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Dietary quality differs by consumption of meals prepared at home vs. outside in Korean adults

Kyung Won Lee[1], Won O. Song[1] and Mi Sook Cho[2§]

[1]Department of Food Science and Human Nutrition, Michigan State University, MI 48824, USA
[2]Department of Nutritional Science and Food Management, Ewha Womans University, 52, Ewhayeodae-gil, Sodaemun-gu, Seoul 03760, Korea

BACKGROUND/OBJECTIVES: Eating out has been reported to have negative effects on nutritional status. However, eating out can include meals prepared at home and eaten outside. Conversely, meals eaten at home can be brought from outside, as take-out and home deliveries have become common in Korea. Thus, we tested whether or not meal preparation location influences daily diet quality.
SUBJECTS/METHODS: From the Korea National Health and Nutrition Examination Survey (KNHANES) 2007-2009, 4,915 Korean adults (20-64 years) were classified into two groups: home-made meal group (HMG), who ate $\geq$ 2 meals per day prepared at home (n = 4,146), and non-home-made meal group (NHMG), who ate $\geq$ 2 meals per day prepared outside home (n = 769). Daily diet quality was determined by energy intake, nutrient intake, Dietary Variety Score (DVS), and Diet Diversity Score (DDS).
RESULTS: Compared to the HMG, the NHMG was more likely to consist of men, single, employed, educated and of a higher economic status (all, $P < 0.01$). The NHMG showed higher energy intakes (1,776 vs. 2,116 kcal/day) with higher percentages of energy from protein (15 vs. 23%) and fat (14 vs. 16%) and lower intakes of dietary fiber, phosphorus, potassium, niacin, and vitamin C (all, $P < 0.01$) than the HMG, with some variations among age groups. The NHMG tended to consume foods prepared by frying and grilling and had more one-dish meals such as *bibimbap*, noodles, and dumplings but also showed higher dietary diversity.
CONCLUSIONS: It should be noted that home-made meals do not necessarily guarantee a healthy diet, and the effects of meal preparation location on nutritional status might vary depending on socio-demographic characteristics.

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INTRODUCTION

Socio-economic and lifestyle factors are dominant determinants of modern dietary behaviors [1,2]. Changes such as economic growth, female participation in the workforce outside home, single-member households, 5-day workweek, and time constraints have made eating out, take-out, and packing meals prepared at home a common lifestyle globally [3]. These changes have generated two opposite trends. First, a culture of bringing packed meals from home due to health concerns has recently developed [4]. Second, cooking at home has decreased while dependence on convenience foods, fast foods, and other foods prepared outside home has increased [5].

Many studies have examined the relationship between eating out and nutritional quality according to these lifestyle changes [6-8]. Findings from previous studies suggest that individuals who eat meals at home are more likely to have a high-quality diet compared with those who eat meals outside home [9]. In contrast, consumption of meals outside home is considered a risk factor for incidence of chronic diseases such as obesity and diabetes in addition to nutritional imbalance [10,11].

Although various studies have examined the relationship between eating out and nutritional status, there are major limitations. There is no consensus on the definition of eating out, as meals can be prepared and consumed at different locations. The effect of eating out on diet quality can vary depending on how eating out is classified (where meal is prepared vs. where meal is consumed). The difference in the definition of eating out can provide inconclusive results regarding the relationship between eating out and diet quality [6,12]. Thus, defining concepts of eating out is a top priority to determine the effect of eating out on diet quality. However, since even home-made meals are composed of foods that come from outside sources, it is difficult to separate eating out from eating in [7]. Criteria for eating out and eating in should consider 'where meal is prepared/obtained' or 'where meal is

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§ Corresponding Author: Mi Sook Cho, Tel. 82-2-3277-2826, Fax. 82-2-3277-2862, Email. misocho@ewha.ac.kr

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consumed/eaten'.

Many researchers in the US and European countries have focused on differences in diet quality according to meal preparation/purchase location rather than eating location. In a previous study on adolescents aged 13-18 years, consumption of foods obtained from outside home, such as fast-food outlets or restaurants, was more likely to have higher energy intake and be of lower diet quality [7]. Powell and Nguyen reported that meals prepared outside home tend to be more problematic in terms of nutrient intake compared to meals consumed at home [6]. Various studies also demonstrated how food source or food purchase location is associated with daily energy and nutrient intakes. They reported that food prepared away from home is a major contributor to increased energy intake from fat as well as lowered micronutrient intakes [13,14] and dietary diversity [15]. However, to date, studies on nutritional value and daily food consumption patterns while eating out and eating in among the Korean population are limited, as they are confined to one meal per day, such as breakfast or lunch. In additions, few studies in this area have elucidated the most consumed dish among Koreans according to meal preparation location and factors affecting eating out behavior and the resulting nutritional status considering socio-demographics [16].

To fill gaps in the literature, we attempted to explore the complex effects of eating out on diet quality by focusing on location of meal preparation. A single food type can be different types of dishes depending on the location where it was obtained. For instance, though vegetables and fruits are healthy foods, they are generally served with a buttery or salty sauce or with dressing when consumed outside the home. In other words, how and where certain meals are prepared may have an effect on nutrient intake and diet quality. Considering that more than one-third of the Korean population consumes a non-home-made meal once a day [17], it is necessary to separate eating out from eating in according to location of meal preparation and explore differences in dish consumption pattern and diet quality. Furthermore, the effects of socio-demographic characteristics on diet quality need to be examined rather than assessing nutritional effects of eating out and eating in for the total population.

The purpose of this study was to determine the effects of meal preparation location on diet quality within the context of total daily intake. We aimed to identify socio-demographic characteristics of those who consumed meals prepared outside in a single day in order to describe Korean adults' patterns of dish consumption and assess dietary adequacy and diversity according to meal preparation location, which has not been studied in the previous literature. The present study can provide important insights into the effect of meal preparation location in terms of nutritional quality and dietary diversity.

SUBJECTS AND METHODS

Data source and study population

The Korean National Health and Nutrition Examination Survey (KNHANES) is conducted by the Korea Centers for Disease Control and Prevention (KCDC) to identify present situations and trends in Korean health and nutritional status. Beginning in 1998, the KNHANES is an ongoing survey conducted continuously every year since 2007 (the first year of the fourth wave) [18,19]. The KNHANES follows a multi-stage clustered sampling design targeted for non-institutionalized Korean citizens who live in Korea and consists of three surveys: health interview, health examination, and nutrition survey [20]. This cross-sectional study used data on meal preparation location and 24-h dietary intake from the KNHANES 2007-2009. We excluded those who were younger than 20 years of age, with < 500 or > 5,000 kcal/day of total energy intake, had incomplete information on 24-h dietary recall and location of meal preparation, and were pregnant and lactating women for a final analytic sample size of 4,915.

Dish groupings

The KNHANES collected information on types and amounts of foods and dishes consumed during the previous day using the 24-h dietary recall method. All dishes consumed by subjects were assigned a 5-digit dish identification code. We used dish codes from the KNHANES 2007-2009 to determine the most consumed dishes based on a single 24-h dietary recall. However, dish codes from the KNHANES were over-segmented. To compensate for these weak points, we used the second- and third-digit code from the KNHANES [19]. The second- and third-digits in the dish code identify one of the 23 major dish groups. Based on the KNHANES coding scheme and previous studies [21-23], all dish items were aggregated into 47 specific groups on the basis of the main ingredient (i.e., vegetables, meat, and seafood) and cooking methods (i.e., steaming, boiling, grilling, frying, etc.).

Definition of meal preparation location

The definition of eating out is a still controversial issue, as mentioned above. The location where the meal is prepared or consumed may be equally classified as eating out or eating in by an individual researcher. In the case of eating take-out or delivery at home, the location where the meal is consumed is home while nutritional characteristics of the consumed meal resemble a non-home-made meal. On the other hand, in the case of a home-made packed meal consumed outside home, nutritional characteristics of the meal are akin to that of a home-made meal. Therefore, this study focused on nutritional characteristics of meals rather than the effect of eating location in order to separate home-made meals from non-home-made meals in terms of preparation.

Starting from 1998, the KNHANES has accumulated information on meal preparation/purchase location (variable: N_MTYPE) of all dishes consumed by participants [19]. Thus, it is possible to determine where all dishes were obtained. We classified each dish item consumed by an individual into two categories according to meal preparation based on a previous study [24]: meal prepared at home (home-made meal; HM) and outside home (non-home-made meal; NHM) (Table 1). HMs included meals packed at home and prepared at a neighbor or relative's house. NHMs were mainly obtained from outside home at quick-service restaurants, including delivery and take-out, full-service restaurants such as Korean, Chinese, Western, or Japanese restaurants, fast-food outlets, street food or snack restaurants, instant and

Table 1. Classification of meals by preparation location

Description (code)[1)]	Meal preparation location
Prepared at home (01)	Home-made meal (HM)
Prepared and packed at home (02)	
Prepared at a neighbor or relative's house (03)	
Delivery of prepared meals from a commercial establishment (04)	Non-home-made meal (NHM)
Purchased at Korean (05), Chinese (06), Western (07), or Japanese (08) restaurant	
Purchased at fast-food outlets (09)	
Instant and ready-to-eat foods (10)	
Street foods (11)	
Bread/cookies purchased outside home (12)	
Other types of meals purchased outside home (13)	
Prepared at institutional cafeteria meals; School (14), workplace (15), senior-citizen centers (17), free (18), or others (19)	

[1)] We used information on meal preparation/purchase location (variable: N_MTYPE) of all dishes in KNHANES 2007-2009.

ready-to-eat foods (e.g., instant ramen), and other types of eating out, including institutional cafeteria food. In the present study, as only a few people consumed meals from institutional cafeterias such as the workplace and schools, we classified meals from commercial and institutional places into NHMs.

After dividing each dish item into HMs and NHMs, we classified subjects into two groups: home-made meal group (HMG) and non-home-made meal group (NHMG). Based on the fact that most Koreans consume three meals (breakfast, lunch, and dinner) per day [25,26], we can determine the major source of meal preparation during the entire day based on the frequency of consuming meals prepared at home or obtained from outside home. In this study, the HMG included those who consumed more than two meals a day prepared at home while the NHMG included individuals who consumed more than two meals a day obtained outside home. People who missed more than two meals a day were determined as not having sufficient nutrient intake and were excluded from the present analyses.

Socio-demographic characteristics of subjects

We included socio-demographic variables affecting individuals' eating out behavior. All subjects were divided according to socio-demographic status of interest: sex (men and women), age (20-29, 39-49, and 50-64 years of age), income (income was calculated based on total household income of residents and then divided into quartiles from poorest to wealthiest; low, mid-low, mid-high, and high) [19], education (elementary school graduates, middle or high school graduates, and college graduate or above), marital status (married and single including divorced, widowed, or never-married), occupation (employed including self-employed and unemployed), body mass index (BMI; kg/m^2) (calculated as weight [kg] divided by squared height [m]; underweight, < 18.5; normal, 18.5 to < 23; overweight, 23 to < 25; and obese, ≥ 25) [27,28].

Dietary assessment

We used the 24-h dietary recall information on food intake to assess the nutritional status of study participants by meal preparation place (HMG vs. NHMG). In the current study, 24-h dietary energy, ratio of energy intake from each macronutrient (e.g., carbohydrate, protein, and fat; C:P:F ratio), and the amounts of selected micronutrient intakes were assessed for sex and each age group. The cutoff used to assess compliance individual's relative intake levels of micronutrients (e.g., dietary fiber, calcium, iron, sodium, and vitamins) was recommendations from the Dietary Reference Intakes for Koreans (KDRIs) [29]. Calcium, phosphorus, iron, vitamin A, vitamin B_1, vitamin B_2, vitamin C, and niacin levels were calculated based on the recommended nutrient intakes. Intake ratio of sodium and potassium was calculated based on adequate intake, whereas that of dietary fiber was calculated based on absolute intake since crude fiber content was used. Micronutrients were presented as the percentage of KDRIs.

We used both Dietary Variety Score (DVS) and Diet Diversity Score (DDS) to measure dietary diversity to gain a more detailed understanding of whether or not the HMG and NHMG showed changes in diet quality. Previous studies already showed that the DVS and DDS can reflect Korean adults' overall diet quality and are linked to their nutritional and health status [30,31]. The DVS was calculated using the sum of the total number of different food groups consumed the previous day. However, there is currently no consensus on food grouping to calculate this score [32]. Some food items cooked by different cooking methods were classified in the same food group, resulting in a total of 17 food groups (i.e., cereals, potato and starches, sugars and sweeteners, pulses, nuts and seeds, vegetables, fungi and mushrooms, fruits, meats, eggs, fish and shellfishes, seaweeds, milks, oils and fat, beverages, seasoning, and others) for this study based on previous literature [33,34]. All foods consumed by each subject over the 24-h dietary recall period were classified and calculated for the DVS. Seasonings and alcoholic beverages were excluded from the DVS calculation. We also used the DDS developed by Kant *et al*. [35,36]. Every single food consumed in a single day was divided into five food groups (i.e., cereals-grains, meats, fruits, vegetables, and dairy products) and was then summed. Whenever a consumed food group was added, 1 point was given with the range of 5 (highest) to 0 (lowest) points. To prevent getting scores for intake of a small quantity in the DDS calculation, a minimum intake criterion from previous studies was set by each food group [23,37]. Scores were not given for an intake lower than the criterion.

Statistical analyses

All data were analyzed using the SAS (version 9.3, SAS Institute Inc, Cary, NC, USA). The KNHANES data were collected by multi-stage stratified probability sampling instead of simple random sampling. We included weight, stratifying variables (KSTRATA), and the primary sampling unit (PSU) suggested by the KCDC and used the SURVEY procedure to account for the KNHANES complex sampling scheme [19,20]. We calculated the average intake amount of each dish and determined the top 20 most consumed dish items (listed from highest to lowest) to describe the meal consumption pattern of Korean adults by meal preparation location, sex, and age group. The Wald chi-square test and multiple linear regression were used to estimate the association between meal preparation location and socio-demographic characteristics. General characteristics of subjects were represented as frequency and weighted percentage using the SURVEYFREQ procedure. To achieve our objectives, SURVEYREG procedure was used to compare differences between means of total energy intake, nutrient intake, and diet variety by meal preparation location. *P*-values < 0.05 were considered as statistically significant.

RESULTS

General characteristics of subjects

The socio-demographic characteristics of study subjects overall and by meal preparation location and age group are presented in Table 2. On the whole, among Korean adults aged 20-64 years in the KNHANES 2007-2009, 80.3% (n = 4,146) were in the HMG while 19.7% (n = 769) were in the NHMG. No differences were reported between overall BMI categories. However, differences between the HMG and NHMG by age, sex, income, education level, marital status, and occupation were significant ($P < 0.01$). When stratified by age, the younger adult group (20-29 years) constituted the highest proportion of those in the NHMG, whereas those 50-64 years of age formed the greatest proportion of the HMG. Those 30-49 years and 50-64 years of age comprised 78.2% and 92.0% of the HMG, respectively, which were much higher than those in the NHMG. In contrast, for younger adults, the difference between the two groups was relatively smaller (HMG; 66.2% vs. NHMG; 33.8%).

Dish consumption patterns by meal preparation location, sex, and age

Table 3 and Table 4 list the most consumed dish items according to meal preparation location. Overall, most often

Table 2. Socio-demographic characteristics of subjects by meal preparation location and age group, KNHANES 2007-2009

	Total (n = 4,915)		Age group					
			20-29 yrs (n = 670)		30-49 yrs (n = 2,284)		50-64 yrs (n = 1,961)	
	HMG[1]	NHMG	HMG	NHMG	HMG	NHMG	HMG	NHMG
Sample size	4,146 (80.3)[2]	769 (19.7)	460 (66.2)	210 (33.8)	1,863 (78.2)	421 (21.8)	1,823 (92.0)	138 (8.1)**[3]
Sex								
Men	1,256 (36.4)	421 (61.4)**	168 (46.9)	107 (57.8)*	429 (29.2)	248 (66.0)**	659 (40.7)	66 (52.1)*
Women	2,890 (63.6)	348 (38.7)	292 (53.1)	103 (42.2)	1,434 (70.8)	173 (34.0)	1,164 (59.3)	72 (48.0)
Income (Won/yrs)								
Q1 (low)	1,209 (29.1)	166 (21.9)**	126 (28.0)	48 (25.2)*	542 (29.7)	89 (20.5)**	541 (28.7)	29 (18.9)
Q2	1,095 (26.3)	174 (22.4)	133 (27.9)	42 (19.1)	484 (24.9)	96 (23.6)	478 (27.3)	36 (25.7)
Q3	974 (24.1)	207 (26.0)	119 (27.9)	60 (26.9)	457 (25.2)	112 (24.8)	398 (21.2)	35 (28.6)
Q4 (high)	868 (20.6)	222 (29.7)	82 (16.2)	60 (28.7)	380 (20.3)	124 (31.1)	406 (22.8)	38 (26.8)
Education								
Elementary school	979 (19.3)	59 (5.6)**	1 (0.4)	1 (0.2)**	112 (5.6)	13 (2.5)**	866 (44.4)	45 (31.4)*
Middle or high school	2,026 (49.2)	294 (36.6)	133 (27.9)	27 (15.1)	1,069 (57.6)	196 (46.6)	824 (47.8)	71 (51.7)
College or above	1,141 (31.6)	416 (57.8)	326 (71.7)	182 (84.7)	682 (36.8)	212 (51.0)	133 (7.8)	22 (16.9)
Marital status[4]								
Single	757 (21.4)	278 (41.4)**	315 (71.2)	177 (86.2)**	201 (10.5)	66 (16.4)*	241 (13.3)	35 (26.9)**
Married	3,389 (78.6)	491 (58.6)	145 (28.8)	33 (13.8)	1,662 (89.5)	355 (83.6)	1,582 (86.7)	103 (73.1)
Occupation								
Employed	2,194 (50.81)	616 (80.91)**	165 (35.19)	146 (68.94)**	963 (52.65)	359 (88.39)**	1,066 (55.27)	111 (81.95)**
Unemployed	1,927 (49.19)	147 (19.09)	294 (64.81)	63 (31.06)	885 (47.35)	57 (11.61)	748 (44.73)	27 (18.05)
BMI[5]								
Underweight	189 (4.8)	41 (5.3)	56 (10.4)	22 (9.6)	93 (5.0)	16 (3.6)**	40 (2.1)	3 (1.5)
Normal weight	1,628 (39.5)	295 (39.5)	232 (50.6)	94 (46.0)	852 (44.5)	154 (35.5)	544 (28.6)	47 (39.2)
Overweight	1,003 (24.1)	200 (26.5)	68 (14.5)	47 (20.5)	415 (23.3)	122 (31.2)	520 (29.3)	31 (23.0)
Obese	1,326 (31.6)	233 (28.6)	104 (24.5)	47 (23.9)	503 (27.2)	129 (29.7)	719 (40.0)	57 (36.4)

[1] The study subjects were divided into two groups according to the location where meals are prepared for a single day: 1) home-made meal group (HMG) (≥ 2 meals prepared at home consumed), 2) non-home-made meal group (NHMG) (≥ 2 meals prepared away from home consumed).
[2] Unweighted sample size (weighted percentage)
[3] *P*-value was obtained from the Wald Chi-square test for categorical variables and the t-test for continuous variables (* $P < 0.05$, ** $P < 0.01$).
[4] Marital status was divided into two groups; single (including separated, divorced, widowed, and stayed unmarried) and married.
[5] Body mass index (BMI) was calculated as weight (kg) divided by squared height (m) (kg/m^2); underweight: < 18.5 kg/m^2; normal weight: 18.5 to > 23 kg/m^2; overweight: 23 to < 25 kg/m^2; and obese: ≥ 25 kg/m^2.

Table 3. Top 20 dishes consumed most by Korean men according to meal preparation location and age group, KNHANES 2007-2009

Rank	Age group																	
	20 - 29 yrs						30 - 49 yrs						50 - 64 yrs					
	HMG[1]			NHMG			HMG			NHMG			HMG			NHMG		
	Dish group[2]	g/d	%[3]	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%
1	Fruits	196.4	14.5	Alcohol	329.5	17.9	Fruits	131.1	9.4	Alcohol	294.5	16.4	Rice with mixed grains	204.9	14.4	Alcohol	339.5	21.4
2	Rice with mixed grains	137.5	10.2	Fruits	143.9	7.8	Rice with mixed grains	128.5	9.3	Fruits	148.4	8.2	Fruits	190.1	13.4	White rice	143.4	9.0
3	Kimchi	124.3	9.2	Milk and dairy products	129.3	7.0	Kimchi	126.7	9.1	White rice	123.2	6.8	Kimchi	184.2	13.0	Kimchi	119.8	7.6
4	Noodles and dumplings	119.2	8.8	Noodles and dumplings	128.6	7.0	Alcohol	117.5	8.5	Kimchi	116.1	6.4	Alcohol	112.7	7.9	Fruits	104.7	6.6
5	Alcohol	86.3	6.4	Carbonated drinks	126.3	6.8	White rice	109.9	7.9	Noodles and dumplings	99.9	5.6	White rice	90.1	6.4	Noodles and dumplings	78.2	4.9
6	White rice	73.5	5.4	Rice mixed with vegetables and beef (bibimbap)	103.5	5.6	Noodles and dumplings	95.0	6.9	Rice mixed with vegetables and beef (bibimbap)	95.5	5.3	Stew and casserole with vegetables	56.1	4.0	Milk and dairy products	69.2	4.4
7	Milk and dairy products	72.6	5.4	White rice	100.2	5.4	Stew and casserole with vegetables	83.0	6.0	Carbonated drinks	87.3	4.9	Soups with meat	54.1	3.8	Soups with meat	64.5	4.1
8	Carbonated drinks	63.1	4.7	Kimchi	86.7	4.7	Milk and dairy products	70.7	5.1	Coffee and tea	83.1	4.6	Noodles and dumplings	50.2	3.5	Soups with vegetables	55.3	3.5
9	Soups with meat	56.8	4.2	Grilled meat	74.5	4.0	Soups with meat	59.2	4.3	Milk and dairy products	60.5	3.4	Soups with vegetables	48.3	3.4	Rice with mixed grains	48.6	3.1
10	Coffee and tea	39.5	2.9	Coffee and tea	53.3	2.9	Coffee and tea	58.8	4.2	Stew and casserole with vegetables	50.8	2.8	Steamed and seasoned vegetables	39.7	2.8	Steamed and seasoned vegetables	45.7	2.9
11	Stew and casserole with vegetables	38.6	2.9	Fried meat	48.5	2.6	Soups with vegetables	43.4	3.1	Salads	49.1	2.7	Milk and dairy products	39.4	2.8	Coffee and tea	44.5	2.8
12	Beans and nuts	35.0	2.6	Salads	46.8	2.5	Steamed and seasoned vegetables	37.3	2.7	Grilled meat	42.3	2.4	Beans and nuts	36.8	2.6	Grilled meat	41.4	2.6
13	Grilled meat	33.3	2.5	Stew and casserole with vegetables	41.2	2.2	Grilled meat	37.0	2.7	Soups with seafood	38.9	2.2	Coffee and tea	30.9	2.2	Salads	40.8	2.6
14	Steamed meat	27.3	2.0	Soups with meat	38.0	2.1	Salads	31.1	2.2	Steamed and seasoned vegetables	37.5	2.1	Soups with seafood	30.6	2.2	Soups with seafood	39.9	2.5
15	Pizzas, hamburgers, bakeries, and confectioneries	21.2	1.6	Pizzas, hamburgers, bakeries, and confectioneries	36.3	2.0	Rice mixed with vegetables and beef (bibimbap)	30.4	2.2	Fried meat	37.2	2.1	Vegetables and seaweed	27.0	1.9	Vegetables and seaweed	31.9	2.0
16	Rice mixed with vegetables and beef (bibimbap)	20.4	1.5	Steamed meat	33.4	1.8	Carbonated drinks	20.7	1.5	Soups with vegetables	37.2	2.1	Salads	20.4	1.4	Rice mixed with vegetables and beef (bibimbap)	28.7	1.8
17	Soups with vegetables	15.6	1.2	Stir-fried seafood	25.6	1.4	Beans and nuts	20.2	1.5	Pizzas, hamburgers, bakeries, and confectioneries	34.9	1.9	Steamed meat	16.6	1.2	Pizzas, hamburgers, bakeries, and confectioneries	25.2	1.6
18	Seasonings	15.3	1.1	Soups with vegetables	25.6	1.4	Vegetables and seaweed	16.7	1.2	Stir-fried meat	34.9	1.9	Stew and casserole with seafood	15.4	1.1	Carbonated drinks	23.7	1.5
19	Steamed and seasoned vegetables	15.2	1.1	Stir-fried meat	25.0	1.4	Soups with seafood	16.0	1.2	Soups with meat	33.2	1.9	Braised seafood	14.6	1.0	Stew and casserole with vegetables	21.9	1.4
20	Pan-fried meat	13.5	1.0	Steamed seafood	24.2	1.3	Stir-fried vegetables	15.3	1.1	Vegetables and seaweed	28.4	1.6	Grilled meat	12.3	0.9	Grilled seafood	21.8	1.4

[1] The study subjects were divided into two groups according to the location where meals are prepared for a single day: 1) home-made meal group (HMG) (≥ 2 meals prepared at home consumed), 2) non-home-made meal group (NHMG) (≥ 2 meals prepared away from home consumed).
[2] All dishes in KNHAENS data were re-classified into 47 groups based on the main ingredient and cooking methods. Among 47 dish groups, only top 20 dishes consumed most are represented in the table.
[3] Each value represents the mean intake amount and the relative percentage contribution to the total intake amount of each dish group.

consumed dishes per day varied by meal preparation location, sex, and age group. The HMG consumed more dishes consisting of grains, including white rice and rice with mixed grains, compared with the NHMG. Both men and women in the NHMG consumed more meat but fewer vegetables compared to the HMG. The HMG primarily consumed meat in stews or steamed

Table 4. Top 20 dishes consumed most by Korean women according to meal preparation location and age group, KNHANES 2007-2009

Rank	Age group																	
	20 - 29 yrs						30 - 49 yrs						50 - 64 yrs					
	HMG[1]			NHMG			HMG			NHMG			HMG			NHMG		
	Dish group[2]	g/d	%[3]	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%	Dish group	g/d	%
1	Fruits	212.2	17.4	Alcohol	131.1	9.4	Fruits	247.1	20.7	Fruits	198.1	15.5	Fruits	255.7	22.2	Fruits	234.6	16.4
2	Alcohol	113.5	9.3	Fruits	128.5	9.3	Rice with mixed grains	129.0	10.8	Noodles and dumplings	108.3	8.5	Rice with mixed grains	162.6	14.1	Milk and dairy product	107.1	7.5
3	Rice with mixed grains	97.9	8.0	Carbonated drinks	126.7	9.1	Kimchi	120.7	10.1	Alcohol	105.0	8.2	Kimchi	123.9	10.8	White rice	97.9	6.9
4	Milk and dairy products	90.3	7.4	Coffee and tea	117.5	8.5	White rice	69.8	5.9	Coffee and tea	71.7	5.6	White rice	61.7	5.4	Kimchi	86.8	6.1
5	Kimchi	87.3	7.2	Milk and dairy products	109.9	7.9	Milk and dairy product	60.2	5.0	Milk and dairy product	69.9	5.5	Milk and dairy product	45.1	3.9	Alcohol	86.0	6.0
6	White rice	69.2	5.7	Noodles and dumplings	95.0	6.9	Noodles and dumplings	51.9	4.4	Kimchi	66.6	5.2	Noodles and dumplings	44.6	3.9	Carbonated drinks	72.6	5.1
7	Stew and casserole with vegetables	48.9	4.0	Rice mixed with vegetables and beef (bibimbap)	83.0	6.0	Alcohol	46.5	3.9	White rice	65.5	5.1	Stew and casserole with vegetables	43.5	3.8	Noodles and dumplings	62.0	4.3
8	Noodles and dumplings	44.1	3.6	Pizzas, hamburgers, bakeries, and confectioneries	70.7	5.1	Stew and casserole with vegetables	45.3	3.8	Rice mixed with vegetables and beef (bibimbap)	58.9	4.6	Beans and nuts	41.2	3.6	Soups with vegetables	56.0	3.9
9	Beans and nuts	36.2	3.0	Salads	59.2	4.3	Coffee and tea	35.7	3.0	Grilled meat	56.2	4.4	Soups with vegetables	40.6	3.5	Rice mixed with vegetables and beef (bibimbap)	52.7	3.7
10	Rice mixed with vegetables and beef (bibimbap)	32.4	2.7	Kimchi	58.8	4.2	Soups with vegetables	31.8	2.7	Salads	45.5	3.6	Steamed and seasoned vegetables	39.1	3.4	Beans and nuts	45.7	3.2
11	Pizzas, hamburgers, bakeries, and confectioneries	30.8	2.5	Stir-fried meat	43.4	3.1	Steamed and seasoned vegetables	28.8	2.4	Carbonated drinks	43.2	3.4	Soups with meat	35.5	3.1	Salads	44.7	3.1
12	Steamed and seasoned vegetables	30.0	2.5	Grilled meat	37.3	2.7	Beans and nuts	27.3	2.3	Pizzas, hamburgers, bakeries, and confectioneries	32.9	2.6	Coffee and tea	28.6	2.5	Steamed and seasoned vegetables	44.0	3.1
13	Stir-fried vegetables	25.0	2.1	White rice	37.0	2.7	Salads	23.3	2.0	Steamed and seasoned vegetables	26.3	2.1	Vegetables and seaweed	25.3	2.2	Coffee and tea	43.8	3.1
14	Carbonated drinks	25.0	2.0	Soups with meat	31.1	2.2	Vegetables and seaweed	22.4	1.9	Vegetables and seaweed	25.1	2.0	Rice cakes	18.3	1.6	Rice cakes	41.2	2.9
15	Coffee and tea	24.1	2.0	Fried meat	30.4	2.2	Soups with meat	22.3	1.9	Stew and casserole with vegetables	24.9	2.0	Alcohol	15.9	1.4	Fried fish paste and processed meat	29.6	2.1
16	Soups with vegetables	22.0	1.8	Steamed meat	20.7	1.5	Rice mixed with vegetables and beef (bibimbap)	20.6	1.7	Soups with seafood	23.5	1.8	Salads	15.2	1.3	Grilled meat	29.1	2.0
17	Braised vegetables	19.9	1.6	Stew and casserole with vegetables	20.2	1.5	Grilled meat	16.2	1.4	Rice with mixed grains	23.4	1.8	Soups with seafood	13.4	1.2	Rice with mixed grains	28.3	2.0
18	Soups with meat	19.8	1.6	Stir-fried vegetables	16.7	1.2	Pizzas, hamburgers, bakeries, and confectioneries	15.8	1.3	Soups with vegetables	21.5	1.7	Carbonated drinks	12.6	1.1	Soups with seafood	28.0	2.0
19	Pan-fried meat	18.1	1.5	Beans and nuts	16.0	1.2	Stir-fried vegetables	15.7	1.3	Beans and nuts	21.4	1.7	Pan-fried vegetables	11.4	1.0	Braised seafood	25.2	1.8
20	Salads	17.8	1.5	Picked vegetables	15.3	1.1	Soups with seafood	14.7	1.2	Rice cakes	17.0	1.3	Stir-fried vegetables	9.9	0.9	Steamed seafood	22.0	1.5

[1] The study subjects were divided into two groups according to the location where meals are prepared for a single day: 1) home-made meal group (HMG) (≥ 2 meals prepared at home consumed), 2) non-home-made meal group (NHMG) (≥ 2 meals prepared away from home consumed).
[2] All dishes in KNHAENS data were re-classified into 47 groups based on the main ingredient and cooking methods. Among 47 dish groups, only top 20 dishes consumed most are represented in the table.
[3] Each value represents the mean intake amount and the relative percentage contribution to the total intake amount of each dish group.

meat, whereas the NHMG used various other cooking methods such as grilling, deep-frying, and stir-frying for meat as well as boiling and steaming.

Dish consumption patterns according to sex showed that men in the HMG consumed a wider variety of vegetable dishes, such as stews and casseroles, soups, raw vegetables including

Table 5. Distribution of daily total energy and relative nutrient intake in Korean adults by meal preparation location and age group

	Total		Age group					
			20-29 yrs		30-49 yrs		50-64 yrs	
	HMG[1)]	NHMG	HMG	NHMG	HMG	NHMG	HMG	NHMG
Energy (kcal)	1,776 ± 14.4[2)]	2,116 ± 34.8**[3)]	1,796 ± 40.4	2,141 ± 59.8**	1,785 ± 21.6	2,136 ± 48.1**	1,754 ± 21.3	1,978 ± 85.6*
Men	2,076 ± 26.1	2,358 ± 41.2**	1,976 ± 64.4	2,407 ± 71.5**	2,163 ± 45.0	2,373 ± 56.9**	2,045 ± 32.9	2,149 ± 104.5
Women	1,589 ± 14.0	1,678 ± 46.0	1,624 ± 45.7	1,728 ± 78.0	1,609 ± 19.2	1,601 ± 59.2	1,547 ± 22.7	1,770 ± 115.5
% Energy from carbohydrates, protein, fat								
Carbohydrate (%)	71.3 ± 0.2	60.4 ± 0.5**	67.5 ± 0.6	56.9 ± 0.8**	70.3 ± 0.3	61.3 ± 0.6**	74.2 ± 0.3	65.8 ± 1.1**
Protein (%)	14.9 ± 0.2	23.2 ± 0.4**	18.2 ± 0.5	26.6 ± 0.7**	15.7 ± 0.2	22.1 ± 0.5**	12.2 ± 0.2	18.3 ± 0.9**
Fat (%)	13.9 ± 0.1	16.5 ± 0.2**	14.3 ± 0.3	16.5 ± 0.4**	14.0 ± 0.1	16.6 ± 0.3**	13.6 ± 0.1	15.9 ± 0.5**
Daily actual nutrient intake (% KDRI)								
Dietary fiber	35.5 ± 0.5	29.0 ± 0.8**	30.6 ± 1.0	25.1 ± 1.2**	36.3 ± 0.7	29.5 ± 0.9**	36.6 ± 0.7	36.6 ± 3.0
Calcium	67.2 ± 1.0	74.5 ± 1.8**	63.7 ± 2.4	71.7 ± 3.3	67.9 ± 1.6	74.6 ± 2.1*	67.7 ± 1.4	81.3 ± 5.7*
Phosphorus	155.5 ± 1.5	175.3 ± 3.2**	151.3 ± 3.8	169.4 ± 6.4*	156.2 ± 2.1	180.0 ± 4.2**	156.6 ± 2.1	172.0 ± 8.5
Iron	132.1 ± 2.5	154.0 ± 7.3**	107.3 ± 5.1	135.8 ± 11.9*	109.2 ± 2.8	159.4 ± 11.7**	172.3 ± 4.4	179.1 ± 12.8
Sodium	318.8 ± 4.4	376.3 ± 8.8**	298.2 ± 9.6	352.8 ± 13.9**	320.4 ± 6.0	390.6 ± 11.6**	326.2 ± 7.5	380.7 ± 22.1*
Potassium	82.6 ± 1.0	91.3 ± 1.8**	76.7 ± 2.6	86.5 ± 3.2*	82.5 ± 1.3	94.0 ± 2.5**	85.3 ± 1.4	93.2 ± 4.6
Vitamin A	116.7 ± 3.3	121.3 ± 4.4	102.0 ± 5.4	108.7 ± 6.8	120.1 ± 4.9	124.6 ± 6.0	119.2 ± 4.7	140.6 ± 14.7
Vitamin B_1	103.6 ± 1.2	123.0 ± 3.1**	110.3 ± 3.6	123.3 ± 5.6	107.1 ± 1.9	126.9 ± 4.1**	96.3 ± 1.5	107.7 ± 5.2*
Vitamin B_2	82.1 ± 1.1	93.2 ± 2.1**	90.3 ± 3.2	92.3 ± 3.9	85.7 ± 1.5	93.8 ± 2.6**	73.8 ± 1.3	92.9 ± 5.6**
Niacin	94.5 ± 1.0	122.4 ± 2.7**	92.6 ± 2.8	120.5 ± 5.1**	96.1 ± 1.5	125.3 ± 3.5**	93.3 ± 1.5	116.0 ± 7.3**
Vitamin C	105.5 ± 2.4	106.3 ± 3.8	101.9 ± 6.9	100.4 ± 7.3	106.2 ± 3.3	109.0 ± 4.7	106.3 ± 2.9	111.0 ± 7.9

[1)] The study subjects were divided into two groups according to the location where meals are prepared for a single day: 1) home-made meal group (HMG) (≥ 2 meals prepared at home consumed), 2) non-home-made meal group (NHMG) (≥ 2 meals prepared away from home consumed).
[2)] Data values are reported as mean ± SE.
[3)] *P*-value was obtained from the t-test for continuous variables (* $P < 0.05$, ** $P < 0.01$).

salads and lettuce wrap, and steamed and seasoned vegetables. If examined based on intake amounts, men from the NHMG consumed approximately 3-fold more alcoholic beverages and 2-fold more grilled meat (e.g., *samgyeopsal*, grilled pork belly meat) compared to those in the HMG, although there was no significant difference in ranking. In particular, men aged 30-49 years in the NHMG group consumed more one-dish meals than those in the HMG, who consumed rice, soups, and other side dishes separately. One-dish meals most often consumed by the NHMG included *bibimbap* (rice mixed with vegetables, sliced beef, and gochujang), rice topped with meats or vegetables, noodles (e.g., ramen, *udon*, *jajangmyeon*, and Korean style noodle dishes), and dumplings (Table 3). Women in the NHMG consumed carbonated drinks as well as coffee and tea about 5.7-fold and 2.7-fold more often, respectively, than those in the HMG. Women aged 20-29 years in the NHMG consumed more noodles and bakeries than those in the HMG. The older adult group (50-64 years) showed a different consumption pattern from their counterparts. Even when eating NHMs, this age group consumed more Korean foods than other foods, with high consumption of rice. The most consumed dishes in the NHMG at this age consisted of more diverse items, including rice, soups, *kimchi*, steamed and seasoned vegetables, grilled meat, and dairy products. In terms of milk and dairy products, women in the NHMG consumed approximately twice as much compared to those in the HMG with no significant difference in ranking. On the contrary, women 50-64 years of age in the HMG showed a monotonous meal pattern consisting of rice, soups, and *kimchi* (Table 4).

Comparison of nutrient intakes between HMG and NHMG

Energy intakes and nutritional status of the HMG and the NHMG are shown in Table 5. The HMG consumed significantly lower energy intake than the NHMG (1,776 vs. 2,116 kcal/day, $P < 0.01$). There was no significant difference in energy intake among women in both groups, whereas men in the HMG consumed significantly lower energy intake than those in the NHMG ($P < 0.01$). The NHMG also consumed a lower percentage of carbohydrates and higher percentage of protein and fat compared to the HMG (all, $P < 0.01$). The NHMG consumed 60.0%, 23.2%, and 16.5% carbohydrates, protein, and fat, respectively. However, the HMG consumed 71.3%, 14.0%, and 13.9% carbohydrates, protein, and fat, respectively. Relative nutrient intakes were similar for both the NHMG and HMG. Compared to the HMG, the NHMG consumed significantly less dietary fiber than recommended values but adequate amounts of calcium, potassium, and vitamin B_2 (all, $P < 0.01$). Both groups consumed more phosphorus, iron, and vitamin B_1 than recommended values by KDRIs, particularly in the NHMG. There was no difference in the relative intakes of vitamins A and C. Two micronutrients, dietary fiber (HMG, 35.5%; NHMG, 29.0%) and calcium (HMG, 67.2%; NHMG, 74.5%), were consumed in far less amounts than their recommended values.

Variety in consumption of foods from HMs and NHMs

To investigate diet quality of meals prepared at home and outside home, dietary diversity was compared between the HMG and NHMG (Table 6). For the DVS, the NHMG showed a significantly higher score than the HMG overall in each age

Table 6. Mean Dietary Variety Score and mean Diet Diversity Score by meal preparation location and age group

	Total		Age group					
			20-29 yrs		30-49 yrs		50-64 yrs	
	HMG[1]	NHMG	HMG	NHMG	HMG	NHMG	HMG	NHMG
DVS[2]	10.0 ± 0.1[4]	11.6 ± 0.1**[5]	9.9 ± 0.1	12.0 ± 0.2**	10.4 ± 0.1	11.6 ± 0.1**	9.5 ± 0.1	11.2 ± 0.3**
Men	9.7 ± 0.1	11.6 ± 0.1**	9.5 ± 0.2	12.0 ± 0.3**	10.1 ± 0.1	11.5 ± 0.2**	9.3 ± 0.1	11.2 ± 0.3**
Women	10.2 ± 0.1	11.7 ± 0.2**	10.2 ± 0.2	11.9 ± 0.3**	10.5 ± 0.1	11.7 ± 0.2**	9.6 ± 0.1	11.2 ± 0.4**
DDS[3]	3.6 ± 0.0	3.7 ± 0.0**	3.6 ± 0.1	3.8 ± 0.1	3.7 ± 0.0	3.6 ± 0.0	3.5 ± 0.0	3.7 ± 0.1**
Men	3.5 ± 0.0	3.7 ± 0.0**	3.6 ± 0.1	3.8 ± 0.1	3.5 ± 0.0	3.6 ± 0.1	3.4 ± 0.0	3.6 ± 0.1*
Women	3.6 ± 0.0	3.8 ± 0.1	3.7 ± 0.1	3.8 ± 0.1	3.7 ± 0.0	3.7 ± 0.1	3.5 ± 0.0	3.8 ± 0.1

[1] The study subjects were divided into two groups according to the location where meals are prepared for a single day: 1) home-made meal group (HMG) (≥ 2 meals prepared at home consumed), 2) non-home-made meal group (NHMG) (≥ 2 meals prepared away from home consumed).
[2] DVS = Dietary Variety Score; counts the total number of different food groups consumed in a single day from 17 food groups (i.e., cereals, potato and starches, sugars and sweeteners, pulses, nuts and seeds, vegetables, fungi and mushrooms, fruits, meats, eggs, fish and shellfishes, seaweeds, milks, oils and fat, beverages, seasoning, and others).
[3] DDS = Diet Diversity Score; counts the total number of foods consumed in a single day from five major food groups (i.e., cereals-grains, meats, fruits, vegetables, and dairy products).
[4] Data values are reported as mean ± SE.
[5] *P*-value was obtained from the t-test for continuous variables (* $P<0.05$, ** $P<0.01$).

or sex group (all, $P < 0.01$). The DVS was highest in men aged 20-29 years in the NHMG at 12.0 and lowest in men aged 50-64 years in the HMG at 9.3. The DDS was significantly different for men aged 50-64 years between the HMG and NHMG overall (all, $P < 0.01$). The mean DDS of the HMG was 3.6, whereas it was 3.7 in the NHMG, indicating that most consumed an average of at least three of the five basic food groups each day. The NHMG showed a higher score than the HMG, although no statistically significant differences in DDS between the HMG and NHMG were observed. Comparison of the DVS and DDS showed that the NHMG generally consumed a greater diversity of food items than the HMG.

DISCUSSION

The present study provides a more precise picture of how meal preparation location affects diet quality in Korean adults aged 20-65 years who participated in the KNHANES 2007-2009. We defined eating out by the location of meal preparation, not location of meal consumption. Based on this definition, this study determined the relationship between eating out and diet quality and examined whether or not this relationship varies by socio-economic factors.

We found that the NHMG tended to be men, single, educated, occupied, and of higher economic status. The distributions of the HMG and NHMG were similar to results of previous studies, showing that younger subjects consumed NHMs at higher frequency compared to older individuals [16,38]. The proportion of married individuals was higher in the HMG compared to the NHMG, and this observation may be attributable to their choice of eating meals at home regularly with family compared with non-married individuals [1,39]. However, this study showed a higher proportion of high-income people in the NHMG, which is in contrast to previous studies [9,40]. The findings of this study may be explained by differences in marginal time and money between low-income and high-income groups. Consumption of HMs is necessarily accompanied by cooking and sometimes may be a forced option due to economic or time constraints. Compared with the HMG, the NHMG tended to have higher income and employment status. This result shows that meal preparation at home is a forced option for the low-income group due to financial constraints, whereas but eating in is limited because of time constraints for households having many working members [1,9].

We observed significant differences in dish consumption patterns based meal preparation location overall or based on sex and age group. The contribution of the top 5 dish items were fruits, rice with mixed grains, *kimchi*, white rice, and alcohol in the HMG. However, alcohol, fruits, noodles and dumplings, white rice, and *kimchi* were ranked by the NHMG as the most highly consumed dish items. As rice was ranked as the most consumed dish item for both HMG and NHMG, rice plays an important role in the Korean diet and is a significant source of energy and nutrient intake [21,41]. The HMG consumed a wide range of vegetable dishes, including steamed and seasoned vegetables, vinegar-based vegetable salad, or *kimchi*, which are the most common forms of vegetable consumption in Korea [42]. Men in the HMG consumed vegetables in the form of *kimchi*, steamed and marinated vegetables, and raw vegetables from lettuce wraps, whereas the NHMG consumed vegetables primarily in the form of *kimchi* at a 60% level compared to the HMG. Both HMG and NHMG frequently consumed alcoholic beverages and grilled meat such as grilled pork belly meat, although the average amounts of alcoholic beverage and grilled meat consumption in the NHMG were 3- and 2-fold higher, respectively. These results are consistent with prior research indicating that men from the KNHANES 2007 frequently consumed *soju* (a Korean distilled rice liquor) and pork belly meat [17]. Men in the older adult group from the NHMG consumed large amounts of alcoholic beverages and meat, similar to trends in other groups, resulting in increased risk for cardiovascular disease [43]. Therefore, caution is needed when consuming alcoholic beverages and meat during meals.

Total daily energy intake was significantly lower in the HMG, and energy intake from protein and fat was significantly higher in the NHMG. When stratified by age, the younger adult group in the HMG consumed relatively lower amounts of meat,

deep-fried dishes, and meals obtained from snack restaurants, resulting in a relatively lower proportion of energy intake from protein and fat. On the other hand, those from the NHMG highly consumed meat-based dishes. In addition, consumption of fried or grilled dishes was more common than steaming or boiling, possibly increasing the proportion of energy intake from protein and fat. Consistent with a previous work [44], diets of those aged 50-64 years in the HMG mainly consisted of rice, *kimchi*, and soups with a high proportion of energy intake from carbohydrates (74.2%), which was much higher compared to other groups. This result may be attributable to frequent consumption of rice and noodles. NHMG consumed a wider variety of food items, leading to balanced intake of energy from carbohydrates, protein, and fat.

Both HMG and NHMG showed significantly different relative nutrient intakes, with the exception of vitamins A and C. Both groups consumed three times more sodium daily than that recommended by KDRIs ($\leq$ 2,000 mg), and this may be related to frequent consumption of high sodium-content *kimchi* and soups [45]. Sodium intake in the NHMG was 4-fold higher than recommended guidelines, similar to the results of a previous study [46]. Potassium intake may compensate for sodium overconsumption [47,48], particularly in the NHMG consuming less fruits and vegetables. It is therefore important to encourage fruit and vegetable consumption in the NHMG. Consistent with previous studies [2,42], both groups were deficient in dietary fiber and calcium intakes. Insufficient intake of calcium often occurs in cultures and countries where grains are the staple food and fruits or dairy are quite rare [49]. Fortunately, the 50-64 year age group in the NHMG showed a similar calcium intake to recommended guidelines, possibly attributable to their greater consumption of milk and dairy products, compared to those in the HMG. Since milk and dairy products, which are major food sources of calcium intake, are more accessible when eating meals obtained outside home, individuals aged 50-64 years in the HMG should be encouraged to consume calcium-rich foods such as dairy products and mushrooms.

Although we assessed meal consumption and nutritional status for the entire day according to meal preparation location, the present study has several limitations. First, the KNHANES data used in this study are cross-sectional data and cannot be sure of a causal relationship between meal preparation location and diet quality. Second, the coding system for meal preparation location in the KNHANES may be ambiguous. It is impossible to clearly identify whether or not a dish is fully cooked starting with fresh ingredients or merely warmed such as ready-to-cook or ready-to-eat in the case of HMs based on information from the KNHANES. Finally, the definitions of eating out and eating remain ambiguous. This study selected meal preparation location as a criterion for separating eating out from eating in and used the terms HM and NHM instead of eating out and eating in. However, different results may be derived based on how researchers define what eating out is.

Despite these limitations, this is the first-ever demonstration that meal preparation location contributes to diet quality using nationally representative large datasets of Korean adults. Furthermore, the KNHANES used for this study has the best data available to understand dish consumption patterns and nutritional adequacy according to Koreans' meal preparation location. This study is unique in that it examined consumed dish items according to meal preparation location for an entire day at the population level. Unlike previous studies reporting that eating out has a negative effect on nutritional status, we attempted to understand the effect of eating out on nutritional quality and observed that dietary diversity may be different according to socio-demographic factors.

Our findings may be helpful for developing basic guidelines for healthy diets for Korean adults. When preparing meals at home, understanding healthy food and ingredient selection and preparation can produce changes in dietary behaviors. Focusing on selection of cooking methods and healthy ingredients in nutrition education is an effective way to improve individual health status and have a more healthful diet. In the case of eating out, it is also important to consider how to select a healthy meal that fits an individual's nutritional needs. Furthermore, nutritional education should emphasize different strategies for meal preparation and selection of healthy ingredients depending on socio-demographic status, rather than merely evaluating advantages and disadvantages of eating out.

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