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Comparing the nutritional status of children and adolescents from North Korean defector families and South Korean families

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ABSTRACT

Objective This study aimed to investigate the nutritional status of children and adolescents from North Korean defector (NKD) families who are currently living in South Korea (SK) and compared with the status of those from SK families.

Design A cross-sectional study comparing the prevalence of malnutrition, overweight and obesity between children and adolescents from NKD families and SK families.

Setting Children and adolescents from NKD families were interviewed face-to-face directly, whereas the data about those from SK families acquired by using 2017 Korea National Health and Nutrition Examination Survey. Their nutritional status were estimated using the 2017 Korean National Growth Charts for children and adolescents.

Participants The total number of children and adolescents was 2136 consisting of 527 subjects from the NKD families and 1609 subjects from the SK families.

Results The overall prevalence of stunting, wasting, underweight, overweight and obesity in NKD group was 8.9%, 10.2%, 10.4%, 11.2% and 12.2% respectively, and 1.9%, 7.1%, 5.9%, 9.2% and 9.3%, respectively, in SK families. The NKD group showed significantly higher prevalence than SK group in stunting ($p<0.001$), wasting ($p=0.014$), underweight ($p<0.001$), obesity ($p=0.041$) but not in overweight.

Conclusions The nutritional status of children and adolescents form NKD families was worse than that of those from SK families, and also higher prevalence of obesity.

Strengths and limitations of this study

- ► This study is significant in that it is the first large-scale comparison of the nutritional status of children and adolescents of North Korean defector (NKD) families and those of South Korea families.
- ► Because participants of NKD families were drawn with convenience sampling, the findings are difficult to generalise.
- ► Variables that could affect nutritional status such as education level could not be collected.

INTRODUCTION

According to the North Korean defectors (NKDs) data published by the Ministry of Unification, a total of 33 718 NKD entered South Korea (SK) as of September 2020. About 15% of all defectors 5097 are children and adolescents aged 0–19 years.[1] Since the NKD data only included children and adolescents born in North Korea (NK), the number is estimated to be larger if the third country-born or SK-born children or adolescents are included.[2] Moreover, as for September 2020, the number of children and adolescents of the NKD families living in SK is expected to increase steadily in the future if we consider the fact that women tentatively comprise up to 72% of the total NKDs and the proportion of childbearing aged women is high among them.[1]

According to the 2012 National Nutrition Survey, NK verified the effectiveness of its food aid programme on 35.1%, 4.6% and 15.2% of NK children. Each was found to be suffering from malnutrition.[3] Based on the 2017 Multiple Indicator Cluster Survey conducted via support from UNICEF 5 years later, 19.1%, 2.5% and 9.3% of the NK children were also reported to suffer from stunting, wasting and underweight, respectively, and one-third of the children aged 6–23 months were unable to meet the minimum dietary standard.[4] Furthermore, the 2019 Food and Agriculture Organization (FAO) survey on nutritional status showed that 1.1 million people comprising up to 43.4% of the whole population were malnourished in NK,[5] showing the still-deprived nutritional status of NK.

These food shortages are expected to have adversely affected the growth and health of the children and adolescents in NK.[6] Due to the food shortages, since the NK children and adolescents were exposed to undernourishment during their early life including the

fetal period, they are likely to have more risk factors for various chronic diseases than SK children and adolescents. Moreover, because children and adolescents of the NKD families were unlikely to receive appropriate health management during their growth period due to the instability of life after the defection from NK, they are expected to have poor health status.[7]

The nutritional status of infancy and childhood is related to the health problems of both the growth period and adulthood. The early life malnourishment leads to growth retardation and undersized body. Adolescence is the period requiring the most nutrition, where the balanced nutrition intake and appropriate dietary habits during this period could lead to better physical health.[8] During the growth period, it is also important to form appropriate dietary habits because the dietary habits formed during this period do not change easily after one has reached adulthood.[9]

Previous studies on children and adolescents of the NKD families mostly focused on adaptation to the SK society, and the studies related to health mostly focused on psychological and mental health status and reported that, due to difficulties faced during the adaptation to the SK society after defecting from NK and entering SK, children and adolescents were psychologically and mentally deprived.[10–13] Even though there was a study reporting deprivation of growth and nutritional status and lack of nutritional intake in children and adolescents of the NKD families, it only examined the status right after the entry into SK.[14] To the best of our knowledge, there was no study focusing on the nutritional status of children and adolescents of the NKD families after settlement in SK society.

We aimed to investigate the nutritional status of children and adolescents of the NKD families after settlement in SK society and compare their nutritional status to that of children and adolescents of the SK families.

METHODS

Participants

Children and adolescents of the NKD families were defined as those aged 0–18 years who are currently being raised in SK and were born in families where at least one parent is an NKD. A total of 527 participants were recruited from local Hana Centers, alternative schools and non-governmental organisations (NGOs) across SK between September 2017 and December 2019.

Among the total of 8127 participants of the 2017 Korea National Health and Nutrition Examination Survey (2017 KNHANES), children and adolescents of the SK families were defined as 1609 children and adolescents aged 0–18 years.

Patient and public involvement

This study was done without involving patients or members of the public in the design, conduct, reporting and disseminating plans of the research.

Data collection methods

Children and adolescents of the NKD families

We contacted participants of the NKD families through local Hana Centers, alternative schools, and NGOs across SK between September 2017 and December 2019. We thoroughly explained the purpose and the details of the study to the contacted participants and informed them that they could participate voluntarily and could drop out anytime on their own will. Children younger than 7 years were deemed to have difficulties in communication; thus, the informed consent and the questionnaire responses were acquired from their guardians (surrogates). In children aged 7 years or older, the informed consent was acquired from both the participants and their guardians (surrogates). Trained researchers face to face interviewed the participants using structured questionnaires, and measured height and weight.

Children and adolescents of the SK families

The data for children and adolescents of SK families were acquired using 2017 KNHANES data. The KNHANES calculates representative and reliable statistics regarding health status, health behaviour, and food and nutrition intake behaviour of Koreans through health survey, examination survey and nutrition survey on a national and a provincial scale.[15] KNHANES is being used as the basic data source for the healthcare policies such as setting and evaluating goals of the national health promotion plan or developing health promotion programmes. In this study, among the total 8127 participants of 2017 KNHANES, 1609 children and adolescents aged 0–18 years were defined as children and adolescents of the SK families.

Investigated variables

General characteristics of the participants

For children and adolescents of NKD families, sex, age, country of birth, duration of settlement, nationality of birth mother, nationality of birth father were surveyed. Height was measured using the mobile InKids height metre (InLab S50, InBody, Seoul, Korea) and weight was measured using the CAS HE-58 scale (CAS, Gyeonggi-do, Korea). Body mass index (BMI) was calculated as the weight (kg) divided by the square of height(m^2).

For children and adolescent of SK families, the data of sex, age, height, weight and quartile of monthly household income were acquired from 2017 KNHANES data. We defined the socioeconomic status using quartile of monthly household income and recategorised as high (highest and medium-high) and low (medium-low and lowest). In KNHANES, the age was given in months in children aged 2–6 years, but the age was only given in years in children older than 6 years. Thus, in children 6 years or younger, the age was recorded in months as given, and in children older than 6 years, the age was recorded as the representative monthly age (age in years×12 months).

Participants' growth status, malnutrition, overweight and obesity

To assess the participants' growth status, we used the 2017 Korean National Growth Charts (KNGC).[16] The KNGC are percentile curves representing the distribution of physical trait values such as height and weight of SK children and adolescents. They were jointly developed by the Korean Pediatric Society and the Korea Disease Control and Prevention Agency in 2017 and are used as an index to assess the growth status of children and adolescents checking the presence of short stature, underweight, obesity and so on. In 2017 KNGC, WHO Growth Standards[17] were introduced for children aged 3 years or younger to accurately assess the physical growth status of the children and adolescents. WHO Growth Standards were developed by including breastfed infants only to be used as the standards for breastfed infants. In the case of children aged 3–18 years, we used the same data from 2007 KNGC, but the height charts were adjusted upward and the criterion for obesity (BMI of ≥95th percentile) was adjusted downward to reflect the current status of the SK children and adolescents.

We compared malnutrition, overweight and obesity of participants using the standards of the 2017 KNGC.[18] Stunting was defined as height for age of <3rd percentile for both children aged 0–23 months and children aged 2–18 years. Wasting was defined as weight for age of <5th percentile in children aged 0–23 months and as BMI for age of <5th percentile in children aged 2–18 years. Underweight was defined as weight for age of <5th percentile for both children aged 0–23 months and children aged 2–18 years. Overweight was defined as weight for age of ≥95th percentile in children aged 0–23 months and as BMI for age of ≥85th percentile and <95th percentile in children aged 2–18 years. Obesity was defined as BMI for age of ≥95th percentile in children aged 2–18 years.

Data analysis

The statistical programme SPSS V.25 was used to analyse the collected data. The general characteristics of the participants were analysed using frequency, percentage, mean and SD. Independent t-test for the mean of the growth status and χ^2 test and Fisher's exact test for the proportional distribution of malnutrition, overweight and obesity were used to evaluate the significance of the differences between two groups. Statistical significance was defined as a p value of overweight, and obesity prevalence of the NKD <0.05 in all analyses.

RESULTS

Comparison of the general characteristics

The general characteristics of total 2136 subjects (527 in NKD group and 1609 in SK group) are shown in table 1. In the NKD group, there were 35 (6.6%) children aged 0–23 months and 492 (93.4%) children aged 24 months or older, and in the SK household group, there were 74 (4.6%) children aged 0–23 months and 1535 (95.4%) children aged 24 months or older. The duration of settlement was 4.2±3.4 (mean±SD) years. The most common nationality of birth mother was NK (96.9%), and the most common nationality of birth father was China(50.7%).

Table 1 General characteristics

Variable	Total	North Korean Defector group	South Korean group
Number	2136 (100.0)	527 (24.7)	1609 (75.3)
Sex			
Boy	1120 (52.4)	277 (52.6)	843 (52.4)
Girl	1016 (47.6)	250 (47.4)	766 (47.6)
Age (months)	119.7±61.7	133.0±65.2	115.4±59.91
0–23	109 (5.1)	35 (6.6)	74 (4.6)
≥24	2027 (94.9)	492 (93.4)	1535 (95.4)
Age (years)	9.5±5.1	10.6±5.4	9.2±5.0
Height (cm)	135.8±28.4	138.3±29.6	134.9±28.0
Weight (kg)	37.5±19.9	40.3±20.3	36.5±20.0
BMI (kg/m^2)	18.7±3.9	19.4±4.1	18.4±3.8
Country of birth			
South Korea		192 (37.4)	
North Korea		86 (16.7)	
China		235 (45.7)	
Other		1 (0.2)	
Duration of settlement (years)		4.2±3.4	
<5		186 (65.5)	
≥5		98 (34.5)	
Nationality of birth mother			
South Korea		10 (1.9)	
North Korea		504 (96.9)	
China		6 (1.2)	
Nationality of birth father			
South Korea		113 (21.9)	
North Korea		138 (26.7)	
China		262 (50.7)	
Other		4 (0.8)	
Monthly household income			
Low			566 (35.2)
High			1041 (64.8)

Values are presented as number (%) or mean±SD.
BMI, body mass index.

Comparison of the prevalence of malnutrition, overweight and obesity

The prevalence of stunting, wasting, underweight, overweight and obesity was 8.9%, 10.2%, 10.4%, 11.2% and

Table 2 Comparison of the prevalence of malnutrition, overweight and obesity between South Korean group and North Korean Defector group

Variable	Total	North Korean Defector group	South Korean group	P value
Stunting	77 (3.6)	47 (8.9)	30 (1.9)	<0.001
Wasting	168 (7.9)	54 (10.2)	114 (7.1)	0.014
Underweight	150 (7.0)	55 (10.4)	95 (5.9)	<0.001
Overweight	207 (9.7)	59 (11.2)	148 (9.2)	0.105
Obesity	203 (9.5)	60 (12.2)	143 (9.3)	0.041

Values are presented as number (%).

12.2%, respectively, in the NKD group; 1.9%, 7.1%, 5.9%, 9.2% and 9.3%, respectively, in the SK group. The The NKD group showed significantly higher prevalence than SK group in stunting (p<0.001), wasting (p=0.014), underweight (p<0.001), obesity (p=0.041) but not in overweight (table 2).

Comparison of malnutrition, overweight and obesity according to monthly household income

The comparison of malnutrition, overweight and obesity according to monthly household income are shown in table 3. The prevalence of stunting, wasting, underweight, overweight and obesity was 1.1%, 7.9%, 5.8%, 9.3% and 9.0% in the high-income SK group; 3.4%, 5.7%, 6.2%, 9.0% and 9.9% in the low-income SK group; 8.9%, 10.2%, 10.4%, 11.2% and 12.1% in the NKD group. There were significant differences in the prevalence of stunting (p<0.001), wasting (p=0.020) and underweight (p=0.002), but not in overweight and obesity.

DISCUSSION

In this study, we investigated the nutritional status of children and adolescents from NKD families and compared with the status of those from SK families. Our result demonstrated that the prevalence of stunting, wasting, underweight and obesity of NKD group were significantly higher than those of SKD group. Based on these results, we could find out that children and adolescents of the NKD families had more nutritional problems than those of the SK families. Children who experienced severe malnutrition during the growth period had a higher possibility of developing extensive functional disabilities such as decreased immune response, decreased physical fitness, and cognitive and emotional retardation when they are in their adulthood leading to a long-term negative societal effect.[14] In the growth period, overweight and obesity can lead to adult obesity-related and obesity-related complications such as metabolic syndrome.[19] Thus, further examination and management of malnutrition, overweight and obesity in children and adolescents of the NKD families are needed.

Table 3 Comparison of the malnutrition, overweight and obesity according to monthly household income

Variable	South Korean group		North Korean Defector group	P value
	High	Low		
Stunting	11 (1.1)	19 (3.4)	47 (8.9)	<0.001
Wasting	82 (7.9)	32 (5.7)	54 (10.2)	0.020
Underweight	60 (5.8)	35 (6.2)	55 (10.4)	0.002
Overweight	37 (9.3)	51 (9.0)	29 (11.2)	0.415
Obesity	91 (9.0)	52 (9.9)	60 (12.1)	0.169

Values are presented as number (%).

Previous studies have evaluated the malnutrition of children and adolescents of the NKD families. In one study, the researchers assessed the physical condition of the NK children defectors in Hanawon right after entering SK. They reported a worrisome growth status of 33.3% of short stature and 38.9% of underweight.[20] Another study examined the growth, developmental, and nutritional status of the NK children and adolescents who entered SK from 2009 to 2010. Compared with the SK standard at the time, children of the NKD families showed 19% and 15% shortfall in height and weight, respectively.[21] Though the participants of the study settled in SK about 4 years, there were 8.9%, 10.2% and 10.4% of stunting, wasting and underweight, respectively, implying children and adolescents of the NKD families still seem to suffer from malnutrition.

Our results demonstrated that the prevalence of obesity of NKD group was significantly higher than that of SK group. When NKDs entered into SK, only malnutrition was a nutritional problem in NKD children. However, the prevalence of obesity has been increasing as the duration of settlement increases.[22] In previous study comparing the nutritional intake level, children of NKD families had higher rates of fat intake than those of SK families.[20 22] Inadequate food intake in early childhood can alter metabolic processes, reducing the use of fat as an energy source, which in turn accumulates in the body[21 22] and increases the risk of obesity.[22–24]

In our results, the malnutrition prevalence of NKD group was higher than that of low-income SK group. In the study examining the socioeconomic status of the NKDs currently residing in SK, the authors reported that the mean monthly income of the NKDs in 2020 was only one-third of the SK's mean monthly income.[23] Economically vulnerable groups such as low-income people were reported to have poor health status as a result of the accumulation of socioeconomic inequalities in areas including income, medical insurance and education from an early age.[24–26] Based on these studies, NKDs are currently in more impoverished condition than the low-income SK families, and these economic conditions are thought to have influenced the nutritional and growth status of children of the NKD families. Higher meal

skipping rate and inadequate meals of NKD families are thought to be the cause of malnutrition. These results showed that children and adolescents of the NKD families are in the economically vulnerable group due to difficulties in adapting after settlement in SK society,[27] still experience malnutrition due to inadequate food and nutrition uptake, and are thought to be in poor nutritional status compared with the original SK children. Improvement in the nutritional status of children and adolescents of the NKD families is needed through continuous follow-up.

There are some limitations to this study. The results are hard to generalise to the whole children and adolescents of the NKD families because the participants were not sampled through random sampling but convenience sampling. Also, variables such as the educational level of the parents that could influence nutritional status of children and adolescents could not be collected were not collected.

Despite these limitations, This study is significant in that it is the first large-scale comparison of the nutritional status of children and adolescents of SK families and those of NKD families after they entered and settled in SK.

In conclusion, the nutritional status of children and adolescents from NKD families was worse than that of those from SK families, and also higher prevalence of obesity.

Contributors S-WC (guarantor) and S-YK conceived the idea. S-WC and S-YK collected data and performed literature search. JP, YRS, MAH and SYP developed analysis plan. S-YK analysed the data under the supervision of S-WC. S-YK drafted the paper. All authors contributed to the interpretation of results and in making an important intellectual contribution to the manuscript. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained from parent(s)/guardian(s)

Ethics approval The study procedures were approved by the Bioethical Committee of Chosun University (IRB No. 2-1041055-AB-N-01-2017-0025).

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Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

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