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Energy intake from commercially-prepared meals by food source in Korean adults: Analysis of the 2001 and 2011 Korea National Health and Nutrition Examination Surveys

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BACKGROUND/OBJECTIVES: The commercial foodservice industry in Korea has shown rapid growth recently. This study examined Korean adults' consumption of commercially-prepared meals based on where the food was prepared.

SUBJECTS/METHODS: Data from a 24-hour dietary recall of the 2001 and 2011 Korea National Health and Nutrition Examination Surveys were analyzed. A total of 10,539 subjects (n = 6,152 in 2001; n = 4,387 in 2011) aged 19-64 years were included for analysis. Commercially-prepared meals were classified into four food source groups based on where the food was prepared: Korean restaurants, Chinese/Western/Japanese restaurants, fast-food restaurants, and retail stores. Subjects' energy intake, including the amount and proportion of calories, was examined for each food source. The analysis was also conducted by gender for age-stratified groups: 19-29, 30-49, and 50-64 years old.

RESULTS: Korean adults' energy intake from commercially-prepared meals increased in the amount of calories (551 kcal to 635 kcal, $P < 0.01$), but not in the proportion of daily calories (27% to 28%) from 2001 to 2011. The most frequent food source of commercially-prepared meals was Korean restaurants in both years. The amount and proportion of calories from retail stores increased from 83 kcal to 143 kcal ($P < 0.001$) and from 4% to 7% ($P < 0.001$), respectively, during the same period. Males aged 30-49 years (34%) and females aged 19-29 years (35%) consumed the highest proportion of daily calories from commercially-prepared meals in 2011.

CONCLUSIONS: Korean adults consumed about one-fourth of their energy intake from commercially-prepared meals. In particular, males aged 30-49 years and females aged 19-29 years consumed more than one-third of their energy intake from commercially-prepared meals. Korean restaurants played a significant role in Korean adults' energy intake. Retail stores increased influence on Korean adults' energy intake. These results could be useful for developing health promotion policies and programs.

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INTRODUCTION

The proportion of eating out in Korean diet has gradually increased over the past 30 years. The foodservice industry has experienced a seven-fold growth over 25 years from 10 billion US dollars (11 trillion Korean won) in 1986 to 70 billion US dollars (77 trillion Korean won) in 2012 [1]. With this growth, the frequency of consuming food prepared outside the home and the usage of foodservice facilities among Koreans also increased. About one in three Koreans consumed meals outside the home at least once per day in 2013 [2].

Increased consumption of food prepared outside the home has prompted concerns about its effects on the nutrition and health status of Koreans. In particular, eating out may be related with increased prevalence of obesity among Korean adults, which exceeded 30% in 2005 [3-5]. Further, rapid changes in the demographic environment of Korea, such as the aging population and a growing number of single-person households, have attracted attention from researchers in various fields, including public health and nutrition [6,7]. Reflecting these demographic changes, the scope of the current research on eating out has become broader, covering the social, economic, and cultural aspects of eating out using an interdisciplinary approach [8,9].

Quite a few studies have been conducted on eating out among Koreans using data from the Korea National Health and Nutrition Examination Survey (KNHANES). However, to date, research on eating out conducted in Korea has only dealt with the difference between eating outside the home and eating at home, and thus eating out in the majority of research has included meals from both institutional and commercial foodservices [10-13]. In Western countries where the foodservice industry is more developed, studies focusing on commercial foodservices have been conducted since the early 2000s [14-17].

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A number of studies have further explored commercial foodservices by dividing the category into sub-areas such as full-service restaurants, fast-food restaurants, and retail-food stores [18-21].

Given the rapid changes in the area of commercial foodservice in Korea over the past decades, in-depth studies exploring commercial foodservices are urgently needed. Few studies have examined differences in food consumption among various sources of commercially-prepared meals in Korea. While much is known about consumption of commercially-prepared meals in Western countries, far less is known about these sub-areas in Korea.

The purpose of this study was to examine Korean adults' consumption of commercially-prepared meals based on the food source with a focus on energy intake in 2001 and 2011. Investigation of energy intake from commercially-prepared meals based on the food source will provide more in-depth understanding of eating out among Korean adults. Examining changes over the 10-year period may also provide additional insights that public health agencies could use to formulate policies and programs to improve Korean adults' nutrition and health status.

SUBJECTS AND METHODS

Data source and study subjects

The present study analyzed individuals' dietary intake data from a 24-hour dietary recall of the 2001 and 2011 KNHANES. KNHANES, a nationwide cross-sectional survey using multistage stratified cluster sampling, provides data for a representative sample of the Korean population. The 2011 KNHANES was approved by the Institutional Review Board (IRB) of Korea Centers for Disease Control and Prevention (KCDC) (IRB approval number: 2011-02CON-06-C). KCDC IRB approval is inapplicable to the 2001 KNHANES since the surveys conducted in 2007 and thereafter received KCDC IRB approval.

KNHANES data were available for the years 1998, 2001, 2005, 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014 at the time of this study. We used the 2001 and 2011 dietary intake data after considering events that may have influenced the foodservice industry and thus consumption of food prepared outside the home. These events were the 1997-98 Korean financial crisis and the Master Plan for Food Service Industry Promotion established in 2012, and therefore we chose the year after 1998 and prior to 2012.

Among a total of 17,672 individuals, we selected 10,572 adults aged 19-64 years. Exclusion of those with invalid data for 'occasions for food consumption' or 'places of food preparation' resulted in 10,539 subjects, consisting of 6,152 subjects from the 2001 data and 4,387 from the 2011 data. Those who were excluded were having missing data (n = 18) or two different places of food preparation for one meal occasion (n = 25).

Along with the dietary intake data, the sociodemographic data including gender, age, residential area, household income, education, employment status, and marital status were analyzed. Chung *et al*. [10] reported that gender, age, residential area, employment status, and marital status were factors that may influence the frequency of eating out in Korean adults. Household income and education were also added since they have been considered the main dimensions of socioeconomic status in other dietary studies [22,23].

The subjects were divided into three age groups in accordance with the age brackets used in the Dietary Reference Intakes for Koreans 2015: 19-29, 30-49, and 50-64 years old [24]. Those living in urban areas (city, *dong*) were distinguished from those in rural areas (town, *eup/myeon*). Household income was calculated based on monthly household income and then categorized into quartiles from lowest to highest.

Education, employment status, and marital status were reclassified due to the differences in the population segmentation for those criteria between the two surveys conducted in 2001 and 2011. Regarding education, the subjects were grouped into three groups of middle school, high school, and college graduates or above. The unemployed included housewives, students, and soldiers. Marital status was divided into two categories of married and unmarried, and the married included subjects who were separated, divorced, and widowed as well as subjects who lived with their spouses, as categorized in the 2011 survey.

Definition of commercially-prepared meals and classification of food sources

We used the principal term 'commercially-prepared meals' throughout the present study. We imposed three criteria to carefully define the term: the place of food preparation, the purpose of food provision, and the occasion of food intake. Thus, a commercially-prepared meal was defined as 'food prepared outside the home, provided in pursuit of profit, and consumed as a meal, regardless of where the food was eaten' in this study.

Based on the definition, commercially-prepared meals comprise both meals prepared and purchased at restaurants and meals purchased at stores. Restaurant meals include those eaten-in at restaurants, carried-out from restaurants, and delivered to home, worksites, or other places where the food was eaten [17]. Store meals include store-bought foods that are fully store-prepared at purchase as well as that are heated at home or other places where the food was eaten [25]. For example, ready-to-eat/heat meals purchased at supermarkets and packed meals [*dosirak*] purchased at convenience stores are regarded as store meals.

The term 'food source' is a dual concept and thus may indicate different meanings depending on the study. Some studies have used food source in identifying the type of facility where the food was prepared (e.g., home, worksites, and restaurants) [5,26,27]. However, a few studies have used food source interchangeably with food group in investigating the dietary intake based on the type of food or dish (e.g., pizza, pasta, *ramyeon*, and *gimbap*) [20,28]. The present study defined food source as 'the specific place where the food was prepared'.

In the dietary data from KNHANES, each consumed food was assigned a code among 20 food source codes under the variable name N_MTYPE. We classified those items into six food source categories: home, Korean restaurants, Chinese/Western/Japanese restaurants, fast-food restaurants, retail stores, and institutions (Table 1). Among the six food sources, Korean restaurants, Chinese/Western/Japanese restaurants, fast-food restaurants, and retail stores composed the food sources for

Table 1. Classification of food sources

Food source[1)]	Code[2)]	Description of food included in each food source
Home	1	Food prepared at home
	2	Packaged meals prepared at home
	3	Food prepared at someone else's home (e.g., neighbors and relatives)
Korean restaurants[3)]	4	Packaged meals prepared at and delivered by commercial vendors
	5	Food prepared and purchased at Korean restaurants
Chinese/Western/Japanese restaurants[3)]	6-8	Food prepared and purchased at Chinese restaurants (6), Western-style restaurants (7), or Japanese restaurants (8)
Fast-food restaurants[3)]	9	Food prepared and purchased at fast-food restaurants
	11	Food prepared and purchased at snack bars
Retail stores[3)]	10	Instant food (e.g., instant noodles [*ramyeon*]) purchased at stores
	12	Bread or packaged snacks (e.g., cookies, chips, and crackers) purchased at stores
	13	Other food purchased at stores
Institutions	14-17	Food prepared at and provided by schools (14), worksites (15), childcare centers or preschools (16), or senior centers (17)
	18	Food prepared at and provided through free meal services
	19	Food prepared at and provided by religious communities (e.g., temples and churches)
	20	Food prepared at other institutions

[1)] Places where food was prepared
[2)] Code assigned to each consumed food for the place of preparation under the variable name N_MTYPE in the dietary intake data from the Korea National Health and Nutrition Examination Survey
[3)] Food sources for commercially-prepared meals

commercially-prepared meals. In the present study, we performed analyses focusing on these four food sources of commercially-prepared meals other than Home or Institutions.

Retail stores, including supermarkets, convenience stores, and specialty food stores, were included among the food sources for commercially-prepared meals in this study. They have been established as extended areas of commercial foodservices in a previous study [29]. These places provide ready-to-eat/heat foods including, but not limited to, instant food (e.g., instant noodles [*ramyeon*]), bread, and packaged snacks.

Data analysis

Statistical analyses were performed using SPSS (version 22.0; IBM Corp., Armonk, NY, USA). The KNHANES data were collected using a complex sampling design in both 2001 and 2011. We performed complex samples procedures by adopting stratification, clustering, and sample weight variables. In addition, time-series weight incorporating the 2005 projected Korea standard population estimates was used since we combined two data sets from the 2001 and 2011 surveys, which belonged to the separate phases of KNHANES I and V, respectively.

We calculated the percentage of subjects who consumed commercially-prepared meals at least once per day and examined their distribution by sociodemographic characteristics. We analyzed subjects' consumption frequency of commercially-prepared meals by food source as well as subjects' energy intake from commercially-prepared meals by food source in terms of calorie amount and calorie share. Calorie share was calculated by dividing calorie amount from a specific food source by daily total energy intake. We also conducted analyses by gender for age-stratified groups.

The results were reported as numbers (n), weighted percentages, mean values, and standard errors (SE). The difference between the years 2001 and 2011 was tested for statistical significance using χ^2 test or analysis of covariance (ANCOVA) with gender, age, residential area, household income, education, employment status, and marital status as covariates.

RESULTS

Sociodemographic characteristics of study subjects

Table 2 presents the distribution of study subjects by sociodemographic characteristics. There was no observed difference in

Table 2. Sociodemographic characteristics of study subjects

Characteristics	2001 (n = 6,152)	2011 (n = 4,387)	*P*-value[1)]
Gender			
Male	2,888 (50.6)[2)]	1,792 (50.7)	0.940
Female	3,264 (49.4)	2,595 (49.3)	
Age, yrs			
19-29	1,361 (28.4)	642 (22.3)	
30-49	3,395 (51.3)	2,078 (49.8)	< 0.001
50-64	1,396 (20.3)	1,667 (27.8)	
Residential area			
Urban	4,941 (82.8)	3,684 (83.3)	0.873
Rural	1,211 (17.2)	703 (16.7)	
Household income (n = 5,801, 4,339)[3)]			
1st quartile (lowest)	970 (17.4)	404 (9.4)	
2nd quartile	1,456 (25.7)	1,183 (29.3)	< 0.001
3rd quartile	1,554 (27.6)	1,385 (32.1)	
4th quartile (highest)	1,821 (29.4)	1,367 (29.2)	
Education (n = 6,145, 4,012)[3)]			
Middle school	1,623 (25.0)	977 (20.7)	
High school	2,425 (40.8)	1,563 (42.7)	0.007
College or above	2,097 (34.1)	1,472 (36.7)	
Employment status (n = 6,141, 4,011)[3)]			
Employed	3,896 (63.3)	2,581 (68.5)	< 0.001
Unemployed	2,245 (36.7)	1,430 (31.5)	
Marital status (n = 6,151, 4,371)[3)]			
Married	4,969 (75.3)	3,634 (75.0)	0.845
Unmarried	1,182 (24.7)	737 (25.0)	

Data were analyzed using the complex samples module.
[1)] By chi-square test
[2)] n (weighted %)
[3)] Different from the total number of subjects due to missing data

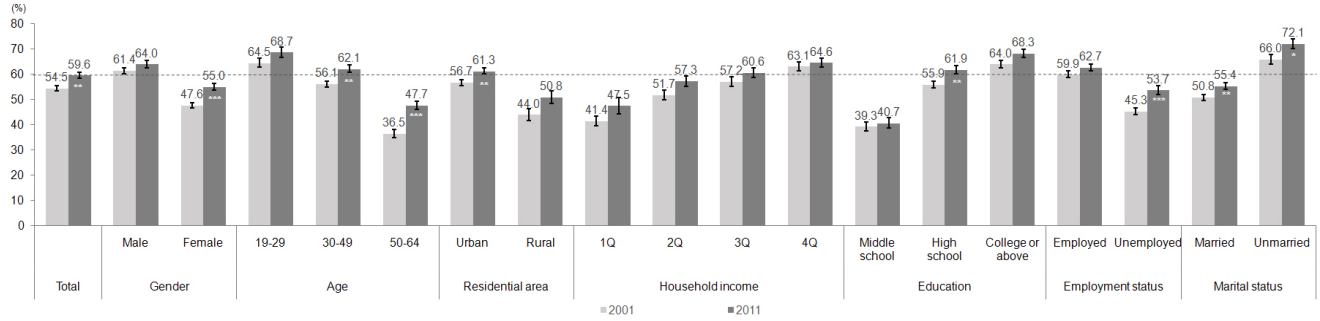

Fig. 1. Percentages of Korean adults who consumed commercially-prepared meals at least once per day by sociodemographic characteristics in 2001 and 2011. Data were analyzed using the complex samples module. Significant change between 2001 and 2011 at * $P<0.05$, ** $P<0.01$, or *** $P<0.001$, by chi-square test

Table 3. Korean adults' consumption frequency of commercially-prepared meals by food source in 2001 and 2011

Food source	Year[1)]	None	Once	Twice	Three times	*P*-value[2)]
Korean restaurants	2001	4,018 (64.8)[3)]	1,616 (26.5)	467 (7.9)	51 (0.8)	0.192
	2011	2,823 (63.1)	1,230 (29.0)	301 (7.1)	33 (0.8)	
Chinese/Western/Japanese restaurants	2001	5,679 (92.0)	453 (7.6)	20 (0.4)	0 (0.0)	0.593
	2011	4,077 (92.1)	301 (7.7)	9 (0.2)	0 (0.0)	
Fast-food restaurants	2001	5,691 (92.1)	432 (7.4)	29 (0.5)	0 (0.0)	< 0.001
	2011	4,186 (95.1)	190 (4.5)	11 (0.4)	0 (0.0)	
Retail stores	2001	5,379 (86.6)	664 (11.6)	98 (1.6)	11 (0.2)	< 0.001
	2011	3,435 (78.2)	832 (19.0)	112 (2.6)	8 (0.2)	

Data were analyzed using the complex samples module.
1) The sample size was 6,152 in 2001 and 4,387 in 2011 from the 24-hour dietary recall data of the Korea National Health and Nutrition Examination Surveys in respective years.
2) By chi-square test
3) n (weighted %)

the distribution of study subjects in terms of gender, residential area, or marital status between 2001 and 2011. Males comprised about half of the study subjects. Approximately, four in five appeared to be urban residents, and three in four were married. The 30-49 year-old group accounted for about half of the subjects in both 2001 and 2011, although the age composition of the subjects differed between these years ($P < 0.001$). The distribution of the subjects also differed between the years in terms of employment status ($P < 0.001$) along with household income ($P < 0.001$) and education ($P < 0.01$).

Proportion of Korean adults consuming commercially-prepared meals

The percentage of Korean adults having consumed commercially-prepared meals at least once per day was about 60% in 2011 with a significant increase from 2001 (55%, $P < 0.01$). Korean adults who were males, 19-29 years old, urban residents, earners falling into the fourth quartile of household income, graduates from college or above, employed, or unmarried more tended to consume commercially-prepared meals. The percentages of Korean adults having consumed commercially-prepared meals significantly increased between 2001 and 2011 among those who were females ($P < 0.001$), 30-49 or 50-64 years old ($P < 0.01$ and $P < 0.001$, respectively), urban residents ($P < 0.01$), high school graduates ($P < 0.01$), unemployed ($P < 0.001$), or both married and unmarried ($P < 0.01$ and $P < 0.05$, respectively) (Fig. 1).

Consumption frequency of commercially-prepared meals by food source

Table 3 shows Korean adults' consumption frequency of commercially-prepared meals by food source. More than one-third (35% to 37%) of Korean adults consumed their meals at Korean restaurants at least once per day in both 2001 and 2011. The distribution of Korean adults' consumption frequency significantly differed in the categories of retail stores and fast-food restaurants between 2001 and 2011. In particular, a prominent change was observed in the retail stores category. The percentage of Korean adults who ate meals prepared at retail stores substantially increased from 2001, nearly doubling to 22% in 2011 ($P < 0.001$). In contrast, Korean adults who ate at fast-food restaurants decreased almost by half, with only 5% of Korean adults having eaten their meals prepared at fast-food restaurants in 2011 ($P < 0.001$).

Calorie share by food source

Commercially-prepared meals constituted 27% and 28% of the daily energy intake of Korean adults in 2001 and 2011, respectively. The calorie share of meals prepared at Korean restaurants was 16% in 2001 and 17% in 2011, making up more than half of the commercially-prepared meals in both years (Fig. 2).

Although the calorie share of commercially-prepared meals did not differ in total between 2001 and 2011, there were substantial changes in both retail stores and fast-food restaurants between the two years. The calorie share of meals prepared at retail stores was 7% in 2011, increasing from 4% in 2001

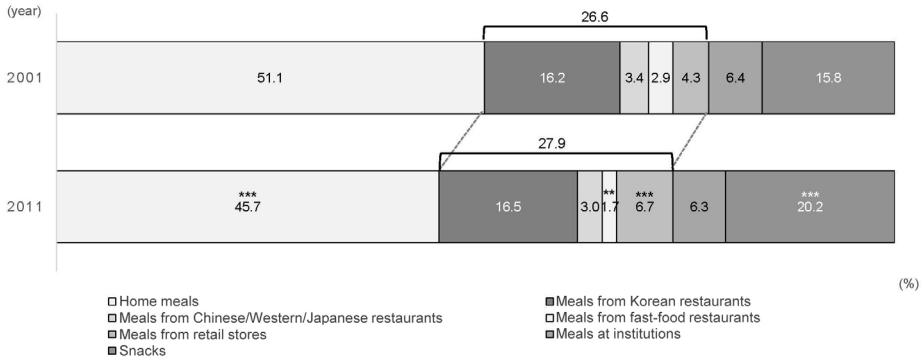

Fig. 2. Calorie share by food source among Korean adults in 2001 and 2011. The number above each bar is the calorie share of commercially-prepared meals. Each calorie share was obtained by dividing the energy intake from the respective food source by daily total energy intake. Total percentages may not be equal to 100% due to rounding. Data were analyzed using the complex samples module. Significant change between 2001 and 2011 at ** $P < 0.01$ or *** $P < 0.001$, by ANCOVA with gender, age, residential area, household income, education, employment status, and marital status as covariates

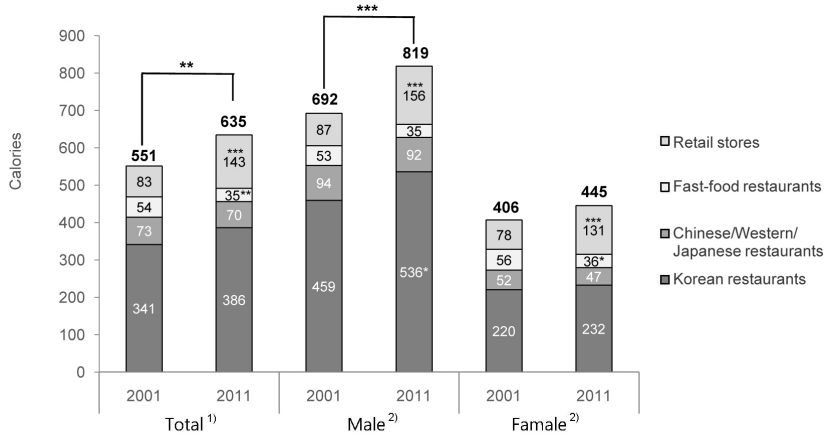

Fig. 3. Calorie amount from commercially-prepared meals by food source among Korean adults in 2001 and 2011. The number at the top of each bar is the total calorie amount from commercially-prepared meals. Data were analyzed using the complex samples module. [1] Significant change between 2001 and 2011 at ** $P < 0.01$ or *** $P < 0.001$, by ANCOVA with gender, age, residential area, household income, education, employment status, and marital status as covariates, [2] Significant change between 2001 and 2011 at * $P < 0.05$ or *** $P < 0.001$, by ANCOVA with age, residential area, household income, education, employment status, and marital status as covariates

($P < 0.001$). In contrast, the calorie share of meals prepared at fast-food restaurants decreased from 2001 to 2011 and remained the lowest (from 3% to 2%, $P < 0.01$).

Additionally, a significant increase from 2001 to 2011 was detected in calorie share of snacks (from 16% to 20%, $P < 0.001$).

Calorie amount and calorie share from commercially-prepared meals by food source

Fig. 3 shows the calorie amounts of commercially-prepared meals in Korean adults' daily energy intake by food source. The calorie amounts from all sources of commercially-prepared meals significantly increased from 551 kcal in 2001 to 635 kcal in 2011 ($P < 0.01$). Among those calories, Korean adults consumed 341 kcal and 386 kcal from Korean restaurants in 2001 and 2011, respectively. It is notable that the calorie amount from retail stores substantially increased from 83 kcal in 2001 to 143 kcal in 2011 ($P < 0.001$), whereas those from fast-food restaurants decreased from 54 kcal to 35 kcal ($P < 0.01$).

An increase in calorie amount from commercially-prepared meals was observed between 2001 and 2011 in males, who consumed 819 kcal from commercially-prepared meals in 2011 with a significant increase from 692 kcal in 2001 ($P < 0.001$). Females consumed 445 kcal in 2011 from commercially-prepared meals and 406 kcal in 2001, but the difference was not statistically significant.

Table 4 presents the analysis results of calorie amount and calorie share of commercially-prepared meals consumed by Korean adults by food source and age-stratified gender group. In 2011, the highest calorie share from commercially-prepared meals was detected in males aged 30-49 years (34%) and females aged 19-29 years (35%). On average, these groups consumed 908 kcal and 641 kcal, respectively, from commercially-prepared meals. In particular, males aged 30-49 years showed a significant increase in calorie amount from commercially-prepared meals from 731 kcal in 2001 to 908 kcal in 2011 ($P < 0.001$).

The calorie share of meals prepared at Korean restaurants was the highest across age groups for both genders in 2001 and 2011. The most significant increase between the years was observed in the calorie amount from retail stores. Especially, the 19-29 year-old groups for both genders consumed the most calories from retail stores; males and females aged 19-29 years consumed averages of 214 kcal and 213 kcal in 2011, increasing

Table 4. Calorie amount and calorie share from commercially-prepared meals by food source among Korean adults by gender-age group in 2001 and 2011

	Total subjects			Male			Female		
	2001	2011	*P*-value[1]	2001	2011	*P*-value[2]	2001	2011	*P*-value[2]
Aged 19-29 yrs, n	1,361	642		614	256		747	386	
Calorie amount, kcal (Calorie share, %)									
Korean restaurants	337.5 ± 21.4 (17.1)[3]	364.8 ± 33.0 (16.0)	0.831	424.2 ± 35.2 (19.8)	443.4 ± 52.2 (17.0)	0.485	246.6 ± 20.5 (14.2)	280.4 ± 33.9 (14.7)	0.782
Chinese/Western/ Japanese restaurants	97.1 ± 10.4 (4.8)	88.3 ± 13.6 (4.1)	0.560	118.9 ± 17.5 (5.0)	102.3 ± 24.6 (4.0)	0.653	74.2 ± 10.8 (4.5)	73.4 ± 13.1 (4.3)	0.766
Fast-food restaurants	112.8 ± 10.6 (6.0)	79.0 ± 13.5 (3.9)	0.043	112.3 ± 13.6 (5.6)	82.8 ± 22.4 (3.6)	0.196	113.2 ± 13.6 (6.4)	75.1 ± 13.3 (4.3)	0.093
Retail stores	123.8 ± 11.3 (6.5)	213.4 ± 24.1 (10.3)	0.001	131.3 ± 16.0 (6.0)	214.2 ± 33.3 (8.5)	0.007	116.0 ± 14.2 (7.1)	212.5 ± 33.0 (12.1)	0.023
Total	671.2 ± 27.1 (34.3)	745.6 ± 40.9 (34.2)	0.397	786.7 ± 40.6 (36.4)	842.6 ± 62.8 (33.1)	0.874	550.0 ± 26.7 (32.2)	641.4 ± 46.8 (35.4)	0.281
Aged 30-49 yrs, n	3,395	2,078		1,633	833		1,762	1,245	
Calorie amount, kcal (Calorie share, %)									
Korean restaurants	386.6 ± 13.7 (17.6)	416.9 ± 18.9 (17.4)	0.526	523.2 ± 19.3 (22.1)	598.6 ± 31.1 (22.1)	0.142	244.9 ± 13.8 (12.8)	288.1 ± 14.8 (12.6)	0.302
Chinese/Western/ Japanese restaurants	75.6 ± 6.4 (3.3)	80.4 ± 7.8 (3.1)	0.726	98.5 ± 10.2 (4.0)	113.1 ± 13.1 (4.0)	0.388	52.0 ± 6.0 (2.6)	46.4 ± 7.1 (2.2)	0.352
Fast-food restaurants	38.3 ± 3.2 (2.0)	32.5 ± 4.0 (1.5)	0.097	32.7 ± 4.1 (1.4)	28.8 ± 5.0 (1.3)	0.936	44.0 ± 4.2 (2.6)	36.3 ± 6.5 (1.8)	0.026
Retail stores	73.2 ± 6.9 (3.6)	145.8 ± 11.3 (6.6)	< 0.001	76.8 ± 8.8 (3.4)	167.6 ± 20.5 (6.1)	< 0.001	69.6 ± 7.6 (3.8)	123.2 ± 9.3 (7.0)	0.001
Total	573.7 ± 17.4 (26.4)	675.6 ± 23.8 (28.6)	0.013	731.1 ± 22.7 (30.8)	908.0 ± 37.3 (33.5)	0.001	410.5 ± 17.4 (21.8)	434.0 ± 19.1 (23.6)	0.829
Aged 50-64 yrs, n	1,396	1,667		641	703		755	964	
Calorie amount, kcal (Calorie share, %)									
Korean restaurants	230.7 ± 17.1 (11.3)	347.9 ± 20.7 (15.4)	0.001	341.4 ± 27.3 (15.5)	497.9 ± 34.5 (19.3)	0.001	123.9 ± 13.4 (7.4)	201.9 ± 14.2 (11.5)	0.036
Chinese/Western/ Japanese restaurants	33.6 ± 6.1 (1.6)	35.5 ± 5.5 (1.8)	0.876	44.1 ± 10.3 (2.0)	43.6 ± 8.1 (2.0)	0.753	23.5 ± 5.6 (1.2)	27.6 ± 5.2 (1.6)	0.753
Fast-food restaurants	12.7 ± 2.9 (0.7)	5.6 ± 2.3 (2.3)	0.014	18.8 ± 4.8 (1.0)	6.5 ± 4.2 (0.2)	0.025	6.7 ± 3.3 (0.4)	4.8 ± 2.1 (0.3)	0.456
Retail stores	48.4 ± 7.0 (2.8)	82.7 ± 9.2 (4.0)	0.044	47.7 ± 10.3 (2.4)	84.5 ± 14.1 (3.4)	0.195	49.1 ± 7.6 (3.2)	80.9 ± 8.9 (4.7)	0.066
Total	325.4 ± 19.3 (16.3)	471.8 ± 23.9 (21.4)	0.001	452.1 ± 31.5 (20.8)	632.5 ± 38.7 (24.8)	0.002	203.2 ± 16.4 (12.0)	315.2 ± 18.4 (18.0)	0.008

Data were analyzed using the complex samples module.
[1] By ANCOVA with gender, residential area, household income, education, employment status, and marital status as covariates
[2] By ANCOVA with residential area, household income, education, employment status, and marital status as covariates
[3] Mean ± SE (weighted % of daily total energy intake)

from 131 kcal ($P < 0.01$) and 116 kcal ($P < 0.05$) in 2001, respectively. In 2011, females aged 19-29 years also showed their highest calorie share (12%) from meals prepared at retail stores among age-gender subgroups, followed by males aged 19-29 years (9%).

DISCUSSION

The results of the current study indicate that the calorie share of commercially-prepared meals among Korean adults remained relatively stable from 2001 and 2011 at about 27% and 28%, respectively. However, it is noticeable that Korean adults consumed more than one-fourth of their daily energy intake from commercially-prepared meals. It was reported that American adults consumed about one-fourth of their daily energy intake (24% to 26%) from fast-food and full-service restaurants in the mid- and late-2000s. [19,20]. Although those studies did not include energy intake from retail stores, our study results seem to be comparable considering that the calorie share of retail stores was only 4% in 2001 and 7% in 2011.

Our study demonstrated a significant increase in calorie amount from commercially-prepared meals from 2001 to 2011. This upward trend has also been reported in a previous study examining Korean adults' energy intake from eating out from 1998 to 2012 [30]. The increased calorie amount from commercially-prepared meals is cause for concern since it may lead to excessive energy intake from fat and may be a risk factor for obesity [21,31-33].

Presumably, the increased calorie amount from commercially-prepared meals may have an influence on the nutritional quality of Korean adults' diet. Several studies assessed the nutritional quality of food away from home in Korea [13,27,30,31]. They have commonly reported a higher energy contribution of fat from commercially-prepared meals, specifically compared with that from food prepared at home. Current evidence from studies on American adults has also revealed a positive association between fast-food and full-service restaurant consumption and intakes of sodium and fat [34,35]. Additionally, research performed in Western countries has consistently reported a negative impact of frequent consumption of food away food home on health. Specifically, they investigated a relation between frequency of food away from home consumption and unfavorable body weight outcomes (e.g., weight gain, overweight, and higher body mass index) [36-39].

Our analysis of the calorie share by food source identified that Korean restaurants were a source of substantial energy intake compared to the other food sources of commercially-prepared meals. Korean adults consumed 16% and 17% of their daily energy intakes from Korean restaurants in 2001 and 2011, respectively. In comparison, studies on American adults' consumption of commercially-prepared meals showed that the calorie share of fast-food restaurants was the highest, ranging

from 13% to 16% [20,40].

A large number of studies conducted in the US have focused on dietary intake from fast-food restaurants and its impact on the diets and health of the population [16,21,36,41-44]. In contrast, research on dietary intake from Korean restaurants is scarce although they are the most common places for Koreans to eat commercially-prepared meals as shown in our study. In fact, Korean restaurants comprise almost half of the foodservice industry in Korea in terms of the number of stores [45]. Therefore, more studies should be conducted on dietary intake from this food source.

The present study identified retail stores as crucial food sources of commercially-prepared meals. We detected substantial increases, from 2001 to 2011, in both calorie amount and calorie share of retail stores. Research performed in the US has also indicated an increase in daily energy intake from store-bought foods [25].

As Story *et al*. [47] proposed in their research published in 2008 [46], research on retail stores as well as restaurants is necessary to create healthy eating environments. In Korea, research interest in the consumption of food prepared or purchased at stores has also increased. A recent report showed that almost one-fourth (23%) of Korean adults purchased ready-to-eat/heat food more than once per week.

Since both the calorie amount and calorie share of retail stores have increased, it is necessary to consider the heterogeneity of various retail stores and disaggregate the retail store sector in more detail [48]. The current coding scheme used by KNHANES does not specify where instant food, bread, packaged snacks, or other food items were prepared or purchased. It is imperative to identify and examine specific types of retail stores in the process of collecting future dietary intake data. The retail store sector needs to be further classified into supermarkets, convenience stores, and specialty food stores in future surveys [46,47].

According to our results, males aged 30-49 years (34%) and females aged 19-29 years (35%) consumed relatively higher calorie shares of commercially-prepared meals compared with other age groups in 2011. A previous study conducted in Switzerland showed that age and gender were associated with fast-food and take-away food consumption [49]. This might imply that a specific age and gender group should be investigated further so that targeted health promotion measures regarding commercially-prepared meals could be developed. In this regard, studies on dietary intake from commercially-prepared meals focusing on males aged 30-49 years and females aged 19-29 years are needed.

In particular, males aged 30-49 years are known to be at high risk of metabolic syndrome [50]. A recent study on Chinese adults suggested that males require relatively more attention in terms of food away from home consumption compared to females [51]. The study revealed a significant association between more energy intake from food away from home and higher body weight outcomes among males. This finding is in line with studies conducted in Korea. A few studies focusing on males have examined the association between their dietary intake from eating out and its impact on health-related issues such as obesity and metabolic syndrome [4,52]. Thus, targeted health promotion measures on eating out should be developed for males in their 30s and 40s.

In addition, females aged 19-29 years were identified as the population who consumed the highest calorie share of commercially-prepared meals (35%) and retail stores (12%). According to current research on the status of under- and over-nutrition in the overall Korean population, the prevalence of nutritional deficiency was found to be higher in females in their 20s [53]. A few studies have focused on females to investigate an association of their eating-out frequency and health risk factors [54,55]. However, studies on dietary intake from commercially-prepared meals among Korean females are limited, and thus this specific demographic subgroup should be emphasized in future studies.

This study has some limitations. The analyses of the study were based on the dietary data obtained from a 24-hour recall for a single day. Thus, the information might not reflect the subjects' usual dietary intake. Further, consumption of commercially-prepared meals may be influenced by the day of the week. In particular, the dietary intake from commercially-prepared meals may differ between weekdays and weekends. However, it is noteworthy that the current study adopted a novel analytical approach to eating out or food away from home and analyzed the consumption of commercially-prepared meals by specific food source. To the best of our knowledge, no other nationally representative estimates of Korean adults' calorie amount or calorie share from commercially-prepared meals by food source are available in the published literature.

Our findings suggest that public health policy makers need to pay attention to the specific food sources of commercially-prepared meals in which the energy intake is substantial or increased. Further, specific demographic groups needs to be focused for developing targeted health promotion measures to improve their dietary practices related to consumption of commercially-prepared meals.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interests.

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