Acculturation and changes in dietary behavior and anthropometric measures among Chinese international students in South Korea

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BACKGROUND/OBJECTIVES: International students face dissimilar food environments, which could lead to changes in dietary behaviors and anthropometric characteristics between before and after migration. We sought to examine the risk factors, including dietary behaviors, acculturation, and demographic characteristics, related to overweight subjects residing in South Korea.
SUBJECTS/METHODS: We conducted a cross-sectional study, collecting data from 142 Chinese international students (63 males, 79 females) in 2013.
RESULTS: The mean age of the subjects was 25.4 years, and almost half of them immigrated to South Korea to earn a master's degree or doctoral degree (n = 70, 49.3%). Chinese international students showed an increase in skipping meals and eating speed, but a decrease in the frequency of fruit and vegetable consumption in South Korea compared to when they lived in China. We found a statistically significant increase in weight (69.4 → 73.9 kg) and BMI (22.4 → 23.8 kg/m^2) for male subjects (P < 0.001) but no change for female subjects. We also found that overweight subjects were more likely to be highly acculturated and male compared with normal-weight subjects.
CONCLUSION: Among Chinese international students living in South Korea, male and more highly acculturated subjects are more vulnerable to weight gain. This study provides useful information to design tailored nutrition intervention programs for Chinese international students.

INTRODUCTION

Chinese international students face high levels of stress in language, finances, personal relationships, and academic performance as well as a different cuisine and culture in South Korea [1-3]. Migration may play an important role in nutritional and health status because migrants may be exposed to dissimilar environmental influences and culture shock [4-7]. Adopting new dietary behaviors is challenging when people migrate to a new country [8]. Zhu [9] indicated that Chinese international students decreased their consumption of fruits and vegetables while increasing their consumption of instant noodles and fast food and skipping breakfast more frequently. Moreover, they drank tea less but drank coffee more often in South Korea. It is critical to identify the nutritional problems for Chinese international students to develop an evidence-based nutrition intervention program.

The number of Chinese students in South Korea has increased sharply over the past two decades. Chinese students began studying abroad in Korea just after the conclusion of the contract on Korea-Chinese Cultural Exchange in 1994. According to the National Statistical Office 2013, Chinese students compose 65.1% of all international students in South Korea [10]. Chinese students numbered approximately 300 in early 1993, but this number increased to 53,251 in 2013. International students generally stay in South Korea for more than 2 years. This is a critical time for these international students to develop healthy eating habits for chronic disease prevention.

Acculturation can have positive or negative impacts on dietary practices. One recent study found that a higher level of acculturation was associated with a high intake of more vegetables and less meat among Mongolians living in South Korea [11]. The author also noted that the level of acculturation was positively correlated with the consumption of sodium. Another previous study indicated that acculturation improved the variety and adequacy of the diet but facilitated lower dietary moderation in Chinese women living in the United States [12]. International students were exposed to different food environments compared to migrant workers and international married immigrant women. Because the majority of the subjects in previous studies were migrant workers, we need to conduct research that uses international students as study subjects.

Understanding acculturation, diet behaviors, and nutritional status is crucial for designing a nutrition intervention program for this understudied population.

In addition to acculturation, there are many factors associated with changes in dietary behavior among immigrants. Rosenmoller *et al.* [13] found that Chinese immigrants stayed in Canada for a longer period of time, consumed significantly larger meals, ate out more often and consumed convenience foods more frequently. Pan *et al.* [14] investigated the eating patterns of Asian international students before and after migration to the United States. This study reported that there was a significant increase in the intake of fruits, fats, sweets and skipping breakfast among Asian students; however, they also significantly reduced their intake of meat and vegetables after migration to the United States. Most foreign students reside in a dormitory while at university, and because the school provides 2-3 meals per day, school meals are responsible for the bulk of students' nutritional status. Chinese students experience many problems adjusting to Korean food, which is unfamiliar to them at first because the dormitory restaurants do not offer Chinese food. Therefore, according to research by Jung and Jeon (2011), 45.5% of Chinese students stated that they did not use the school restaurants because of an unfavorable taste, and 11.4% of subjects did not use the restaurants because there were not enough types of foods [15]. Thus, some students said that they had to live alone to freely cook and eat Chinese food. Taking into consideration the characteristics and different living conditions of international students, we implemented research focusing on the dietary behaviors of international students.

Previous studies on Chinese international students have mostly focused on changes in dietary behaviors [16], surveys on the preference for Korean food and satisfaction with the school food service [17-19], acculturation and stress among Chinese students in Korea [5], and the relationship between acculturative stress and the preference for traditional Korean food [20]. Research that examines the risk factors for overweight and obese Chinese international students, however, including general characteristics, diet and health behaviors and acculturation, is limited.

The specific aim of this study is to explore how gender and the acculturation level change the dietary practices or anthropometric characteristics before and after migration among Chinese international students in South Korea. First, we evaluated the difference between Chinese students' weight and the prevalence of obesity before and after studying abroad. Second, we examined the differences in dietary behaviors and dietary intake patterns among Chinese students. Third, we analyzed the risk factors including dietary factors, demographic characteristics, acculturation, and lifestyle factors, associated with overweight and obese Chinese international students in South Korea.

SUBJECTS AND METHODS

Survey

We conducted a cross-sectional study targeting Chinese international students in two universities from August through October 2013. We set the inclusion criteria for study subjects as individuals who were born in China and had stayed in South Korea as international students. The participants who met the inclusion criteria filled out a self-administered questionnaire. The survey questionnaire was written in Chinese. The pilot test was completed by five Chinese international students. We revised the questionnaire based on the results of the pilot test.

Demographic characteristics

We collected the demographic characteristics of the study subjects, including age, gender, length of residence in South Korea, marital status, education level, residential type and purpose for visiting South Korea. Age was classified into two groups: < 25 years and ≥ 25 years. The length of residence in South Korea was categorized into two groups: < 2 years and ≥ 2 years. The marital status of subjects was grouped into two categories: single and married. Educational level was classified into four groups: graduated from high school, two-year college, attending a university and graduated from university or above. Residential type was categorized in three groups: rented room, dormitory or other. The purpose for visiting South Korea was grouped into four categories: studying Korean, international exchange student program, earning a bachelor's degree and earning a master's or a doctoral degree.

Anthropometric measures and lifestyle factors

We collected the self-reported height and weight of subjects in China prior to migration as well as the current height and weight of subjects in South Korea after migration. We calculated subjects' body mass index (BMI), dividing the weight in kilograms by the height in meters squared (kg/m^2). Subjects' BMI was classified into four groups using the WHO regional office for the western Pacific-Asian criteria: underweight (BMI < 18.5), normal weight (18.5-22.9), overweight (23.0-24.9), obese (BMI ≥ 25.0) [21]. We also included sleeping time (≤ 12:00 midnight or > 12:00 midnight) as a lifestyle factor.

Dietary behavior

The frequency of eating breakfast was classified into three groups: always, often and seldom/never. Eating speed was categorized into three groups: slow (≥ 30 min), normal (15-29 min) and fast (< 15 min). The number of meals per day was grouped in three categories: ≤ two times, three times and four times. The frequency of meal regularity and uniformity of meal size were classified in four groups: always, often, sometimes and seldom/never.

Food consumption pattern

The frequency of eating vegetables was grouped in four categories: ≤ 1 time/day, 2 times/day, 3 times/day and ≥ 4 times/day. The frequency of eating fruits was classified in four groups: almost never, 1 time/day, 2 times/day and ≥ 3 times/day. The frequency of eating bread or instant noodles (instead of rice) was categorized in four groups: < 1 time/week, 1-2 times/week, 3-4 times/week, ≥ 5 times/week. The frequency of fast food consumption was classified in four groups: 1-2 times/ month, 3-4 times/month, 2 times/week and ≥ 3 times/week. The frequency of late-night snack consumption was grouped in three categories: ≤ 2 times/month, 3-4 times/month and ≥ 2

times per week.

Acculturation

The acculturation index includes nine categories: 1) Korean speaking ability, 2) satisfaction with the language program at the university, 3) contacts with Koreans, 4) participation in meetings with Koreans, 5) participation in social activities for students, 6) understanding Korean drama and movies, 7) understanding Korean newspapers, 8) understanding lectures at university, 9) and participation in a club or study meetings [5,22]. We used a five-point Likert scale with the following point values for each question: 1 point, not at all satisfied; 2 points, not satisfied; 3 points, partially satisfied; 4 points, satisfied; and 5 points, highly satisfied.

Only those Chinese international students who agreed to participate in the study were included as study subjects. We attained institutional review board approval (IRB-2013A-5) before conducting this study at Seoul Women's University.

Statistical analysis

The data set was analyzed using SPSS 21.0 (SPSS Inc., Chicago, IL). We compared the demographic characteristics and acculturation status of subjects between males and females. Paired t-tests were employed to investigate changes in anthropometric measurements of subjects before and after immigrating to South Korea. We also investigated the BMI categories of subjects before and after migration to South Korea using the Chi-square test. Additionally, we examined any changes in the dietary behaviors and food consumption patterns before and after immigrating to South Korea. We also used a logistic regression for predicting overweight subjects. We investigated the adjusted odds ratio (OR) and 95% confidence intervals (CI) in a logistic regression model. We employed two-sided P-values < 0.05 to test this hypothesis.

RESULTS

Demographic characteristics

This study included 142 subjects, 63 male Chinese international students (44.4%) and 79 female Chinese international students (55.6%) (Table 1). The mean age of subjects was 25.4 years, and their mean length of residence in South Korea was 35.5 months. Most of them were not married (135 subjects, 95.1%). The education level was mostly above graduating from university (64.8%), and male students (76.2%) had a higher education level than female students (55.7%). There was a significant difference in residential type by gender. The most common residential type for female students was 'rented room' (45 subjects, 57.0%),

Table 1. Demographic characteristics of Chinese international students by gender

Variables	Male (n = 63)	Female (n = 79)	Total (n = 142)
	n (%) or mean ± SD		
Age (yrs)			
< 25	20 (31.7)	29 (36.7)	49 (34.5)
≥ 25	43 (68.3)	50 (63.3)	93 (65.5)
Average	25.5 ± 2.9	25.4 ± 2.5	25.4 ± 2.7
Length of residence in South Korea (months)			
< 24	29 (46.0)	24 (30.4)	53 (37.3)
≥ 24	34 (54.0)	55 (69.6)	89 (62.7)
Average	36.9 ± 28.0	34.4 ± 22.4	35.5 ± 24.9
Marital status			
Single	60 (95.2)	75 (94.9)	135 (95.1)
Married	3 (4.8)	4 (5.1)	7 (4.9)
Education level			
Graduated from high school	5 (7.9)	8 (10.1)	13 (9.2)
Graduated from two-year college	1 (1.6)	8 (10.1)	9 (6.3)
Attending university	9 (14.3)	19 (24.1)	28 (19.7)
Graduated from university or above	48 (76.2)	44 (55.7)	92 (64.8)
Residential type			
Rented room	18 (28.6)	45 (57.0)	63 (44.4)
Dormitory	43 (68.3)	28 (35.4)	71 (50.0)
Other	2 (3.2)	6 (7.6)	8 (5.6)
Purpose for visiting South Korea			
Studying Korean	10 (15.9)	17 (21.5)	27 (19.0)
International exchange student program	6 (9.5)	2 (2.5)	8 (5.6)
Earning a bachelor's degree	10 (15.9)	23 (29.1)	33 (23.2)
Earning a master's or a doctoral degree	35 (55.6)	35 (44.3)	70 (49.3)
Other	2 (3.2)	2 (2.5)	4 (2.8)

while the most common type for male students was 'dormitory' (43 subjects, 68.3%). Almost half of the students came to Korea to study for a master's degree or doctoral degree (70 subjects, 49.3%).

Anthropometric characteristics

The mean height of all subjects before immigrating to South Korea was 167.7 cm, and their current mean height was 167.2 cm (Table 2). However, the mean weight of subjects before coming to Korea was 60.1 kg, and the current mean weight of subjects was 62.4 kg. We found that there was a statistically significant change in BMI after coming to Korea compared to subjects' previous BMI (21.9 vs. 21.2). Accounting for gender, we investigated a statistically significant change in weight and BMI for male Chinese students, but not for female Chinese international students. We found a significant increase in body

Table 2. Changes in the anthropometric indices of Chinese international students students

Variables	Male (n = 63)			Female (n = 79)			Total (n = 142)		
	In China	In South Korea	t-value	In China	In South Korea	t-value	In China	In South Korea	t-value
	Mean ± SD			Mean ± SD			Mean ± SD		
Body weight (kg)	69.4 ± 13.7	73.9 ± 15.1	-5.1***	52.6 ± 6.9	53.2 ± 6.3	-1.0	60.1 ± 13.4	62.4 ± 15.1	-4.5***
Height (cm)	175.6 ± 6.5	174.3 ± 14.9	0.8	161.4 ± 5.4	161.5 ± 5.5	-2.6*	167.7 ± 9.2	167.2 ± 12.4	0.7
BMI (kg/m^2)	22.4 ± 3.9	23.8 ± 4.4	-4.8***	20.2 ± 2.6	20.4 ± 2.2	0.2	21.2 ± 3.4	21.9 ± 3.7	-4.0***

* P< 0.05, *** P< 0.001 significantly different by paired t-tests

weight (69.4 kg to 73.9 kg) and BMI (22.4 to 23.8) after the students immigrated to South Korea ($P < 0.001$); however, we did not observe any significant change in weight and BMI for female Chinese international students.

When we examined the nutritional status of subjects by gender, the proportion of male obese subjects increased between China and South Korea (17.5% vs. 33.3%) (Table 3). Conversely, the proportion of female obese subjects decreased from 7.6% in China to 2.5% in South Korea. The proportion of normal weight subjects decreased after immigrating to South Korea in male students (57.1% to 42.9%), while the proportion of normal weight subjects increased in female students (64.6% to 74.7%).

Dietary behavior

For the frequency of eating breakfast, the proportion of subjects who answered 'always eat breakfast' decreased from 43.0% in China to 23.2% in South Korea, while subjects who responded 'seldom or never eat breakfast' significantly increased from 25.4% to 46.5% (Table 4). For the number of meals per day, 80.3% of subjects responded that 'they had 3 meals a day' in China, while only 49.3% of subjects said that 'they had 3 meals a day' in South Korea. Additionally, respondents who had ≤ 2 meals a day significantly increased from 14.1% in China to 42.3% in South Korea. For the frequency of meal regularity, 31.7% of the respondents answered that 'they always had a regular meal time' in China, while the proportion decreased to

Table 3. Body mass index of Chinese international students by gender

	Male (n = 63)			Female (n = 79)		
	In China	In South Korea	X^2-value	In China	In South Korea	X^2-value
Underweight (BMI < 18.5)	5 (7.9)	3 (4.8)		20 (25.3)	14 (17.7)	
BMI	17.3 ± 1.8	17.7 ± 0.6		17.6 ± 0.7	17.4 ± 0.5	
Normal weight (BMI 18.5-22.9)	36 (57.1)	27 (42.9)		51 (64.6)	59 (74.7)	
BMI	20.7 ± 1.2	20.8 ± 1.3	4.954^{NS}	20.4 ± 1.4	20.6 ± 1.1	4.307^{NS}
Overweight (BMI 23.0-24.9)	11 (17.5)	12 (19)		2 (2.5)	4 (5.1)	
BMI	23.8 ± 0.6	23.8 ± 0.6		24.0 ± 1.1	23.6 ± 0.8	
Obese (BMI ≥ 25.0)	11 (17.5)	21 (33.3)		6 (7.6)	2 (2.5)	
BMI	29.1 ± 3.6	28.6 ± 4.0		26.6 ± 1.1	27.8 ± 1.8	

n (%) or mean ± SD
BMI; Body mass index
NS; Not statistically significant

Table 4. Changes in the dietary behaviors of Chinese international students

Variables	Male (n = 63)			Female (n = 79)			Total (n = 142)		
	In China	In Korea	X^2-value	In China	In Korea	X^2-value	In China	In Korea	X^2-value
Frequency of eating breakfast									
Always	23 (36.5)	14 (22.2)		38 (48.1)	19 (24.1)		61 (43.0)	33 (23.2)	
Often	18 (28.6)	16 (25.4)	4.507^{NS}	27 (34.2)	27 (34.2)	14.014**	45 (31.7)	43 (30.3)	17.209***
Seldom/Never	22 (34.9)	33 (52.4)		14 (17.7)	33 (41.8)		36 (25.4)	66 (46.5)	
Eating speed									
Slow (> 30 min)	5 (7.9)	3 (4.8)		7 (8.9)	6 (7.6)		12 (8.5)	9 (6.3)	
Normal (15-29 min)	35 (55.6)	32 (50.8)	1.125^{NS}	53 (67.1)	46 (58.2)	1.963^{NS}	88 (62.0)	78 (54.9)	2.773^{NS}
Fast (< 15 min)	23 (36.5)	28 (44.4)		19 (24.1)	27 (34.2)		42 (29.6)	55 (38.7)	
Number of meals/day									
≤ 2 times	16 (25.4)	20 (31.7)		44 (55.7)	25 (31.6)		20 (14.1)	60 (42.3)	
3 times	39 (61.9)	33 (52.4)	14.175**	31 (39.2)	38 (48.1)	21.148***	114 (80.3)	70 (49.3)	31.222***
4 times	8 (12.7)	4 (6.3)		4 (5.1)	8 (10.1)		8 (5.6)	12 (8.5)	
Frequency of meal regularity									
Always	20 (31.7)	11 (17.5)		25 (31.6)	11 (13.9)		45 (31.7)	22 (15.5)	
Often	33 (52.4)	39 (61.9)	3.713^{NS}	38 (48.1)	27 (34.2)	20.025***	71 (50.0)	66 (46.5)	19.726***
Sometimes	4 (6.3)	4 (6.3)		8 (10.1)	12 (15.2)		12 (8.5)	16 (11.3)	
Seldom/Never	6 (9.5)	9 (14.3)		8 (10.1)	29 (36.7)		14 (9.9)	38 (26.8)	
Uniformity of meal size									
Always	14 (22.2)	6 (9.5)		16 (20.3)	10 (12.7)		30 (21.1)	16 (11.3)	
Often	30 (47.6)	37 (58.7)	4.960^{NS}	44 (55.7)	21 (26.6)	25.919***	74 (52.1)	58 (40.8)	21.456***
Sometimes	18 (28.6)	17 (27.0)		17 (21.5)	30 (38.0)		35 (24.6)	47 (33.1)	
Seldom/Never	1 (1.6)	3 (4.8)		2 (2.5)	18 (22.8)		3 (2.1)	21 (14.8)	

** $P < 0.01$, *** $P < 0.001$ significantly different by chi-square tests
NS; Not statistically significant

15.5% in South Korea. Furthermore, the proportion of respondents who seldom or never had regular meal times substantially increased from 9.9% in China to 26.8% in South Korea. The proportion of subjects who 'always had a regular sized meal' was 21.1% before coming to South Korea and decreased to 11.3%.

Dietary pattern

For the frequency of eating vegetables daily, the proportion of subjects who had vegetables three times per day declined from 44.4% in China to 24.6% in South Korea (Table 5). However,

there was a statistically significant increase from 16.2% to 46.5% in the percentage of subjects that had vegetables ≤ 1 time per day. Regarding the frequency of eating fruits daily, 30.3% of respondents had fruits ≥ 3 times per day in China, but only 2.8% of them had fruits ≥ 3 times per day in South Korea. For the weekly frequency of eating bread or instant noodles instead of rice, almost half of the subjects consumed bread or instant noodles ≤ 1 time per week in China, but the proportion of them decreased from 47.9% in China to 29.6% in South Korea. We also observed a statistically significant change in the frequency of fast food consumption. The proportion of subjects who

Table 5. Changes in the food consumption patterns of Chinese international students

Variables	Male (n = 63)			Female (n = 79)			Total (n = 142)		
	Before	After	X^2-value	Before	After	X^2-value	Before	After	X^2-value
Frequency of eating vegetables per day									
≤ 1 time	10 (15.9)	20 (31.7)		13 (16.5)	46 (58.2)		23 (16.2)	66 (46.5)	
2 times	11 (17.5)	21 (33.3)	12.793**	23 (29.1)	14 (17.7)	32.309***	34 (23.9)	35 (24.6)	37.933***
3 times	33 (52.4)	18 (28.6)		30 (38.0)	17 (21.5)		63 (44.4)	35 (24.6)	
≥ 4 times	9 (14.3)	4 (6.3)		13 (16.5)	2 (2.5)		22 (15.5)	6 (4.2)	
Frequency of eating fruits per day									
Almost never eat	13 (20.6)	35 (55.6)		8 (10.1)	16 (20.3)		21 (14.8)	51 (35.9)	
1 time	19 (30.2)	21 (33.3)	25.342***	19 (24.1)	43 (54.4)	38.000***	38 (26.8)	64 (45.1)	56.076***
2 times	13 (20.6)	3 (4.8)		27 (34.2)	20 (25.3)		40 (28.2)	23 (16.2)	
≥ 3 times	18 (28.6)	4 (6.3)		25 (31.6)	0 (0.0)		43 (30.3)	4 (2.8)	
Frequency of eating bread or instant noodles (instead of rice) per week									
< 1 time	28 (44.4)	16 (25.4)		40 (50.6)	26 (32.9)		68 (47.9)	42 (29.6)	
1-2 times	22 (34.9)	22 (34.9)	7.156^{NS}	26 (32.9)	14 (17.7)	22.013***	48 (33.8)	36 (25.4)	25.563***
3-4 times	9 (14.3)	16 (25.4)		12 (15.2)	26 (32.9)		21 (14.8)	42 (29.6)	
≥ 5 times	4 (6.3)	9 (14.3)		1 (1.3)	13 (16.5)		5 (3.5)	22 (15.5)	
Frequency of fast food consumption									
1-2 times/month	32 (50.8)	16 (25.4)		46 (58.2)	35 (44.3)		78 (54.9)	51 (35.9)	
3-4 times/month	22 (34.9)	32 (50.8)	9.535*	28 (35.4)	27 (34.2)	9.068*	50 (35.2)	59 (41.5)	14.407**
2 times/week	6 (9.5)	7 (11.1)		5 (6.3)	13 (16.5)		11 (7.7)	20 (14.1)	
≥ 3 times/week	3 (4.8)	8 (12.7)		0 (0.0)	4 (5.1)		3 (2.1)	12 (8.5)	
Frequency of late-night snack consumption									
≤ 2 times/month	43 (68.3)	15 (23.8)		52 (65.8)	28 (35.4)		95 (66.9)	43 (30.3)	
3-4 times/month	12 (19.0)	22 (34.9)	25.988***	15 (19.0)	22 (27.8)	15.573***	27 (19.0)	44 (31.0)	39.998***
≥ 2 times/week	8 (12.7)	26 (41.3)		12 (15.2)	29 (36.7)		20 (14.1)	55 (38.7)	

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ significantly different by chi-square tests
NS; Not statistically significant

Table 6. Acculturation status of Chinese international students

| Variables	Male (n = 63)	Female (n = 79)	t-value	Total (n = 142)
Korean speaking	2.9 ± 1.0	3.1 ± 0.8	-1.091^{NS}	3.0 ± 0.9
Satisfaction with language program at university	3.3 ± 0.6	3.4 ± 0.9	-1.360^{NS}	3.4 ± 0.8
Contacts with Koreans	3.3 ± 0.9	3.0 ± 0.9	2.115*	3.1 ± 0.9
Participation in meetings with Koreans	3.0 ± 1.1	2.3 ± 1.1	3.539**	2.7 ± 1.2
Participation in social activities for students	2.5 ± 1.1	2.3 ± 1.0	1.043^{NS}	2.4 ± 1.1
Understanding Korean drama and movies	3.1 ± 0.9	3.1 ± 1.0	0.080^{NS}	3.1 ± 1.0
Understanding Korean newspapers	3.0 ± 1.0	2.9 ± 0.9	0.757^{NS}	2.9 ± 1.0
Understanding lectures at university	3.0 ± 0.9	3.0 ± 0.9	-0.062^{NS}	3.0 ± 0.9
Participation in a club or study meetings	2.2 ± 1.1	2.1 ± 1.1	0.918^{NS}	2.1 ± 1.1
Mean acculturation score	2.9 ± 0.6	2.8 ± 0.6	1.171^{NS}	2.9 ± 0.6

Mean ± SD
* $P < 0.05$, ** $P < 0.01$ significantly different by independent t-tests
NS; Not statistically significant

consumed fast food 2 times per week increased from 7.7% before immigrating to 14.1% after immigrating to South Korea. In addition, 2.1% of subjects who consumed fast food ≥ 3 times per week in China increased to 8.5% in South Korea. Similarly, for the frequency of late-night snack consumption, the proportion of respondents consumed late-night snacks ≥ 2 times per week increased from 14.1% in China to 38.0% in South Korea.

Acculturation

The mean acculturation score of all subjects was 2.9, which shows a reasonably bicultural acculturation (Table 6). Male Chinese international students had a higher mean acculturation score than female students (2.9 vs. 2.8), but the difference was not significant. More specifically, for contacts with Koreans, male students had a higher mean score than female students (3.3 vs. 3.0). Additionally, for participation in meetings with Koreans, the mean score was higher in males than in females (3.0 vs. 2.3). The groups did not show any significant difference in the other components: Korean speaking ability, satisfaction with language programs at the university, participation in social activities for students, understanding Korean dramas and movies, understanding Korean newspapers, understanding lectures at the university, and participation in a club or study meetings. For the frequency of eating out, the proportion of subjects who responded '≥ 2 times/week' significantly increased from 43.8% for the subjects who seldom or never participated in meeting with Koreans to 59.4% for the subjects who always or often
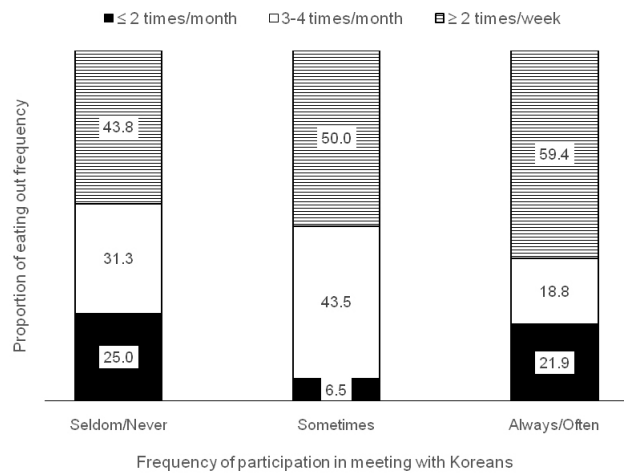
Fig. 1. Proportion of eating out frequency by participation in meeting with Koreans

participated ($P < 0.05$) (Fig. 1). We also found highly acculturated group consumed more frequently bread and instant noodles compared with less acculturated group ($P < 0.05$) (Table 7).

Predictors of overweight and obese Chinese students compared to normal weight subjects

We observed that overweight and obese subjects were more likely to be male and be of a higher acculturation group

Table 7. Changes in the food consumption patterns of Chinese international students

Variables	Low acculturation (n = 78)	High acculturation (n = 64)	X^2-value
Frequency of eating vegetables per day			
≤ 1 time	33 (42.3)	33 (51.6)	
2 times	20 (25.6)	15 (23.4)	1.66[NS]
3 times	22 (28.2)	13 (20.3)	
≥ 4 times	3 (3.8)	3 (4.7)	
Frequency of eating fruits per day			
Almost never eat	29 (37.2)	22 (34.4)	
1 time	33 (42.3)	31 (48.4)	2.80[NS]
2 times	15 (19.2)	8 (12.5)	
≥ 3 times	1 (1.3)	3 (4.7)	
Frequency of eating bread or instant noodles (instead of rice) per week			
< 1 time	31 (39.7)	11 (17.2)	
1-2 times	16 (20.5)	20 (31.3)	9.50*
3-4 times	22 (28.8)	20 (31.3)	
≥ 5 times	9 (11.5)	13 (20.3)	
Frequency of fast food consumption			
1-2 times/month	29 (37.2)	22 (34.4)	
3-4 times/month	32 (41.0)	27 (42.2)	0.34[NS]
2 times/week	10 (12.8)	10 (12.8)	
≥ 3 times/week	9 (9.0)	7 (9.0)	
Frequency of late-night snack consumption			
≤ 2 times/month	23 (29.5)	20 (31.3)	
3-4 times/month	20 (25.6)	24 (37.5)	3.32[NS]
≥ 2 times/week	35 (44.9)	20 (31.3)	

* *P* < 0.05 significantly different by chi-square tests
NS; Not statistically significant

Table 8. Predictors of overweight and obese Chinese students (n = 39) compared to normal-weight subjects (n = 86)

Variables	Adjusted OR (95% CI)
Age (yrs)	
< 25	1.00
≥ 25	2.56 (0.73, 9.07)
Gender	
Male	1.00
Female	0.03 (0.01, 0.15)***
Length of residence in Korea (yrs)	
< 2	1.00
≥ 2	1.04 (0.30, 3.60)
Frequency of eating breakfast	
Always	1.00
Often	1.86 (0.32, 10.81)
Seldom/Never	1.14 (0.18, 7.23)
Number of vegetable consumed per day	
≤ 1 time	1.00
2 times	0.10 (0.02, 0.55)
3 times	0.36 (0.05, 2.45)
≥ 4 times	0.12 (0.01, 2.23)
Frequency of eating fruits per day	
Almost never eat	1.00
1 time	0.24 (0.05, 1.13)
2 times	1.39 (0.24, 8.08)
≥ 3 times	0.20 (0.01, 4.07)
Acculturation[1]	
< 3	1.00
≥ 3	6.33 (1.99, 20.11)**
Sleeping time	
≤ 12:00 midnight	1.00
> 12:00 midnight	0.47 (0.10, 2.19)

[1] Mean acculturation score
** $P < 0.01$, *** $P < 0.001$ significantly different according to the logistic regression model

compared with normal weight subjects (Table 8). There was no significant association between overweight subjects and other explanatory factors, such as age, length of residence in South Korea, eating breakfast, consumption of vegetables and fruits and sleeping time.

DISCUSSION

We conducted this study to examine changes in the dietary behavior, anthropometric characteristics and food consumption patterns of Chinese international students before and after immigrating to South Korea. The total number of study subjects was 142 Chinese international students, including 63 male students and 79 female students. To summarize the results of this study, we found that Chinese international students practiced unhealthier dietary behaviors when they lived in South Korea compared to when they lived in China. We found that there was a decrease in the frequency of eating breakfast, meal time regularity and the uniformity of meal size after Chinese international students immigrated to South Korea. In addition, we observed that there was an increase in study subjects' eating

speed and their tendency to skip meals while they lived in South Korea compared to when they lived in China. Weight and BMI for male Chinese students significantly increased in South Korea compared to those in China, but there was no significant difference in female subjects. Different food environments between China and Korea would result in a change in dietary behaviors before and after studying abroad for Chinese international students.

In this research, after the study subjects immigrated to South Korea, there was a significant increase in the frequency of the consumption of fast food, processed foods, and late-night snacks. The number of convenience stores in South Korea has increased remarkably from 12,000 in 2009 to 23,000 stores in 2013, a 90% increase [23]. Convenience stores sell diverse types of ready-to-eat meals and instant food, such as instant noodles, dried seaweed rolls, fish cake soup, fried chicken and hamburgers. Instant food is appealing to university students due to its easy access, taste and relatively low cost, although overconsumption of instant food can result in weight gain, leading to obesity [24]. When Xu *et al.* [25] examined the exposure to fast-food restaurants and weight changes, they found that the number of Western fast-food restaurants was positively associated with increases in the waist-to-hip and waist-to-height ratio of the rural Chinese population. Additionally, late-night meal delivery services are readily available in the area around universities and are also popular among university students in South Korea. Late-night snacking increases calorie consumption and contains low quantities of micronutrients, such as vitamins and minerals [26]. This finding implies that a nutrition intervention is urgently needed to reduce the prevalence of overweight and obese male Chinese international students in South Korea. Given the suggestive associations between changes in the dietary behaviors, food environments and weight changes in male Chinese international students, health professionals would be well advised to monitor the growth of convenience stores, fast-food restaurants and late night food delivery services and examine their implications in future studies.

Chinese international students showed an increase in skipping meals, eating speed, and eating at irregular times and a decrease in the frequency of fruit and vegetable consumption after migration to South Korea. Unhealthy eating habits and unhealthy dietary patterns were more common among Chinese students after migration than before migration. This unfavorable diet change could result from living away from their parents' homes [27]. Without establishing healthy eating habits when they lived with their parents, migration to a new environment could worsen students' eating habits due to a lack of knowledge, cooking skills, and self-efficacy. Another explanation for these dietary changes may be the limited budget of international students and fruits and vegetables that are more expensive in the host country than in their home country [28]. Taking the independent lifestyle of international students into consideration, nutrition interventions may be critical to guide students in making their own healthy eating decisions for long-term nutrition.

Contrary to our expectations, there was no significant association between migration and weight in female Chinese international students. One possible explanation is that female

students have adopted diet behavior changes influenced by mass-media and peer-pressure rather than the food environment. Lim [8] reported that Chinese female international students felt that Korean female university students paid too much attention to their physical appearance. Previous research shows that even if most female college students were categorized as underweight or normal weight, 93% of subjects wanted to be underweight [29]. The gap between the real and ideal BMI negatively affects the self-esteem of the female college students [30]. The findings of this study also show that the prevalence of being overweight and obese significantly increased for male Chinese students after migrating to South Korea, but not for female Chinese students. When each variable of the acculturation index was closely examined, we found that the mean score of 'contact with Koreans' and 'participation in meeting with Koreans' was significantly higher for Chinese male students than for Chinese female students. Social relationships with more Koreans could give Chinese male students more opportunities to eat out. When eating out, restaurants usually provide energy-dense foods and large portion sizes [31]. Without control over their overconsumption of high calorie foods, this could result in weight gain and obesity.

The limitations of this research include the absence of information on individual ethnicity. Asano *et al*. [32] reported that Han Chinese female married immigrants did not show any statistically significant difference in food intake, dietary habits and dietary acculturation compared with the Korean-Chinese subjects after immigration to South Korea. The ethnicity of Chinese international students may differently affect dietary habits, acculturation and anthropometric parameters due to dissimilar food availability and accessibility. We could not investigate any changes in dietary practice and anthropometric characteristics by ethnicity, however, because of the absence of individual ethnicity information. Accordingly, we need to conduct a further study to examine the impact of acculturation on diet and anthropometric measures among ethnic groups. This will provide useful information to design a nutrition intervention program.

A previous study indicated that Chinese students would be more satisfied with diverse menus and cooking methods for international students and better nutritional value in meals served by schools [18,31]. Guo *et al*. [33] suggested that nutrition education focused on individual energy needs and food exchange units to improve knowledge of nutrition, dietary attitude and intake in South Korea would be effective for Chinese college students. Taking into account the rapid increase of Chinese international students as one of the most nutritionally vulnerable groups, it is urgent to take action to intervene in their nutritional problems. First, for those who use a school cafeteria, menus could be offered with the dishes written in English or in their own language, with the nutritional value of the dishes displayed; additionally, a special event, such as a 'Chinese day', could be organized to serve Chinese cuisine. Second, for those who live in a dormitory, it would be very useful to provide a kitchen equipped with gas, cooking utensils, and a refrigerator. This would increase the opportunity for international students to cook healthier meals in a dormitory. Third, it would be advantageous to offer nutrition education

to Chinese international students. Nutrition education would include information on how to make healthier choices when eating out, how to read the nutritional labels of processed foods, and so on. It is important to support Chinese international students in keeping healthful dietary habits from their own country and to encourage them to adopt dietary behaviors that are nutritionally sound in a new food environment.

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