be supported by both the community and government in order to expand their outreach. In so doing, the access to food away-from-home could supplement the limited access at home and thus improve the dietary intake of food insecure adolescents.

Conversely, food insecure adolescents being less likely to eat away from home frequently also shows the importance of strategies to improve the food environment at home. Behavioral characteristics that are associated with improved dietary intake such as family meals, having meals outside of screen time, and so on should be emphasized among these individuals. Therefore, studies about the characteristics of food insecure adolescents and their home food environment are necessary.

V. CONCLUSION AND SUGGESTIONS

1. Summary and conclusion

This study identified Korean adolescents from food insecure households and assessed their characteristics, dietary intake and habits, in comparison to adolescents from food secure households. The following are the main findings of the study:

- 1) About 14% of households consisting of adolescents experienced food insecurity at some point in time during the period of 2013-2015. Being members of these households, 11.1% of middle school-aged adolescents and 16.8% of high school-aged adolescents were identified as food insecure.
- 2) Reception of basic livelihood security, having householders of less than college education, and being in the low and low-medium quartiles of household income were associated with an increase in the likelihood of being food insecure among adolescents. On the other hand, having elderly householders was associated with a reduced likelihood of being food insecure but only among high school-aged adolescents.
- 3) The overall dietary intake of adolescents from food insecure households was not different from that of adolescents from food secure households. All adolescents, regardless of food security status, exhibited low intakes of vitamin A, vitamin C and calcium as well as foods from groups of vegetable, fruit and dairy. However, in the high school-aged group, adolescents from food insecure households showed a higher risk of vitamin A deficiency compared to

adolescents from food secure households.

- 4) The prevalence of meal skipping, particularly breakfast skipping, was higher among adolescents from food insecure households in both the middle and high school-aged groups. Additionally, a lower percentage of adolescents from food insecure households in the high school-aged group was associated with eating out frequently compared to adolescents from food secure households.

2. Suggestions and limitations

Although the results from the current study do not suggest a direct association between food insecurity and dietary intake, adolescents from food insecure households had undesirable characteristics including being from socio-economically disadvantaged households, and skipping breakfast. Being from a household of low socio-economic status has implications to accessibility of nutritional information and responsiveness to nutritional interventions (Laraia, Leak, Tester and Leung, 2017; US Department of Health and Human Services & US Department of Agriculture, 2015). Therefore, interventions to improve the dietary intake and habits of food insecure adolescents are necessary. Some of the roles that different stakeholders may play in efforts to improve the dietary life of food insecure adolescents are discussed below.

Development of a school breakfast program may help to increase access to breakfast among food insecure adolescents. As earlier stated, the homogeneity of dietary intake among adolescents regardless of food security status may have in part

been due to the school lunch program. The school breakfast program in the US faces a problem of balancing the needs of food insecure adolescents and curbing the problem of obesity among children. However, if set up in Korea, the school breakfast program is not likely to have a similar struggle. This is because Korean adolescents have similar dietary needs as demonstrated in this study.

The food industry is responsible for increasing food insecure adolescents' access to healthy options. The retail industry is of particular importance. The food environment in South Korea is described as a food jungle (Kim, Lee, and Seo, 2016). A food jungle means that individuals are forced to compete for access to nutritious food items which are readily available on the market. Since food insecure individuals are more often economically disadvantaged, their access to these healthy options is often limited. Provision of these options at cheaper prices may increase their access to them. Food manufacturers may consider cutting down production costs by using local raw materials.

Households which are affected by food insecurity require a lot of community support. Education programs that provide skills related to financial responsibility are of particular relevance to food insecure households. Financially responsible individuals are likely to allocate their money carefully when drawing budgets and spend it wisely thus reducing the likelihood of unnecessary spending and diminished savings. In addition, community based programs that directly provide food to food insecure households through food service programs or food baskets require financial and other forms of support from both the local and central governments.

At national level, strategies to improve sustainable agricultural production are necessary. Globally, the problem of food shortage is becoming more widespread.

And locally, Korea is anticipating a reunification. However, North Korea has for a long time been affected by food insecurity (Food and Agriculture Organisation of the United Nations & World Food Programme, 2013). Korea, after unification will have to deal with this problem on a larger scale. In order to manage the severity of the effects of this problem, the government should set up a food security policy prior to unification. Korea has in the past been more concerned with food safety which deals with quality rather than quantity. However, with food shortage becoming a global issue and the ongoing preparations for unification, it is time to draw focus to strategies that will increase food production as well. In tandem with other current global issues such as climate change, it is important to stress sustainable agricultural production (Park et al., 2011).

In contribution to monitoring food insecure adolescents and their households, continuous research is necessary. Previously, food insecurity has been a rare research topic in the context of South Korean adolescents. However, up to date studies are always necessary to support the process of planning and development of intervention programs intended for any risk group. Research should focus on which nutrition intervention programs are more effective among food insecure adolescents, given their unique characteristics. Research directed towards understanding factors that affect food choice among Korean food insecure adolescents is also necessary.

On the other hand, the fact that there were minimal differences observed in the dietary intake of adolescents with regards to food security status may be testament to the success of existing social programs targeting individuals affected by food insecurity. Programs, particularly, food service programs including the school lunch program and other community based food service programs contribute to the dietary

intake of individuals from food insecure households. This should be seen as evidence that these kinds of programs are very useful and can indeed contribute to the wellbeing and social welfare of such individuals. Other countries which are affected by food insecurity may consider adapting similar programs to ameliorate problems of dietary intake among their food insecure population. In Korea, efforts to expand the outreach and improve the efficacy of these programs for them to be even more successful are necessary.

This study suffers from a few limitations. The 18-item questionnaire used to assess food security status asks very sensitive questions especially in case of the part concerning children. Thus many people, most of whom are affected by the problem, opt not to answer. As a result, the small number of food insecure adolescents particularly in the middle school-aged group may have limited the examination of dietary intake. This study also failed to account for day-to-day variations in dietary intake since it used a single 24-hour recall. In addition the 24-hour recall method may not have been good enough to reflect the long-term feeding patterns of the subjects. Assessment of food security is based on an annual period but 24-hour recalls only reflect recent intake. It is possible that for some food insecure individuals, the results presented do not reflect their intake at the time of being food insecure. Be this as it may, the study provided critical and comprehensive information concerning the dietary needs of adolescents from food insecure households.

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국문초록

본 연구는 식품안전성이 확보되지 않은 가구의 청소년을 대상으로 이들의 특성과 식이섭취 및 식습관을 식품안전성이 확보된 가구의 청소년과 비교, 평가하는 것을 목적으로 하였다. 제 6 기 국민건강영양조사(2013-2015)에 참여한 12-18세의 청소년 1,453명을 연령에 따라 중학생(12-14세, 625명)과 고등학생(15-18세, 758명)으로 나누어 분석하였다. 식품안전성은 18개 문항으로 구성된 설문을 이용하여 판정하였다. 식이섭취를 평가하기 위하여 24시간 회상법으로 조사한 식품섭취 자료를 이용하여 영양소섭취와 식품섭취를 분석하였다. 영양소섭취를 평가하기 위하여 영양밀도와 다량영양소의 에너지비율 및 영양소 적정 섭취비를 산출하였다. 평균필요량을 기준으로 주요 영양소의 섭취 부족 여부를, 목표섭취량을 기준으로 나트륨의 과잉섭취 여부를 파악하였다. 또한 에너지적정비율을 기준으로 다량영양소의 적정 섭취여부를 분석하였다. 식품섭취는 식품군별 섭취 횟수와 식품 다양성 점수로 평가하였다. 식습관을 평가하기 위해 간식과 관련된 특성(간식빈도, 열량 섭취량, 식품군별 섭취 횟수)과 식사 결식 및 외식 빈도를 분석하였다. 식품불안정성과 관련 있는 가구 특성을 파악하기 위해 다중로지스틱회귀분석을 실시하였다. 식품불안정성군과 식품안전성군간의 식이섭취 및 식습관의 차이는 나이와 성별을 보정한 공분산분석 또는 다중로지스틱회귀분석을 통해 유의성을 검증하였다. 연구 결과, 식품불안정성 비율은 중학생에서 11.1%, 고등학생에서 16.8%로 나타났다. 기초생활 수급자 여부, 가구소득수준, 가구주의 교육수준, 연령 등의 요인들이 식품불안정성과 관련이 있는 것으로 나타났다. 중학생에서는 식품불안정성군이 식품안전성군에 비해 탄수화물로부터의 에너지섭취 비율은 높았고($p=0.006$), 지방($p=0.010$)

및 포화지방($p=0.005$)으로부터의 에너지섭취 비율은 낮았다. 영양소 적정 섭취비의 분석 결과, 고등학생에서 식품불안정성군이 식품안정성군에 비해 비타민 A의 섭취가 낮았다($p=0.038$). 두 군 모두 비타민 A, 비타민 C, 칼슘을 평균필요량보다 적게 섭취하는 비율이 높은 것으로 나타났다. 또한 두 군 모두 나트륨을 과일 섭취하는 청소년의 비율이 높았고, 탄수화물 및 총 당 섭취량을 에너지적정비율 기준에 적절하지 않게 섭취하는 청소년의 비율이 높았다. 식품불안정성군과 식품안정성군 모두에서 채소군, 과일군 및 우유·유제품군의 섭취가 전반적으로 낮았다. 중학생과 고등학생 모두에서 식품불안정성군이 식품안정성군보다 아침식사 결식빈도가 높게 나타났다. 또한 고등학생에서는 식품불안정성군이 식품안정성군보다 외식을 자주 하는 청소년의 비율이 더 낮은 것으로 나타났다($p=0.047$). 결론적으로, 한국 청소년의 경우 식품불안정성에 따른 식이섭취의 차이는 거의 없었다. 그러나 식품안정성이 확보되지 않은 청소년들은 식품안정성이 확보된 청소년들과는 사회경제적으로 다른 가구 특성을 가지고 있었으며, 아침식사의 결식율과 같은 식습관에서도 다른 경향을 보였다. 또한 식품안전성이 확보되지 않은 고등학생의 경우, 비타민 A의 결핍 위험이 높은 것으로 나타났다. 그러므로 식품안정성이 확보되지 않은 청소년들의 식생활을 지속적으로 모니터링하고 이를 개선하기 위해 노력할 필요가 있다.

주요어: 식량 공급, 청소년, 식이, 식행동, 영양 조사

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