Still life with less: North Korean young adult defectors in South Korea show continued poor nutrition and physique

Seul Ki Choi¹, Sang Min Park² and Hyojee Joung¹§
¹Graduate School of Public Health & Institute of Health and Environment, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul 151-742, Korea
²Department of Family Medicine, Seoul National University Hospital & Seoul National University College of Medicine, Seoul 110-799, Korea

Abstract

North Korean defectors who settle in South Korea have experienced severe food shortage and transition of food environment which could affect their health status. However, little is known about their anthropometric measurements and dietary intake after settlement in South Korea. The purpose of this study is to compare anthropometric measurements and dietary intake between North Korean young adults who defected to South Korea and those of South Koreans. We hypothesized that North Korean young adults' physiques and dietary intake would be poorer than that of South Koreans. We compared anthropometric measurements and dietary intake from 3-day food records in a cross-sectional study of 103 North Korean young adult defectors, aged 12 to 24 and 309 South Korean subjects. North Korean subjects were significantly shorter (4.9 to 10.8 cm) and lighter (6.0 to 12.5 kg) than the control group. Body mass index were significantly different between North and South Korean groups only in men. North Korean young adult defectors had lower mean daily intakes of energy and most nutrients and food groups compared to the control group, while North Korean subjects had higher nutrient density diet than that of South Koreans. The proportion of subjects who had dietary intakes of nutrients of less than the Estimated Average Requirement was higher in North Korean subjects than in controls except for in the cases of vitamin A and vitamin C. In conclusion, we recommend providing nutrition support programs for North Korean young adult defectors to secure adequate nutrient intake.

Key Words: North Korean, under-nutrition, growth retardation

Introduction

Since the 1990s, North Korea has suffered from chronic severe food shortages because of natural disasters and economic hardships. Many starving North Koreans have escaped from their homeland and roamed around in China and other neighboring countries for food before re-settlement in South Korea. As of January 2009, over 15,000 North Korean defectors including young adult defectors have settled in South Korea [1].

Food deprivation gave rise to prevalent malnutrition in North Korea. A previous study reported that North Korean defectors aged 4 to 19 in China were shorter in stature between 70-90% of the South Korean reference value, indicating serious malnutrition [2]. In 2002, the United Nations Children's Fund (UNICEF) and World Food Programme (WFP) surveyed anthropometric measurements of children aged below 7 and those of South Koreans. We compared anthropometric measurements and dietary intake from 3-day food records in a cross-sectional study of 103 North Korean young adult defectors, aged 12 to 24 and 309 South Korean subjects. North Korean subjects were significantly shorter (4.9 to 10.8 cm) and lighter (6.0 to 12.5 kg) than the control group. Body mass index were significantly different between North and South Korean groups only in men. North Korean young adult defectors had lower mean daily intakes of energy and most nutrients and food groups compared to the control group, while North Korean subjects had higher nutrient density diet than that of South Koreans. The proportion of subjects who had dietary intakes of nutrients of less than the Estimated Average Requirement was higher in North Korean subjects than in controls except for in the cases of vitamin A and vitamin C. In conclusion, we recommend providing nutrition support programs for North Korean young adult defectors to secure adequate nutrient intake.

Key Words: North Korean, under-nutrition, growth retardation
and settlement using a questionnaire. Members, economic status in North Korea, and duration of escape age, sex, monthly household income, number of household family members, economic status in North Korea, and duration of escape and settlement using a questionnaire. Risk factors contributing to nutrition related non-communicable diseases (NR-NCDs) affect adults; it can also contribute to disease pathogenesis in childhood, adolescence, or even fetal period [12]. The risk factors of NR-NCDs accumulate throughout life; therefore, it is important to prevent transmission of risk factors to later life at an early stage [12,13].

Taking these pieces of evidence into consideration, we expect that North Korean young adult defectors who have risk factors of NR-NCDs and other diseases during adolescence will have higher risk of suffering from these conditions later in life. Also, if those who suffered from growth retardation become obese, they could suffer from negative health consequences while their adaptation to living in South Korea. Therefore, it is necessary to improve dietary intake of North Korean young adult defectors to prevent health problems later in life, which would contribute to their successful settlement in South Korea. However, there has been no study about dietary intake of North Korean defectors in South Korea. The purpose of this study is to assess dietary intake of North Korean young adult defectors and to compare it with that of their South Korean counterparts. We hypothesized that North Korean young adults’ physiques and dietary intake would be poorer than that of South Koreans. Assessing growth and dietary intake of North Korean young adults will allow us to develop a plan that caters to their specific health needs.

Subjects and Methods

Subjects

Study population included 141 North Korean young adult defectors aged 12 to 24 who had settled in South Korea and attended one of two alternative schools for North Korean settlers during January 2007 to July 2008. Excluding subjects who did not complete anthropometric measurements and diet records, 103 subjects were included in the final analysis. All subjects signed a written informed consent form which was previously approved by the Institutional Review Board at the Graduate School of Public Health, Seoul National University. The control group comprised 309 South Korean young adults randomly selected from the 2005 Korea National Health and Nutrition Examination Survey matched by age and sex.

Anthropometric measurements

We measured height (cm), weight (kg) and body mass index (BMI; kg/m²) (Inbody 4.0, Biospace Co. Ltd., Seoul, Korea). Subjects aged under 20 were classified by BMI percentiles as underweight (<5th percentile), normal (5-85th percentile) or overweight (≥85th percentile) [14]. For subjects aged over 20, obesity status was defined using BMI (underweight: <18.5 kg/m²; normal: 18.5-25.0 kg/m²; overweight: ≥25.0 kg/m²).

Dietary assessment

Dietary intake was obtained by collecting self-administered food records over three consecutive days including two weekdays and one weekend day. Participants were instructed on how to write the food records by nutrition experts, who reviewed the records. Measurement aids such as food pictures and rulers were provided to help estimate the amount of food and beverage consumed. We calculated daily intake of nutrients from the three day food records using the seventh edition of Food Composition Table of Korea [15] and DS-24 program (Human Nutrition Lab, Seoul National University & Al/DB Lab, Sookmyoung Women’s University, 1996). Nutrient density was calculated as the quantity of nutrient per 1,000kcal and was used to evaluate the nutrient intake of subjects with adjustment for energy intake. To assess nutrient intake status, subjects were divided into three groups according to nutrient intake levels: “insufficiency”, less than Estimated Average Requirement (EAR); “optimum”, EAR–125% Recommended Intake (RI); “excess”, over 125% RI. All foods reported by subjects were categorized into 17 food groups: cereals, potatoes & starches, sugars, legumes & their products, nuts & seeds, vegetables, mushrooms, fruits, meat & meat products, eggs, fish & shellfish, seaweed, milk & milk products, plant oil, animal fat, beverages & alcohol, and seasonings.

Statistical analysis

Growth velocity and anthropometric measurements were differer with respect to the age and sex of subjects. Therefore, for analysis of anthropometry data, subjects were categorized according to age (<20, ≥20) and sex. Differences between North Korean young adult defectors and South Korean young adults were tested for statistical significance using the chi-square test and Fisher’s exact test for categorical variables and Student’s t tests for continuous variables. The significance level for all tests was set at P<0.05. All statistical tests were performed using the SAS version 9.1 (SAS Institute Inc, Cary, NC).

Results

North Korean young adult defectors took an average of 2.8 ± 2.8 years to escape from North Korea and enter South Korea,
Table 1. General characteristics of North Korean young adult defectors and South Korean young adults

| Variables                      | North Korean | South Korean | P \(^1\) |
|--------------------------------|--------------|--------------|---------|
| Sex (n = 409)                  |              |              |         |
| Men 50 (48.5)                  | 150 (48.5)   | 1.000        |
| Women 53 (51.5)                | 159 (51.5)   |              |
| Age group (n = 409)            |              |              |         |
| 20 > 54 (52.4)                 | 162 (52.4)   | 1.000        |
| 20 \(\leq\) 49 (47.6)         | 147 (47.6)   |              |
| Monthly household income (n = 383)*** |          |              |         |
| 1,000 thousand won \(\geq\)    | 52 (68.4)    | 35 (11.4)    | < 0.001 |
| 1,000-2,000 thousand won       | 18 (23.7)    | 78 (25.4)    |         |
| 2,000 thousand won \(\leq\)    | 6 (7.9)      | 194 (63.2)   |         |
| Number of household family members (n = 391)*** | | | |
| 0 18 (22.0)                    | 10 (3.2)     | < 0.001      |
| 1 27 (32.9)                    | 34 (11.0)    |              |
| 2 21 (25.6)                    | 81 (26.2)    |              |
| 3 \(\leq\) 16 (19.5)          | 184 (59.6)   |              |
| Economic status in North Korea (n = 97) | | | |
| High 5 (5.2)                   |              |              |         |
| Middle 65 (67.0)               |              |              |         |
| Low 27 (27.6)                  |              |              |         |
| Duration of escape (years) (n = 83) | 2.8 ± 2.8    |              |         |
| Duration of settlement (years) (n = 87) | 2.4 ± 1.9    |              |         |

Values are number (percentage) of subjects or means ± SD of each variable. 
\(^1\) \(\chi^2\)-test
\(\ast P < 0.05, \ast\ast P < 0.01, \ast\ast\ast P < 0.001\)

Table 2. Comparison of anthropometric measurements between North Korean defectors and South Korean young adults by age and gender

| Variable                      | Men          | Women        | P          |
|-------------------------------|--------------|--------------|------------|
|                                | North Korean | South Korean |            |
| Aged under 20                  |              |              |            |
| Height (cm)***                 | 166.0 ± 9.0  | 170.9 ± 9.3  | 0.044      |
| Weight (kg)***                 | 57.8 ± 8.9   | 66.7 ± 14.7  | 0.002      |
| BMI (kg/m\(^2\))              | 20.9 ± 2.3   | 22.6 ± 3.9   | 0.021      |
| Obesity status (%)            |              |              | 0.186      |
| Underweight                   | 10.0         | 6.7          |            |
| Normal                        | 85.0         | 71.7         |            |
| Overweight                    | 5.0          | 21.7         |            |
| Aged over 20                   |              |              |            |
| Height (cm)***                 | 163.4 ± 6.4  | 174.2 ± 6.6  | < 0.001    |
| Weight (kg)***                 | 58.0 ± 6.6   | 70.4 ± 11.9  | < 0.001    |
| BMI (kg/m\(^2\))              | 21.7 ± 2.4   | 23.2 ± 3.5   | 0.013      |
| Obesity status (%)            |              |              | 0.083      |
| Underweight                   | 3.3          | 4.4          |            |
| Normal                        | 90.0         | 71.1         |            |
| Overweight                    | 6.7          | 24.4         |            |
| Values are means ± SD.        |              |              |            |
| Student’s t-test or Fisher’s exact test |          |              |            |
| BMI: Body Mass Index           |              |              |            |
| Underweight : < 5 percentile (aged under 20); BMI < 18.5 kg/m\(^2\) (aged over 20) | | | |
| Normal : 5-85 percentile (aged under 20); BMI 18.5-25.0 kg/m\(^2\) (aged over 20) | | | |
| Overweight : ≥ 85 percentile (aged under 20); BMI ≥ 25.0 kg/m\(^2\) (aged over 20) | | | |
| \(\ast P < 0.05, \ast\ast P < 0.01, \ast\ast\ast P < 0.001\)
Table 3. Comparison of daily food group consumption between North Korean defectors and South Korean young adults

| Food group (g)                  | North Korean | South Korean | P \(^1\) |
|--------------------------------|--------------|--------------|---------|
| Cereals***                      | 232.2 ± 80.3 | 330.0 ± 163.8| < 0.001 |
| Potatoes and starches           | 18.7 ± 30.9  | 23.5 ± 55.0  | 0.269   |
| Sugars                          | 7.2 ± 8.1    | 7.3 ± 12.3   | 0.861   |
| Legumes and their products*     | 25.9 ± 35.5  | 40.1 ± 78.2  | 0.012   |
| Nuts and seeds**                | 1.2 ± 3.5    | 2.6 ± 5.7    | 0.005   |
| Vegetables                      | 263.2 ± 530.5| 277.5 ± 177.7| 0.789   |
| Mushrooms                       | 4.2 ± 8.0    | 2.9 ± 8.8    | 0.195   |
| Fruits                          | 112.5 ± 130.8| 87.1 ± 184.2 | 0.128   |
| Meats***                        | 65.6 ± 67.7  | 114.9 ± 136.5| < 0.001 |
| Eggs                            | 30.4 ± 30.3  | 36.2 ± 52.5  | 0.169   |
| Fish and shellfish              | 42.5 ± 38.2  | 53.7 ± 79.5  | 0.056   |
| Seaweeds                        | 4.1 ± 6.5    | 6.4 ± 23.7   | 0.121   |
| Milk and milk products          | 114.7 ± 100.1| 115.7 ± 174.5| 0.941   |
| Plant oil***                    | 7.9 ± 5.5    | 11.3 ± 12.4  | < 0.001 |
| Animal fat                      | 0.1 ± 0.7    | 0.3 ± 1.7    | 0.220   |
| Beverages and alcohols***       | 54.7 ± 121.4 | 185.1 ± 403.3| < 0.001 |
| Seasonings                      | 33.7 ± 19.3  | 36.2 ± 39.9  | 0.412   |
| Total plant food**              | 739.6 ± 586.2| 969.5 ± 570.0| 0.001   |
| Total animal food**             | 253.2 ± 139.8| 320.9 ± 245.6| 0.001   |
| Total food***                   | 992.8 ± 617.4| 1290.7 ± 676.8| < 0.001 |
| Percentage of plant food        | 73.9 ± 11.2  | 75.4 ± 14.4  | 0.251   |
| Percentage of animal food       | 26.1 ± 11.2  | 24.6 ± 14.4  | 0.251   |

Values are means ± SD for each food group.  
1) Student’s t- test  
* P < 0.05, ** P < 0.01, *** P < 0.001

Table 4. Comparison of daily nutrient intake and nutrient density between North Korean defectors and South Korean young adults

| Nutrient (kcal)                  | North Korean | South Korean | P \(^1\)  | Nutrient density (per 1,000 kcal) | North Korean | South Korean | P \(^1\) |
|---------------------------------|--------------|--------------|---------|-----------------------------------|--------------|--------------|---------|
| Energy (kcal)                   | 1516.2 ± 482.1| 2143.1 ± 904.6***| < 0.001| Protein***                        | 20 (19.4)    | 42 (13.6)    | < 0.001 |
| Protein (g)                     | 59.8 ± 30.1  | 78.8 ± 40.2***| < 0.001| EAR-125% RI \(^3\)               | 49 (47.6)    | 60 (25.9)    | 0.130   |
| Fat (g)                         | 41.2 ± 19.5  | 58.4 ± 37.1***| < 0.001| Over 125% RI                      | 34 (33.0)    | 187 (80.5)   | 0.003   |
| Sugar (g)                       | 220.8 ± 67.3 | 306.6 ± 127.7***| < 0.001| Vitamin A                         | 44 (42.7)    | 135 (43.7)   | 0.013   |
| Calcium (mg)                    | 475.5 ± 494.3| 502.9 ± 298.4 | 0.596  | EAR-125% RI                      | 41 (39.8)    | 96 (30.7)    | 0.005   |
| Phosphorus (mg)                 | 891.5 ± 426.1| 1154.3 ± 403.3| < 0.001| Over 125% RI                      | 17 (16.5)    | 72 (26.3)    | 0.013   |
| Iron (mg)                       | 11.6 ± 15.3  | 12.3 ± 7.7    | 0.649  | Vitamin B\(_2\)**                | 60 (58.3)    | 91 (29.5)    | < 0.001 |
| Potassium (mg)                  | 2076.5 ± 1248.7| 2667.9 ± 1290.1***| < 0.001| EAR-125% RI                      | 17 (16.5)    | 72 (26.3)    | < 0.001 |
| Vitamin A (R.E.)                | 752.0 ± 938.1| 732.7 ± 645.9 | 0.846  | Over 125% RI                      | 9 (8.7)      | 126 (42.8)   | 0.013   |
| Sodium (mg)                     | 3760.7 ± 1332.8| 5181.9 ± 3084.0***| < 0.001| Phosphorus**                      | 29 (28.2)    | 162 (52.4)   | 0.003   |
| Vitamin B\(_2\)** (mg)         | 1.0 ± 0.8    | 1.3 ± 0.7**   | 0.003  | Iron**                            | 72 (69.9)    | 157 (50.8)   | 0.003   |
| Niacin (mg)                     | 13.0 ± 7.0   | 16.8 ± 10.2** | 0.001  | Over 125% RI                      | 19 (18.5)    | 82 (26.5)    | 0.003   |
| Vitamin C (mg)                  | 14.3 ± 11.5  | 94.6 ± 87.5   | 0.068  | Over 125% RI                      | 12 (11.7)    | 70 (22.7)    | 0.003   |
| Retinol (μg)                    | 105.6 ± 78.7 | 109.8 ± 111.3| 0.677  | Values are means ± SD for each nutrient,  
1) Student’s t- test  
* P < 0.05, ** P < 0.01, *** P < 0.001
B2 (P = 0.003) and niacin (P < 0.001) compared to South Korean young adults. However, North Korean subjects showed higher mean nutrient densities than South Korean subjects, for calcium (P = 0.001), vitamin A (P = 0.010), vitamin B2 (P = 0.033), retinol (P < 0.001), carotene (P = 0.016) and fiber (P < 0.001) (Table 4).

Among North Korean young adults, the proportion of subjects whose dietary intake was less than EAR was significantly higher in protein (P < 0.001), vitamin B1 (P < 0.001), vitamin B2 (P < 0.001), niacin (P < 0.001), calcium (P = 0.019), phosphorus (P < 0.001) and iron (P = 0.003) than for South Korean young adults. The proportion of North Korean defectors with vitamin A and vitamin C intake less than EAR was less than that of South Koreans; however, both North and South Korean young adults had poor dietary intake for these nutrients (Table 5).

Discussion

We performed an age and sex matched comparison of anthropometric measurements and dietary intake of North Korean young adult defectors living in South Korea with those of their South Korean counterparts. North Korean defectors were found to have smaller body frames and lower intake of nutrients than South Koreans.

These results are similar to those of other researchers who have assessed anthropometric measurement for young adults in North Korea [3,4] or North Korean defectors in China [2,16]. Kim [17] also reported that the weight and height of North Koreans aged 9-19 who attended Hanawon, the government-run resettlement support center for North Korean defectors, were lower than that of similarly-aged South Koreans. Moreover, about one third of the North Korean subjects suffered from growth stunting or were severely underweight. Previous research had reported that North Korean young adults were shorter than older generations [18]. Growth retardation of North Korean young adults is likely due to severe food shortages in North Korea during 1990s, as well as food and water shortages during the period of escape in China [19]. Pak [5] reported that height stunting was more severe than weight stunting among North Korean children in South Korea, especially among North Korean girls. This implies the possibility that North Korean girls may become overweight later in life. Although the obesity prevalence was low in our data, North Korean young adult defectors exhibited risk factors linked to obesity in later life such as malnutrition in earlier life and growth retardation. Therefore, it is necessary to monitor their weight change closely.

Several previous studies reported that North Koreans were suffered from food shortage not only in North Korea [3], but also during period of deflection in third countries such as China [2]. In this study, intake of nutrients and food groups among North Korean subjects was lower than that of South Korean young adults. North Korean subjects’ dietary intake was still poor during their period of resettlement in South Korea. Such chronic malnutrition status has adversely affected their growth. If North Korean young adult defectors continue to suffer from inadequate nutrient intake, they are likely to experience adverse health outcomes. One third of North Korean subjects had vitamin A, vitamin C, vitamin B1, niacin and iron intakes below EAR. In particular, over 70% of them had vitamin B2 and calcium intakes below EAR. Refugee populations frequently are subjected to micronutrient deficiency [20]. Long term poor eating could impair physical and neurological functions [21-23]. In addition, the US National Intelligence Council [24] has estimated that 17 to 29 percent of North Korean young people of military age would have cognitive disabilities because of malnourishment during childhood. Poor health status of North Korean defectors would eventually degrade their quality of life, interrupt successful settlement in South Korea, and increase social and economic burden of supporting ill North Korean defectors. On the other hand, North Korean subjects in this study showed higher nutrient density diet than South Korean subjects. It indicates that North Korean young adults’ composition of diet is not poorer than that of South Koreans. Daily food consumption of North Korean subjects was about three quarters of South Korean subjects. Therefore, increasing amount of intake would be helpful to improve North Korean subjects’ nutrient intake.

The North Korean subjects in this study lived with fewer family members. It is likely that most of them do not have care givers, including meal providers. Also, monthly household income of North Korean subjects was lower. The lack of ability to prepare meals or deal with economic hardship would inevitably affect dietary intake. According to staff at the study sites, many North Korean defector students skip meals because they do not know how to cook or do not have enough money. Nutrition education about how to cook and how to choose proper foods would be helpful for improving North Korean young adult defectors’ diet.

In this study, subjects who attended alternative schools for North Korean defectors were provided with breakfast [usually kimbab (seaweed-covered rice with vegetables) and milk] and lunch at school. This practice could explain why they had higher intakes of calcium (abundant in milk products), vitamin A and carotene (abundant in carrot, an ingredient of kimbab) compared to South Korean counterparts. This implies that meal services could improve nutrient intakes of North Korean young adult defectors.

There were no significant differences in subjects’ anthropometric measurements and dietary intake by age at escape from North Korea and at entrance to South Korea (data not shown). Since the sample size was small, further study with larger samples would be necessary.

This study had several limitations. First, subjects attended alternative schools; therefore, the subjects in this study may not be a representative sample of all North Korean young adult defectors in South Korea. We did not include regular school students and non-students who do not participate in the school
system. However, among the North Korean young adult defectors attending regular school, only 57.9% were in middle school and 10.9% were in high school. Also, approximately 12.8% of North Korean young adult defectors drop out of regular school [25]. Most North Korean young adult defectors who settle in South Korea are not part the regular school support system and may not have other forms of support. Those left outside of public or private aid-networks would suffer from more severe health problems and lack of proper diet. Second, it was not possible to gather information about subjects' health status and dietary intake while they were in North Korea and intermediate countries before entering South Korea. As a result, it was not feasible to assess the transition of stature and diet from North Korea to South Korea.

This is the first study that evaluates dietary intake of North Korean young adult defectors. To provide more effective care for vulnerable North Korean young adult defectors, further studies on growth, diet change and comparative studies on differences between North and South Korean life are necessary. Dietary approach would be useful in promoting healthy living for defectors assisting adaptation to their new environment.

In summary, North Korean young adult defectors exhibited smaller body frames and a higher prevalence of under-nutrition than their South Korean counterparts. We recommend providing nutrition support programs such as meal services or financial aid for North Korean young adult defectors to secure adequate nutrient intake.

References

1. Korean Ministry of Unification. Report of North Korean refugees in South Korea; 2009.
2. Chang N, Kang EY, Lee JM, Lee MK. Anthropometric measurements and dietary patterns of North Korean migrant children in China. The Korean Journal of Nutrition 2000;33:324-31.
3. Central Bureau of Statistics, DPRK. Report on the DPRK nutrition assessment; 2002.
4. Shin JE, Yoon J, Jeong SY, Park M, Lee YS. Status of early childhood and maternal nutrition in South Korea and North Korea. Korean Journal of Community Nutrition 2007;12:123-32.
5. Pak S. A study about growth, developmental psychology and welfare service needs of North Korean children and adolescence defectors settled in South Korea. Seoul: Institute of Unification, Seoul National University; 2006.
6. Painter RC, De Rooij SR, Bossuyt PM, Simmers TA, Osmond C, Barker DJ, Bleker OP, Roseboom TJ. Early onset of coronary artery disease after prenatal exposure to the Dutch famine. Am J Clin Nutr 2006;84:322-7.
7. Eriksson JG, Forsen T, Tuomilehto J, Osmond C, Barker DJ. Early growth and coronary heart disease in later life: longitudinal study. BMJ 2001;322:949-53.
8. Walker SP, Gaskin P, Powell CA, Bennett FI, Forrester TE, Grantham-McGregor S. The effects of birth weight and postnatal linear growth retardation on blood pressure at age 11-12 years. J Epidemiol Community Health 2001;55:394-8.
9. McCarron P, Hart CL, Hole D, Smith GD. The relation between adult height and haemorrhagic and ischaemic stroke in the Renfrew/Paisley study. J Epidemiol Community Health 2001;55:404-5.
10. Forsen T, Eriksson J, Qiao Q, Tervahauta M, Nissinen A, Tuomilehto J. Short stature and coronary heart disease: a 35-year follow-up of the Finnish cohorts of The Seven Countries Study. J Intern Med 2000;248:326-32.
11. Grantham-McGregor S. A review of studies of the effect of severe malnutrition on mental development. J Nutr 1995;125:2233-8.
12. Darnton-Hill I, Nishida C, James WP. A life course approach to diet, nutrition and the prevention of chronic diseases. Public Health Nutr 2004;7:101-21.
13. Aboderin I, Kalache A, Ben-Shlomo Y, Lynch JW, Yajnik CS, Kuh D, Yach D. Life course perspectives on coronary heart disease, stroke and diabetes: key issues and implications for policy and research. Geneva: World Health Organization; 2002.
14. The Center for Disease Control Prevention [Internet]. Atlanta: CDC Growth chart for the United States; [cited 2008 October 20]. Available from: http://www.cdc.gov/growthcharts.
15. The Korean Nutrition Society. Food composition table. In: Recommended dietary allowances for Koreans, 7th ed. Seoul: 2000.
16. Pak S. The growth status of North Korean refugee children in China. Cross Cultural Studies 2000;6:199-219.
17. Kim YY. An evaluation of the health status of children from North Korea. Nurs Sci 2005;17:55-63.
18. Min SK, Jeon WT, Yoon DR. Life and development of adolescents in North Korea. Journal of Korean Neuropsychiatric Association 1999;38:1047-62.
19. Lee AR. A study on dietary behavior of North Korean defectors in South Korea -focused on demographic characteristics and psychological acculturation strategy types- [master's thesis]. Seoul: Ewha Womens University; 2002.
20. Weise Prinzo Z, De Benoist B. Meeting the challenges of micronutrient deficiencies in emergency-affected populations. Proc Nutr Soc 2002;61:251-7.
21. Witte KK, Clark AL, Cleland JD. Chronic heart failure and micronutrients. J Am Coll Cardiol 2001;37:1765-74.
22. Walter T. Impact of iron deficiency on cognition in infancy and childhood. Eur J Clin Nutr 1993;47:307-16.
23. Chandra RK. Nutrition and the immune system. Proc Nutr Soc 1993;52:77-84.
24. National Intelligence Council [Internet]. Strategic implications of global health; [cited 2009 May 2]. Available from: http://www.dni.gov/nic/PDF_GIF_otherprod/ICA_Global_Health_2008.pdf.
25. Korean Ministry of Education & Human Resources Development. Report of preparation for unification in education - Adjustment of North Korean refugee adolescents and scheme of founding a school for them. Symposium of policy study. Seoul: 2004.