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Original Article

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Differences of nutritional intake habits and Dietary Inflammatory Index score between occupational classifications in the Korean working population

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ABSTRACT

Background: Human nutrient intake is closely related to the conditions of their workplace.
Methods: This study used data from the Korean National Health and Nutritional Examination Survey (KNHANES) conducted between 2016 and 2020. The study population comprised individuals aged 19 to 65 years who were engaged in paid work, excluding soldiers (total = 12,201, male = 5,872, female = 6,329). The primary outcome of interest was the Dietary Inflammatory Index (DII) score, which was calculated using dietary intake data. Generalized linear models were used for statistical analyses.
Results: Pink-collar workers had higher DII scores, indicating a potentially higher inflammatory diet than white-collar workers (mean: 2.18 vs. 1.89, $p < 0.001$). Green and blue-collar workers displayed lower levels of dietary inflammation (green: 1.64 vs. 1.89, $p = 0.019$, blue: 1.79 vs. 1.89, $p = 0.022$). After adjusting for sex, age, income, education, and energy intake, the sole trend that persisted was the comparison between white-collar and pink-collar workers.
Conclusions: DII scores and dietary patterns differed among occupational groups and genders.

Keywords: Nutritional requirements; Diet, food, and nutrition; Occupational medicine; Public health

BACKGROUND

As people in developed countries spend most of their time in the workplace, their nutrient intake is closely related to their working conditions. Previous studies have reported that shift work affects workers' eating habits.[1] Lee et al.[2] found differences in energy and nutrient intake among workers according to age, gender, and occupational characteristics. Young age, long working hours, shift work, and non-regular work were associated with inadequate energy and nutrient intake. Another study found that longer working hours were linked to lower dietary fiber intake.[3] Additionally, individuals with low socioeconomic status (SES) tend to have poorer diets and worse health indicators.[4]

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Abbreviations
BMI: body mass index; CI: confidence interval; DII: Dietary Inflammatory Index; E-DII: Energy-adjusted Dietary Inflammatory Index; KNHANES: Korean National Health and Nutritional Examination Survey; IL: interleukin; IRB: Institutional Review Board; IQR: interquartile range; SD: standard deviation; SES: socioeconomic status; WHO: World Health Organization.

Competing interests
The authors declare that they have no competing interests.

Authors contributions
Conceptualization: Woo SH, Min J. Data curation: Woo SH, Ju K. Formal analysis: Kim J. Investigation: Woo SH. Methodology: Min J, Song J. Software: Woo SH, Kim YW. Validation: Lee SJ. Visualization: Woo SH. Writing - original draft: Woo SH. Writing - review & editing: Woo SH, Kim YW, Min J.

The definition of a healthy diet is constantly changing based on the role of foods and essential nutrients in health and disease. The Dietary Inflammatory Index (DII) was developed with growing recognition of the role of inflammation in diets in 2009.[5] The DII links macro- and micronutrients to one or more of 6 inflammatory biomarkers: interleukin (IL)-1β, IL-4, IL-6, IL-10, tissue necrosis factor alpha, and C-reactive protein. The DII is calculated by determining the average and standard deviation (SD) of the global nutrient intake and how they contribute to the 6 inflammatory biomarkers. The DII itself is associated with inflammatory biomarkers, and its reliability has been demonstrated in several studies of cardiovascular diseases,[6] respiratory diseases,[7,8] cancer,[9,10] depression and other mental health outcomes,[11-13] aging,[14] and mortality.[15] Moreover, several review papers have been published on the topic of DII.[16-18]

From an occupational health perspective, understanding dietary intake plays a crucial role in promoting the health of workers. Dietary patterns can vary based on SES, working hours, job type, employment status, age, and gender. Therefore, the objective of this study is to comprehensively examine the extent to which dietary patterns differ among occupational classifications and to quantify related health using the DII.

METHODS

Data sources and study population

This study used the Korean National Health and Nutritional Examination Survey (KNHANES), which is an ongoing annual cross-sectional survey program conducted by the Korea Centers for Disease Control and Prevention.[19] Each year, the survey collects data from a sample of 10,000 individuals selected through a 2-stage sampling method or complex sampling. The survey includes variables such as stratification, cluster, and weights, ensuring representation of Korea's total non-institutionalized civilian population.

The KNHANES data comprise information from health interviews, health examinations, and nutrition surveys. The nutrition survey specifically collects data on the frequency and quantity of food and nutrition intake, dietary behavior, and food stability. Trained investigators conduct computer-assisted personal interviews at the residences of the participants. During the interview, the participants are asked to recall their meals eaten in the past 24 hours, and the investigators directly assess the actual food recipes and cooking methods for further analysis.

This study used data from the KNHANES surveys conducted between 2016 and 2020, including 24-hour dietary recall data. The study population was individuals aged 19 to 65 years who were engaged in paid work. Soldiers were excluded from the analysis.

Variables

Dependent variables

The primary outcome of interest in this study is the DII score.[5] Participants were asked to provide information on their dietary intake for the last 24 hours. These data were converted into macronutrients and micronutrients (referred to as food parameters) using known nutrient information and recipes. From the 45 food parameters introduced for constructing and validating DII scores, a selection of 28 relevant food parameters was included based on the 24-hour dietary recall data. These parameters were alcohol, beta-carotene, caffeine,

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carbohydrates, cholesterol, energy, iron (Fe), fiber, folic acid, garlic, ginger, green/black tea, monounsaturated fatty acid, n-3 fatty acids, n-6 fatty acids, niacin, onion, pepper, protein, polyunsaturated fatty acid, riboflavin, saturated fat, thiamin, total fat, vitamin A, vitamin C, vitamin D, and vitamin E.

To calculate the DII scores, each participant's intake of each food parameter was compared with the global daily intake of that parameter. A z-score was derived for each food parameter of each participant using the global mean and SD for that specific parameter.[5]

$$Z-score = \frac{Daily\ Intake\ -\ Global\ Daily\ Intake\ (Mean)}{Global\ Daily\ Intake\ (SD)}$$

After calculating the z-scores for all food parameters, they were converted to a centered percentile value to minimize the effects of right skewing. This conversion was achieved by transforming the z-score to a percentile score, multiplying by 2, and then subtracting one.

$$Centered\ Percentile\ Value = (Z\text{-}score \rightarrow Percentile - Score) \times 2 - 1$$

In the final step, the centered percentile value obtained for each food parameter was multiplied by its corresponding overall inflammatory effect score. The results for each parameter were summed to obtain the overall DII score.[5]

$$\mathrm{DII} = \Sigma\ (Overall\ Inflammatory\ Effect\ Score \times Centered\ Percentile\ Value)$$

We also investigated dietary habits based on occupational classifications. The participants' food stability was assessed and categorized into 4 groups: very good (able to eat enough and a variety of foods), good (able to eat enough food but not a variety of foods), poor (occasional lack of food because of financial difficulties), and very poor (frequent lack of food because of financial difficulties). We also collected information on whether participants had diet control, categorizing their responses as yes (indicating the presence of any disease or weight control measures) or no. Participants who did not respond to the question regarding diet control were excluded from further analysis. Also, data with extreme energy intake values below 31.61321 kcal and above 4,141.27916 kcal were excluded.

Furthermore, we categorized the absence of food consumption within a 24-hour period into 4 groups: no missed meals, missed one meal, missed 2 meals, and missed 3 meals. The frequency of eating breakfast in the past year was assessed and grouped into 3 categories: never in a week, 1–4 times in a week, and 5–7 times in a week. The frequency of eating lunch and dinner was grouped into 2 categories: 0–4 times in a week and 5–7 times in a week. The frequency of dining out was assessed and divided into 3 categories: every day, every week, and every month or less.

Participants were asked whether they had received nutrition education or counseling at public centers, ward offices, community centers, schools, or hospitals within the past year. We also analyzed whether participants had consumed meals (breakfast, lunch, or dinner) at their workplace in the past 24 hours, categorizing the frequency of these meals as a home-cooked meal, restaurant food, store-bought food, group meal in the cafeteria, or convenience food. Additionally, we analyzed whether participants ate with family members, colleagues, or alone during meals at their workplace.

Independent variables

The independent variable in this study was participant occupation. KNHANES provides occupational information based on the International Standard Classifications of Occupations, which categorizes occupations according to skill and duty levels. We categorized the occupations into 4 groups as in other studies.[20,21]

- White-collar workers: This group includes legislators, senior officials, managers, professionals, technicians, and associated professionals.
- Green-collar workers: This group includes individuals in the agriculture, fishery, and forestry sectors.
- Pink-collar workers: This group includes clerks, salespeople, and individuals in customer service roles.
- Blue-collar workers: This group includes individuals in craft, plant and machine operation, assembly, and elementary worker roles.

Soldiers were excluded from the analysis because there were few in the dataset.

Other variables and confounding variables

For the descriptive analysis, several variables were included to describe the characteristics of the participants and to assess potential confounding factors. The variables comprised sex, age, age group, body mass index (BMI, underweight: BMI < 18.5 kg/m^2; normal weight: 25 kg/m^2 > BMI ≥ 18.5 kg/m^2; overweight: 30 kg/m^2 > BMI ≥ 25 kg/m^2; obese: BMI ≥ 30 kg/m^2), SES (income, education), and lifestyle variables (smoking status, drinking habits, physical activity). For self-acknowledged health status, participants were asked to rate their health status using a Likert scale with 5 options: very good, good, so-so, bad, and very bad.

In the analysis, age, sex, SES (income and education), and total energy intake were considered potential confounding factors. Age was later adjusted as a continuous variable in linear regression models.

Statistical analyses

To identify trends between variables based on occupational classifications, various statistical tests and analyses were conducted. For categorical variables, frequency distributions and descriptive statistics were calculated. The χ^2 test was used to assess the associations between categorical variables and occupational classifications. For continuous variables, descriptive statistics were calculated, and a Kruskal-Wallis Rank Sum Test was performed to compare the median and interquartile range (IQR) across occupational classifications.

To examine the differences in DII scores based on occupational classification, generalized linear models were used. Least-square means were calculated, and the models were adjusted for age, income, sex, education, and energy intake. Further analysis was conducted by stratifying the data according to sex to explore potential differences.

All models and analyses were performed using the libraries lsmeans 2.30-0, multcomp 1.4-22, survey 4.1-1, and survival 3.4-0 in R Statistical Software 4.2.2 (R Foundation, Vienna, Austria).[22]

Ethics statement

The use of original data from KNHANES in the study adheres to the personal information protection and statistics law. The study protocol was approved by the Institutional Review Board (IRB) of Hanyang University (IRB No. HYU-2022-244).

RESULTS

Participants

The actual sample sizes for the occupational classifications were 5,615 for white-collar workers, 468 for green-collar workers, 2,740 for pink-collar workers, and 3,369 for blue-collar workers. The demographic characteristics of the participants are presented in **Table 1.** Statistical significance was observed in sex, age, BMI, income, final education, drinking habits, smoking status, aerobic physical activity, self-acknowledged health status, and DII scores (all $p < 0.001$).

Table 1. Descriptive data by occupational classifications

Variables	White-collar (n = 5,615)	Green-collar (n = 468)	Pink-collar (n = 2,740)	Blue-collar (n = 3,369)	*p*-value[a]
Sex					< 0.001***
Male	2,567 (45.7)	265 (56.6)	875 (31.9)	2,159 (64.1)	
Female	3,048 (54.3)	203 (43.4)	1,865 (68.1)	1,210 (35.9)	
Age (year)	41.0 (33.0–49.0)	59.0 (53.0–62.0)	48.0 (36.0–56.0)	52.0 (42.0–59.0)	< 0.001***
Age group (year)					< 0.001***
19–29	852 (15.2)	5 (1.1)	473 (17.3)	236 (7.0)	
30–39	1,639 (29.2)	23 (4.9)	376 (13.7)	471 (14.0)	
40–49	1,794 (32.0)	45 (9.6)	641 (23.4)	781 (23.2)	
50–59	1,055 (18.8)	177 (37.8)	881 (32.2)	1,137 (33.7)	
60–65	275 (4.9)	218 (46.6)	369 (13.5)	744 (22.1)	
BMI					< 0.001***
Underweight	266 (4.7)	6 (1.3)	109 (4.0)	81 (2.4)	
Normal	3,536 (63.0)	247 (52.8)	1,684 (61.5)	1,960 (58.2)	
Overweight	1,528 (27.2)	183 (39.1)	780 (28.5)	1,113 (33.0)	
Obese	285 (5.1)	32 (6.8)	167 (6.1)	215 (6.4)	
Income					< 0.001***
Low	792 (14.1)	166 (35.5)	676 (24.7)	920 (27.3)	
Mid-low	1,170 (20.8)	123 (26.3)	776 (28.4)	994 (29.5)	
Mid-high	1,538 (27.4)	96 (20.5)	720 (26.3)	900 (26.8)	
High	2,113 (37.6)	83 (17.7)	565 (20.6)	550 (16.3)	
Final education					< 0.001***
Elementary school	16 (0.3)	144 (30.8)	215 (7.8)	462 (13.7)	
Middle school	42 (0.7)	102 (21.8)	297 (10.8)	552 (16.4)	
High school	1,153 (20.5)	129 (27.6)	1,355 (49.5)	1,630 (48.4)	
University or higher	4,404 (78.4)	93 (19.9)	872 (31.8)	725 (21.5)	
Drinking habits					< 0.001***
Non-drinker	2,087 (37.2)	200 (42.7)	1,083 (39.5)	1,298 (38.5)	
Mild drinker	2,678 (47.7)	170 (36.3)	1,212 (44.2)	1,326 (39.4)	
Heavy drinker	850 (15.1)	98 (20.9)	445 (16.2)	745 (22.1)	
Smoking status					< 0.001***
Never-smoker	1,306 (37.7)	66 (23.0)	659 (40.4)	531 (21.9)	
Current smoker	1,009 (29.2)	106 (36.9)	550 (33.7)	1,033 (42.7)	
Ex-smoker	1,146 (33.1)	115 (40.1)	421 (25.8)	858 (35.4)	
Aerobic physical activity					< 0.001***
Insufficient	2,898 (51.6)	300 (64.2)	1,506 (55.0)	1,883 (56.0)	
Sufficient	2,716 (48.4)	167 (35.8)	1,233 (45.0)	1,482 (44.0)	
Self-acknowledged health status					< 0.001***
Very good	293 (5.2)	20 (4.3)	121 (4.4)	137 (4.1)	
Good	1,801 (32.1)	103 (22.0)	700 (25.5)	802 (23.8)	
So-so	2,885 (51.4)	261 (55.8)	1,492 (54.5)	1,930 (57.3)	
Bad	594 (10.6)	68 (14.5)	388 (14.2)	446 (13.2)	
Very bad	42 (0.7)	16 (3.4)	39 (1.4)	54 (1.6)	
DII score	2.0 (0.7–3.2)	1.8 (0.3–3.0)	2.3 (1.0–3.4)	1.9 (0.7–3.1)	< 0.001***

Values are expressed as the number (%) or median (interquartile range).
BMI: body mass index; DII: Dietary Inflammatory Index.
[a]Result of χ^2 test or Kruskal-Wallis Rank Sum test.
***$p < 0.001$ (significant level).

There was a significant difference in the sex ratio among occupational classifications. The highest proportion of males was observed in the blue-collar group, while the lowest proportion was in the pink-collar group (64.1% vs. 31.9%, $p < 0.001$). The median age was highest among green-collar workers and lowest among white-collar workers (59.0 vs. 41.0, $p < 0.001$). The median and IQR of the DII scores were 2.0 (0.7–3.2) for white-collar workers, 1.8 (0.3–3.0) for green-collar workers, 2.3 (1.0–3.4) for pink-collar workers, and 1.9 (0.7–3.1) for blue-collar workers.

Dietary habits among occupational classifications

Table 2 presents the differences in dietary habits among occupational classifications. The majority of respondents indicated that food safety is very good or good. Regarding diet control, 30.3% of white-collar workers answered yes, while the percentages for green-collar, pink-collar, and blue-collar workers were 17.1%, 28.0%, and 21.4%, respectively.

The lowest incidence of the absence of food in the past 24 hours was observed among green-collar workers, while pink-collar workers reported the highest incidence. In terms of dining out frequency, the highest percentage that reported eating out every day was white-collar workers (69.5%), while the lowest percentage was green-collar workers (15.4%).

Participants were asked about the type of food they ate at the workplace in the last 24 hours and whether they had meal with someone at the workplace in the last 24 hours. Regarding meals at the workplace, 30.2% of white-collar workers, 7.3% of green-collar workers, 39.2% of pink-collar workers, and 35.5% of blue-collar workers reported having at least one meal at their workplace. Notably, 13.6% of pink-collar workers reported having 2 or more meals at their workplace in the last 24 hours.

Average dietary intake among occupational classifications

In **Supplementary Tables 1** and **2**, the average dietary intake is provided by occupational classification and sex. The DII score was significant in males but not significant in females. The DII scores for male white-collar, green-collar, pink-collar, and blue-collar workers were 1.4 ± 1.7, 1.3 ± 1.8, 1.9 ± 1.7, and 1.6 ± 1.7 ($p < 0.001$), respectively. For these same groups of females, the respective DII scores were 2.3 ± 1.6, 2.0 ± 1.8, 2.3 ± 1.6, and 2.3 ± 1.6 ($p = 0.102$). The difference in energy intake between occupational classifications was not statistically significant in males but was significant in females. Among females, white-collar workers tended to have the highest energy intake (1,733.6 ± 638.3), while blue-collar workers had the least (1,640.8 ± 623.1). Furthermore, the DII scores for each diet category of pro-inflammatory and anti-inflammatory foods were calculated. The pro-inflammatory DII score for all occupational classifications and sexes showed negative results, indicating that each group consumed fewer pro-inflammatory foods than the global mean. The pro-inflammatory DII scores for males in the white-collar, green-collar, pink-collar, and blue-collar categories were −0.3 ± 0.6, −0.5 ± 0.5, −0.3 ± 0.6, and −0.4 ± 0.5 ($p < 0.001$), respectively, while those for females were −0.6 ± 0.5, −0.7 ± 0.4, −0.7 ± 0.5, and −0.7 ± 0.4 ($p < 0.001$).

Alternatively, the DII scores for the anti-inflammatory diet were positive for all occupational classifications and sexes. This indicates that the study population in each group consumed less anti-inflammatory foods than the global mean. The anti-inflammatory DII scores for males in the white-collar, green-collar, pink-collar, and blue-collar categories were 1.7 ± 2.0, 1.8 ± 2.1, 2.2 ± 2.0, and 2.0 ± 1.9 ($p < 0.001$), respectively, while those for females were 2.9 ± 1.8, 2.7 ± 2.0, 2.9 ± 1.9, and 3.0 ± 1.8 ($p = 0.039$).

Table 2. Dietary habit differences among occupational classifications

Variables	White-collar (n = 5,615)	Green-collar (n = 468)	Pink-collar (n = 2,740)	Blue-collar (n = 3,369)	*p*-value[a]
Food stability					< 0.001***
Very good	2,929 (52.2)	207 (44.2)	1,253 (45.7)	1,378 (40.9)	
Good	1,485 (26.4)	127 (27.1)	950 (34.7)	1,175 (34.9)	
Poor	25 (0.4)	4 (0.9)	37 (1.4)	57 (1.7)	
Very poor	3 (0.1)	0 (0.0)	3 (0.1)	7 (0.2)	
Missing	1,173 (20.9)	130 (27.8)	497 (18.1)	752 (22.3)	
Having diet control					< 0.001***
Yes	1,704 (30.3)	80 (17.1)	767 (28.0)	721 (21.4)	
No	3,911 (69.7)	388 (82.9)	1,973 (72.0)	2,648 (78.6)	
Absence of food in last 24 hours					< 0.001***
No missed meal	3,324 (59.2)	384 (82.1)	1,532 (55.9)	2,202 (65.4)	
Missed 1 meal	2,084 (37.1)	79 (16.9)	1,069 (39.0)	1,077 (32.0)	
Missed 2 meals	207 (3.7)	5 (1.1)	139 (5.1)	90 (2.7)	
Missed 3 meals	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Frequency of eating breakfast in a week for last 1 year					0.668
Never	1,189 (56.4)	28 (57.1)	566 (58.6)	530 (58.1)	
1–4 times	919 (43.6)	21 (42.9)	400 (41.4)	383 (41.9)	
5–7 times	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Frequency of eating lunch in a week for last 1 year					< 0.001***
0–4 times	5,565 (99.1)	464 (99.1)	2,672 (97.5)	3,309 (98.2)	
5–7 times	50 (0.9)	4 (0.9)	68 (2.5)	60 (1.8)	
Frequency of eating dinner in a week for last 1 year					< 0.001***
0–4 times	5,590 (99.6)	467 (99.8)	2,711 (98.9)	3,355 (99.6)	
5–7 times	25 (0.4)	1 (0.2)	29 (1.1)	14 (0.4)	
Frequency of dining out					< 0.001***
Everyday	3,904 (69.5)	72 (15.4)	1,249 (45.6)	1,944 (57.7)	
Everyweek	1,382 (24.6)	180 (38.5)	954 (34.8)	821 (24.4)	
Everymonth or less	328 (5.8)	215 (46.0)	537 (19.6)	604 (17.9)	
Received nutrition education or counseling					< 0.001***
Yes	334 (5.9)	26 (5.6)	121 (4.4)	109 (3.2)	
No	5,280 (94.0)	442 (94.4)	2,619 (95.6)	3,260 (96.8)	
Had meal at working place in last 24 hours					< 0.001***
None	3,921 (69.8)	434 (92.7)	1,666 (60.8)	2,174 (64.5)	
Once	1,369 (24.4)	27 (5.8)	702 (25.6)	866 (25.7)	
Twice or more	325 (5.8)	7 (1.5)	372 (13.6)	329 (9.8)	
	(n = 1,534)	(n = 30)	(n = 847)	(n = 957)	
Type of food ate at working place in last 24 hours					< 0.001***
Home meal	188 (12.3)	8 (26.7)	297 (35.1)	198 (20.7)	
Restaurant food	359 (23.4)	5 (16.7)	220 (26.0)	192 (20.1)	
General food	168 (11.0)	4 (13.3)	78 (9.2)	62 (6.5)	
Grouped meal in cafeteria	743 (48.4)	8 (26.7)	196 (23.1)	462 (48.3)	
Convenience food	76 (5.0)	5 (16.7)	56 (6.6)	43 (4.5)	
Had meal with someone ate at working place in last 24 hours					< 0.001***
Alone	373 (25.2)	7 (24.1)	256 (32.7)	168 (18.0)	
With family	33 (2.2)	4 (13.8)	92 (11.7)	33 (3.5)	
With college	1,077 (72.6)	18 (62.1)	436 (55.6)	730 (78.4)	

Values are expressed as the number (%).
[a]Result of χ^2 test.
***$p < 0.001$ (significant level).

Based on these results, it can be inferred that the higher DII score in females compared with males is influenced by their intake of smaller amount of anti-inflammatory foods. However, no difference in DII score was observed between occupational classifications in females.

Crude and adjusted mean DII scores (95% confidence intervals [CIs]) by occupational classification

Table 3 and **Fig. 1** shows the crude and adjusted means and 95% CIs of DII scores categorized by occupational classification using the least-square means of a generalized linear model. The entire sample and the results are weighted using the survey data. Pink-collar workers exhibited higher DII scores compared to white-collar workers (2.18 vs. 1.89, $p < 0.001$),

Table 3. Crude and adjusted mean Dietary Inflammatory Index score (95% confidence interval) by occupational classification

Job collars	All subjects				Males				Females			
	Crude	*p*-value	Adjusted[a]	*p*-value[b]	Crude	*p*-value	Adjusted[c]	*p*-value	Crude	*p*-value	Adjusted[c]	*p*-value
White-collar	1.89 (1.84–1.93)	-	1.97 (1.91–2.04)	-	1.50 (1.43–1.57)	-	1.62 (1.52–1.72)	-	2.34 (2.27–2.40)	-	2.31 (2.23–2.39)	-
Green-collar	1.64 (1.44–1.84)	0.019*	2.03 (1.87–2.19)	0.508	1.45 (1.19–1.71)	0.708	1.69 (1.48–1.90)	0.557	2.02 (1.72–2.32)	0.041*	2.32 (2.08–2.55)	0.960
Pink-collar	2.18 (2.11–2.25)	< 0.001***	2.11 (2.05–2.18)	< 0.001***	1.96 (1.84–2.08)	< 0.001***	1.90 (1.79–2.01)	< 0.001***	2.33 (2.25–2.42)	0.972	2.36 (2.28–2.43)	0.335
Blue-collar	1.79 (1.72–1.86)	0.022*	2.04 (1.99–2.10)	0.083	1.60 (1.52–1.68)	0.080	1.69 (1.61–1.77)	0.202	2.29 (2.19–2.39)	0.476	2.39 (2.30–2.47)	0.190

[a]Results are averaged over the levels of: sex, age, income, education, energy intake.
[b]Result of generalized linear model, least square means with weighted data.
[c]Results are averaged over the levels of age, income, education, energy intake.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ (significant level).

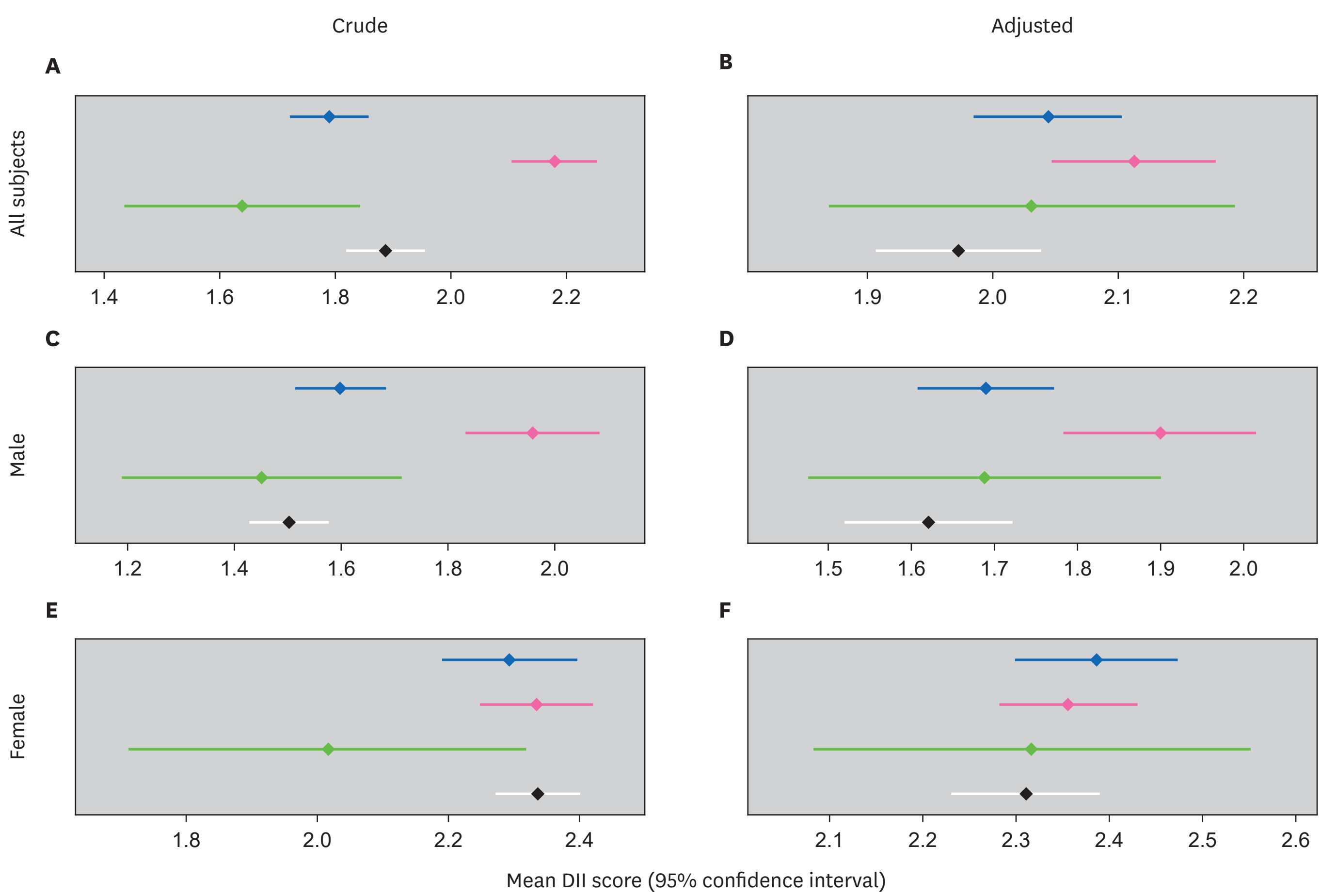

Fig. 1. Crude and adjusted mean DII score (95% confidence interval) by occupational classifications. Occupational classifications are blue, pink, green, white in order and by color of lines. (A) Crude mean DII in all subjects. (B) Adjusted mean DII in all subjects. (C) Crude mean DII in males. (D) Adjusted mean DII in males. (E) Crude mean DII in females. (F) Adjusted mean DII in females.
DII: Dietary Inflammatory Index.

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indicating a potentially higher inflammatory diet. Conversely green and blue-collar workers had lower DII scores compared with white-collar workers (green: 1.64 vs. 1.89, $p = 0.019$, blue: 1.79 vs. 1.89, $p = 0.005$) (1.68 vs. 1.80, $p = 0.022$), suggesting a potentially less inflammatory diet. After adjusting for sex, age, income, education, and energy intake, pink-collar workers continued to show higher DII scores than white-collar workers (2.11 vs. 1.97, $p < 0.001$). Blue-collar showed a higher DII scores than white-collar workers, although this difference was not statistically significant.

In the sub-analysis stratified by sex, we observed differences in the crude and adjusted means of DII scores between males and females. Females exhibited higher DII scores than males across occupational classifications. Among males, pink-collar workers continued to demonstrate higher DII scores than white-collar workers in both the crude and adjusted models (1.96 vs. 1.50, $p < 0.001$; 1.90 vs. 1.62, $p < 0.001$). However, green and blue-collar workers did not show a significant difference in DII scores compared with white-collar workers. In contrast, there was no significant difference in DII scores among white-collar female workers compared with pink and blue-collar workers. Green-collar workers exhibited statistically significantly lower DII scores compared with white-collar workers in the crude model (2.02 vs. 2.34, $p = 0.041$).

DISCUSSION

Diets relate to hypertension, cardiovascular disease,[23] cancer,[24] depression and mental health,[25] as well as aging.[26] Recognizing the importance of diet as a determinant of disease risk, the World Health Organization (WHO) has included strategies to address unhealthy diets. Dietary changes recommended by the WHO include a balanced energy intake, limited saturated and trans fats, a switch to unsaturated fat consumption, an increase in fruit and vegetable intake, and limited sugar and salt intake.

This study examined the differences in DII scores between occupational groups and genders using linear regression analysis and least square means. Overall, we found that pink-collar workers had significantly higher DII scores than white-collar workers, while blue-collar workers and green-collar workers had lower DII scores. After adjusting for sex, age, income, education and energy intake, the only trend of white-collar workers compared to pink-collar workers remained the same.

When we stratified the analysis by gender, notable distinctions emerged between males and females. Among males, a significant difference in DII scores was observed between white-collar and pink-collar workers, with pink-collar workers having higher scores. However, no significant difference in DII scores was found among white and pink-collar female workers. Considering this, it is important to compare with existing literature exploring gender-based dietary differences. A study with British police employees suggested that shorter working hours in females and different job roles between males and females might contribute to females having more control over their dietary choices.[27] Other literature notes that females typically handle cooking and food preparation, suggesting that they hold decision-making authority and interest in meals.[28] Therefore, the lack of significant DII score differences between occupations among females could be due to their involvement in decision-making and interest in dietary matters across jobs.

It is essential to explore the DII score differences between genders, in addition to within each gender as mentioned above. The variation in DII scores between males and females arises from differences in total energy intake. Females tend to have lower intakes across all food parameters, as indicated in the **Supplementary Tables 1** and **2**. Particularly, the lower intake of anti-inflammatory diets in females contributes to higher DII scores for females. Females generally consume more fruits and vegetables, and less processed and red meat,[27] or consume more fruits and fiber, and less high-fat foods and salt.[29] In contrast, this study observed lower absolute intake of diets known to be healthy, leading to an inability to lower the inflammatory index and consequently resulting in higher DII scores. Recognizing the differences in total energy intake across population groups, the study corrected for total energy intake, yet the substantial DII score differences based on gender suggest limitations in the DII score. Therefore, considering the significant gender-related differences, using the Energy-adjusted DII (E-DII) in the analysis could be explored. The E-DII, developed to account for differences in total energy intake across population groups, has been primarily utilized in cross-national studies involving races and nations.[16]

It is necessary to consider the differences in diets between occupational classifications. Previous studies have reported differences in dietary patterns among various occupational groups. For example, blue-collar workers tend to consume higher levels of cholesterol and calories, as well as higher levels of fiber, sodium, total fat, saturated fat, and multiple unsaturated fats than white-collar workers.[30] In this study, fiber intake among males was highest in green-collar workers, while white-collar workers had the highest intake of total fats, saturated fats, and n-6 fatty acids. This same pattern was observed among female white-collar workers.

Various factors can influence the link between occupation and diet. The social context often shapes eating habits. Workers with higher occupational status report lower total fat, saturated fat, and total energy intake, as well as higher fiber intake.[31-34] However, the relationship between occupation and diet is complex and can be influenced by individual, social, and organizational factors.[1,35] Factors such as work demands, availability of meal times, access to convenient meals, presence of workplace cafeterias, and eating habits of co-workers can all contribute to the observed differences in diet.

The findings of our study provide valuable information for health managers, employers, and nutritionists in companies because they highlight differences in diet and DII scores among occupational groups. The data can be instrumental in designing targeted interventions and programs aimed at improving the dietary habits and overall health of workers, particularly in occupational settings. The study's results can be valuable for informing public health strategies, helping policymakers address specific dietary challenges associated with different occupational categories. Understanding the nutrients that are lacking and understanding the factors influencing poor dietary habits can help guide efforts to promote healthy eating habits. This targeted approach may enhance the effectiveness of health promotion initiatives.

The findings of this study highlight the importance of considering the role of diet in occupational classifications and its potential implications for health. The results suggest gender-specific differences in the relationship between occupation and DII scores, with significant differences in white-collar workers and pink-collar workers observed among males but not among females. It is important to further investigate these gender-specific differences and to explore the underlying factors contributing to them.

This study is the first to provide valuable insights into the variations in DII scores across different occupational groups. The strength of this study lies in the utilization of nationally representative data and face-to-face interviews conducted by trained surveyors within a substantial sample size. However, it is important to acknowledge the limitations of the study such as the potential for recall bias associated with 24-hour dietary recalls. Participants may not accurately remember and report their entire dietary intake, leading to an underestimation or overestimation of actual consumption. The cross-sectional nature of the data limits the ability to establish causal relationships. However, the likelihood of causation operating in the opposite direction, where diet influences occupation, is low.

CONCLUSIONS

Using secondary data from KNHANES, we examined the differences in DII scores among Korean workers and observed variations in nutrient intake. The DII score is a measure of the inflammatory potential of an individual's diet and utilizing it as an index for promoting appropriate dietary choices can be instrumental in reducing the risk of chronic diseases and managing them. Furthermore, we conducted a gender stratification analysis and found that the trends in DII scores differed across sex and occupational groups. Our results suggest that the relationship difference in DII score may vary by gender and occupational classification, and further research may be needed to explore these gender-specific differences and their underlying factors.

SUPPLEMENTARY MATERIALS

Supplementary Table 1

Intake of diets among occupational classifications for males

Supplementary Table 2

Intake of diets among occupational classifications for females

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