A comparison of food and nutrient intake between instant noodle consumers and non-instant noodle consumers in Korean adults

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Abstract

Instant noodles are widely consumed in Asian countries. The Korean population consumed the largest quantity of instant noodles in the world in 2008. However, few studies have investigated the relationship between instant noodles and nutritional status in Koreans. The objective of this study was to examine the association between instant noodle consumption and food and nutrient intake in Korean adults. We used dietary data of 6,440 subjects aged 20 years and older who participated in the Korean National Health and Nutrition Examination Survey III. The average age of the instant noodle consumers (INC) was 36.2 and that of the non-instant noodle consumers (non-INC) was 44.9; men consumed more instant noodles than women (P<0.001). With the exception of cereals and grain products, legumes, seaweeds, eggs, and milk and dairy products, INC consumed significantly fewer potatoes and starches, sugars, seeds and nuts, vegetables, mushrooms, fruits, seasonings, beverages, meats, fishes, and oils and fats compared with those in the non-INC group. The INC group showed significantly higher nutrient intake of energy, fat, sodium, thiamine, and riboflavin; however, the INC group showed a significantly lower intake of protein, calcium, phosphorus, iron, potassium, vitamin A, niacin, and vitamin C compared with those in the non-INC group. This study revealed that consuming instant noodles may lead to excessive intake of energy, fats, and sodium but may also cause increased intake of thiamine and riboflavin. Therefore, nutritional education helping adults to choose a balanced meal while consuming instant noodles should be implemented. Additionally, instant noodle manufacturers should consider nutritional aspects when developing new products.

Key Words: Instant noodle, ramyon, food intake, nutrient intake, Korean

Introduction

Instant noodles, a steamed and deep-oil fried noodle that is also known as ramen in Japan and ramyon in Korea, originated in Japan in the 1950s and are currently produced in over 80 countries [1]. As of 2008, approximately 93.6 billion servings of instant noodles have been consumed worldwide [2]. Chinese consumed 45.2 billion packages of instant noodles in 2008, representing 51% of the global consumption of instant noodles, whereas Indonesians consumed 13.7 billion packages, Japanese consumed 5.1 billion packages, Americans consumed 4.3 billion packages, and South Koreans consumed 3.3 billion packages [2]. South Koreans eat the highest per capita quantity of instant noodles at 69 servings per year, which is 4.8 times higher than the consumption of Americans, and 1.7 times higher than the per capita consumption in Japan. Based on the Korean National Health and Nutrition Examination Survey (KNHANES) III report [3], instant noodles were consumed at a level of 18.1 g per day per capita nationwide, which made this the second largest food type after steamed rice that contributes to the overall energy intake of individuals.

Instant noodles are often criticized as unhealthy or as a type of junk food. A single serving of instant noodles is usually high in carbohydrates but is low in fiber, vitamins, and minerals. Instant noodle manufacturers have made efforts to lower the sodium and fat content in response to public health concerns [4]. Instant noodles are now promoted as a nutrient vehicle in developing countries by fortifying either the flours used to make the noodles or the seasoning powders consumed with the noodles [5,6].

The popularity of instant noodles has been expanding very rapidly during recent decades due to their convenience and reasonable price [2]. However, few data are available with respect to the nutritional status of instant noodle consumers in both Asian and western countries [2]. As Koreans consume the largest quantity of instant noodles, it is necessary to identify the relationship between instant noodle consumption and nutritional status and food consumption patterns of Koreans. Therefore, we...
compared food and nutrient intake in Korean adults that consume instant noodles with those who do not consume instant noodles using data from KNHANES III to examine the nutritional status of instant noodle consumers (INC). We also evaluated whether the nutrient intake of Koreans consuming instant noodles is appropriate in comparison to the Korean dietary reference intakes (KDRI) [7]. We hope that this study will help to construct guidelines for nutritional education regarding instant noodle consumption.

Subjects and Methods

Study population

The data analyzed in the present study were obtained from KNHANES III, a study conducted by the Ministry for Health, Welfare, and Family Affairs in Korea in 2005. KNHANES consisted of health behavior, health examination, and nutritional surveys. The surveys were given to stratified multistage samples of the Korean population from multiple geographic areas, ages, and genders. In total, 33,848 people responded to the KNHANES III survey; 6,440 adults aged 20 years and older participated in both the health examination and the nutrition surveys and were selected for the present study. Energy and food intake was obtained from the nutrition survey, whereas data on height, weight, and body mass index (BMI) were obtained from the health examination survey.

As part of the standard KNHANES data collection protocol, 24-hour dietary recalls were elicited and were used here to estimate food and nutrient intake. General characteristics, food and nutrient intake, and anthropometric data were compared across the INC and non-instant noodle consumers (non-INC). Income groups were categorized according to the average monthly income in 2005 in relation to the minimum cost of living. Low income was defined as an average monthly income that was, at most, 1.2 times the minimum cost of living, a middle income was defined as an average monthly income that was > 2.5 times the minimum cost of living × 2.5 and a high income was defined as an average monthly income that was > 2.5 times the minimum cost of living × 2.5.

Results

General characteristics of the participants in the two groups with respect to instant noodle intake are shown in Table 1.

### Table 1. General characteristics of study subjects with respect to the consumption of instant noodles in Korean adults

| Age group (yrs) | N-INC (n = 5,666) | INC (n = 774) | P-value |
|----------------|-------------------|---------------|---------|
| 20–49          | 44.9 ± 0.3        | 36.2 ± 0.5    | < 0.001 |
| 50–64          | 1,360 (21.4, 0.7) | 92 (9.4, 1.1) | < 0.001 |
| ≥ 65           | 959 (13.6, 0.6)  | 45 (3.8, 0.6) |         |
| Sex            |                   |               |         |
| Male           | 2,425 (47.2, 0.7) | 452 (63.5, 1.9)| < 0.001 |
| Female         | 3,241 (62.8, 0.7) | 322 (36.5, 1.9)|         |
| Income         |                   |               |         |
| Low            | 1,388 (22.3, 1.1) | 144 (17.3, 1.8)| 0.009   |
| Middle         | 2,067 (36.8, 1.0) | 320 (41.9, 2.2)|         |
| High           | 2,211 (40.9, 1.4) | 310 (40.8, 2.2)|         |
| Education      |                   |               |         |
| Middle school  | 2,074 (31.3, 1.0) | 150 (15.5, 1.7)| < 0.001 |
| High school    | 1,917 (34.9, 0.9) | 311 (41.1, 2.2)|         |
| College or higher | 1,675 (33.8, 1.2)| 313 (43.4, 2.4)|         |
| Region         |                   |               |         |
| Large city     | 2,577 (47.2, 1.0) | 392 (50.5, 2.4)| 0.053   |
| Small city     | 1,837 (33.6, 1.1) | 258 (34.5, 2.5)|         |
| Rural area     | 1,252 (23.2, 1.0) | 124 (15.0, 1.8)|         |
| Weight (kg)    | 62.4 ± 0.2        | 63.7 ± 0.6    | 0.032   |
| Height (cm)    | 162.3 ± 0.1       | 163.8 ± 0.4   | 0.001   |
| BMI (kg/m²)    | 23.6 ± 0.1        | 23.7 ± 0.1    | 0.724   |

Non-INCa, non-instant noodle consumer group
INCb, instant noodle consumer group
Mean ± SE
N (%, SE)
Low income: monthly income < minimum cost of living × 1.2
Middle income: minimum cost of living × 1.2 ≤ monthly income < minimum cost of living × 2.5
High income: monthly income ≥ minimum cost of living × 2.5
Adjusted for age.
Subjects consuming instant noodles accounted for 12.0% of the 6,440 participants. The mean age of the participants in the INC group was lower than that in the non-INC group (36.2 vs. 44.9 yrs, respectively). Age and gender differences were observed for instant noodle consumption. Participants aged 20-49 years accounted for 86.8% of the INC group; this proportion was significantly higher than that in the non-INC group after adjusting for age. Additionally, the INC group consumed more fat, sodium, thiamine, and riboflavin than those in the non-INC group (P = 0.05). In contrast, the intake of potatoes and starches, sugars and sweets, seeds and nuts, vegetables, mushrooms, fruits, beverages, seasonings, meats, fishes, and oils and fats in the non-INC group was significantly higher than those in the INC group. This food intake pattern was similar for both men and women. However, seeds and nuts, mushrooms, and beverages in the INC group did not differ from those of the non-INC group in men, whereas women in the INC group had a significantly lower intake of legumes and their products compared with women in the non-INC group.

The daily nutrient intake of the INC and non-INC groups is shown along with the contribution of instant noodles in Table 3. The INC group had a significantly higher total energy intake than that in the non-INC group (2,024.6 kcal/day vs. 2,252.3 kcal/day) after adjusting for age. Additionally, the INC group consumed more fat, sodium, thiamine, and riboflavin than those in the non-INC group after adjusting for age and energy intake. In contrast, lower intake of protein, calcium, phosphorus, iron, potassium, vitamin A, niacin, and vitamin C was observed in the INC group. The percentages of energy from carbohydrates was significantly higher than that of the INC group after adjusting for age and energy intake. When we looked separately at each individual food group, intake of cereals and grain products in the INC group was significantly higher than those in the non-INC group (P = 0.05). In contrast, the intake of potatoes and starches, sugars and sweets, seeds and nuts, vegetables, mushrooms, fruits, beverages, seasonings, meats, fishes, and oils and fats in the non-INC group was significantly higher than those in the INC group. This food intake pattern was similar for both men and women. However, seeds and nuts, mushrooms, and beverages in the INC group did not differ from those of the non-INC group in men, whereas women in the INC group had a significantly lower intake of legumes and their products compared with women in the non-INC group.

As shown in Table 2, the intake of total plant-originating foods, animal-originating foods, and total food in the non-INC group was significantly higher than that of the INC group after adjusting for age and energy intake. When we looked separately at each individual food group, intake of cereals and grain products in the INC group was significantly higher than those in the non-INC group (P = 0.05). In contrast, the intake of potatoes and starches, sugars and sweets, seeds and nuts, vegetables, mushrooms, fruits, beverages, seasonings, meats, fishes, and oils and fats in the non-INC group was significantly higher than those in the INC group. This food intake pattern was similar for both men and women. However, seeds and nuts, mushrooms, and beverages in the INC group did not differ from those of the non-INC group in men, whereas women in the INC group had a significantly lower intake of legumes and their products compared with women in the non-INC group.

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### Table 2. Comparison of food intake in study subjects with respect to instant noodle consumption in Korean adults (g/day)

|                          | Total Male | Non-INC (n = 5,866) | INC (n = 774) | Total Female | Non-INC (n = 2,425) | INC (n = 452) | Non-INC (n = 3,241) | INC (n = 322) |
|--------------------------|------------|---------------------|---------------|--------------|---------------------|---------------|---------------------|---------------|
| Plant food intake        | 1,117.9 ± 8.7 | 964.9 ± 18.1 | 1,277.6 ± 13.3 | 1,109.5 ± 25.1 | 961.8 ± 8.7 | 832.8 ± 19.9 |
| Cereals and grain products| 322.8 ± 2.2 | 364.8 ± 4.3 | 351.8 ± 3.4 | 402.0 ± 6.2 | 293.9 ± 2.1 | 325.6 ± 5.8 |
| Potatoes and starches     | 21.4 ± 1.0 | 9.7 ± 1.8 | 22.1 ± 1.4 | 9.2 ± 2.0 | 20.7 ± 1.1 | 12.2 ± 3.3 |
| Sugars and sweets         | 8.2 ± 0.2 | 6.5 ± 0.5 | 9.6 ± 0.3 | 8.0 ± 0.6 | 6.8 ± 0.2 | 5.0 ± 0.6 |
| Legumes and their products| 41.9 ± 1.2 | 35.8 ± 3.9 | 46.5 ± 1.7 | 42.1 ± 5.7 | 37.6 ± 1.4 | 27.5 ± 3.6 |
| Seeds and nuts            | 4.9 ± 0.3 | 3.4 ± 0.5 | 5.6 ± 0.4 | 4.5 ± 0.8 | 4.3 ± 0.3 | 2.1 ± 0.5 |
| Vegetables                | 377.9 ± 3.8 | 302.2 ± 8.3 | 425.9 ± 6.1 | 338.8 ± 10.8 | 331.6 ± 3.4 | 267.6 ± 11.6 |
| Mushrooms                 | 4.8 ± 0.3 | 2.8 ± 0.6 | 4.9 ± 0.4 | 3.2 ± 0.8 | 4.7 ± 0.3 | 2.5 ± 0.7 |
| Fruits                    | 92.7 ± 4.4 | 58.4 ± 7.8 | 82.9 ± 5.1 | 49.4 ± 8.0 | 100.8 ± 5.3 | 80.2 ± 13.4 |
| Seaweeds                  | 9.8 ± 0.5 | 8.2 ± 1.3 | 9.4 ± 0.7 | 6.8 ± 1.2 | 10.1 ± 0.6 | 11.1 ± 2.3 |
| Beverages                 | 170.0 ± 7.9 | 131.7 ± 14.6 | 247.9 ± 14.0 | 199.7 ± 21.8 | 98.4 ± 6.5 | 58.8 ± 13.5 |
| Seasonings                | 43.0 ± 0.6 | 26.5 ± 1.2 | 49.2 ± 0.9 | 30.5 ± 1.8 | 38.9 ± 0.6 | 24.1 ± 1.6 |
| Oils and fats             | 10.4 ± 0.2 | 6.7 ± 0.4 | 12.3 ± 0.3 | 8.4 ± 0.6 | 8.7 ± 0.2 | 5.0 ± 0.4 |
| Others                    | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Animal food intake        | 262.1 ± 3.6 | 196.9 ± 8.3 | 296.3 ± 4.6 | 222.3 ± 10.8 | 228.5 ± 4.5 | 181.3 ± 13.1 |
| Meat, poultry and their products | 98.9 ± 3.0 | 66.1 ± 4.5 | 119.1 ± 3.7 | 82.0 ± 5.9 | 79.2 ± 3.8 | 52.9 ± 7.2 |
| Eggs                      | 24.4 ± 0.8 | 23.8 ± 1.5 | 27.9 ± 1.2 | 28.9 ± 2.0 | 21.0 ± 0.8 | 18.1 ± 1.8 |
| Fishes and shell fishes   | 78.7 ± 1.9 | 52.6 ± 4.8 | 94.0 ± 3.0 | 64.5 ± 6.2 | 63.9 ± 1.9 | 41.5 ± 5.0 |
| Milks and dairy products  | 59.9 ± 2.1 | 53.4 ± 6.1 | 54.9 ± 3.0 | 45.3 ± 6.6 | 64.3 ± 2.5 | 68.7 ± 11.1 |
| Oils and fats             | 0.1 ± 0.0 | 0.0 ± 0.0 | 0.1 ± 0.0 | 0.0 ± 0.0 | 0.1 ± 0.0 | 0.0 ± 0.0 |
| Others                    | 0.2 ± 0.1 | 0.9 ± 0.8 | 0.3 ± 0.1 | 1.6 ± 1.2 | 0.1 ± 0.0 | 0.0 ± 0.0 |
| Total food intake         | 1,380.0 ± 9.0 | 1,161.7 ± 18.1 | 1,573.9 ± 13.9 | 1,331.8 ± 24.8 | 1,190.3 ± 9.4 | 1,014.1 ± 23.0 |

Adjusted for age and energy intake

*INC: instant noodle consumer group

*Significantly different between non-INC and INC groups at P = 0.05, as indicated by the t-test.
Table 3. Comparison of daily nutrient intake in study subjects according to instant noodle consumption in Korean adults

|                | Total (n = 5,666) | Male (n = 2,425) | Female (n = 3,241) |
|----------------|-------------------|------------------|-------------------|
| Energy (kcal)  | 2,044.6 ± 16.9*   | 2,052 ± 17.1     | 2,036 ± 16.8      |
| Protein (g)    | 70.6 ± 0.4*       | 66.8 ± 0.8       | 74.4 ± 0.8        |
| Fat (g)        | 42.7 ± 0.4*       | 41.9 ± 0.7       | 43.2 ± 0.7        |
| Carbohydrates  | 314.0 ± 2.0*      | 307.2 ± 2.4      | 321.8 ± 2.2       |
| Ca (mg)        | 574.9 ± 6.6*      | 553.9 ± 7.2      | 596.0 ± 6.8       |
| Na (mg)        | 5,588.5 ± 21.8    | 5,506.9 ± 21.4   | 5,670.5 ± 22.1    |
| Fe (mg)        | 14.9 ± 0.1*       | 14.1 ± 0.5       | 15.7 ± 0.5        |
| P (mg)         | 1,306.3 ± 6.9*    | 1,209.1 ± 6.3    | 1,403.7 ± 7.2     |
| Ca 315.0 ± 2.0* | 307.0 ± 2.4       | 321.0 ± 2.2      | 315.0 ± 2.0*      |
| Mn 0.3 ± 0.1    | 0.3 ± 0.1         | 0.3 ± 0.1        | 0.3 ± 0.1         |
| Cu 0.3 ± 0.1   | 0.3 ± 0.1         | 0.3 ± 0.1        | 0.3 ± 0.1         |
| Zn 1.3 ± 0.03  | 1.3 ± 0.1         | 1.3 ± 0.1        | 1.3 ± 0.1         |
| K 81.6 ± 0.1   | 81.0 ± 0.1        | 82.1 ± 0.1       | 81.2 ± 0.1        |
| Mg 186.6 ± 1.0 | 186.0 ± 1.0       | 187.2 ± 1.0      | 186.4 ± 1.0       |
| Vitamin A (ug RE) | 1,108.9 ± 4.1 | 1,064.1 ± 4.0 | 1,153.7 ± 4.4 |
| Vitamin C (mg) | 108.2 ± 1.8*      | 107.8 ± 2.0      | 110.0 ± 1.9       |
| Niacin (mgNE)  | 18.5 ± 0.1*       | 18.1 ± 0.2       | 19.0 ± 0.2        |
| Riboflavin     | 87.0 ± 1.1*       | 86.4 ± 1.2       | 87.6 ± 1.3        |
| Thiamine       | 108.9 ± 2.0*      | 108.5 ± 2.1      | 110.0 ± 2.2       |
| Vitamin D (IU) | 7,297.0 ± 24.9    | 7,243.0 ± 24.7   | 7,351.0 ± 25.0    |
| Total intake   | 6,456.9 ± 32.9    | 6,362.6 ± 32.4   | 6,550.3 ± 33.6    |
| Protein (%)    | 17.7 ± 0.2*       | 17.9 ± 0.3       | 17.5 ± 0.2        |
| Fat (%)        | 25.4 ± 0.8        | 25.2 ± 0.9       | 25.6 ± 0.8        |
| Energy (%)     | 23.8 ± 0.8        | 23.7 ± 0.9       | 24.0 ± 0.8        |

* Significantly different between the non-INC and INC groups at P = 0.05, as indicated by the t-test.

Table 4. Comparison of the percentage of Korean dietary reference intakes (KDRI) * according to instant noodle consumption in Korean adults (%)

|                | Total (n = 5,666) | Male (n = 2,425) | Female (n = 3,241) |
|----------------|-------------------|------------------|-------------------|
| Energy (%)     | 95.8 ± 0.8*       | 95.3 ± 0.9       | 96.3 ± 0.9        |
| Protein (%)    | 161.2 ± 0.9*      | 159.0 ± 0.9      | 163.3 ± 1.0       |
| Ca (%)         | 81.6 ± 0.9*       | 79.7 ± 0.9       | 83.5 ± 0.9        |
| P (%)          | 186.6 ± 1.0*      | 184.5 ± 1.0      | 190.7 ± 1.1       |
| Fe (%)         | 137.6 ± 1.5*      | 135.7 ± 1.6      | 141.6 ± 1.7       |
| Na (%)         | 393.4 ± 3.4*      | 389.2 ± 3.6      | 400.6 ± 3.7       |
| K (%)          | 64.2 ± 0.4*       | 64.1 ± 0.5       | 65.0 ± 0.5        |
| Vitamin A (%)  | 95.7 ± 0.8*       | 95.0 ± 0.9       | 96.5 ± 0.9        |
| Vitamin C (%)  | 119.3 ± 1.3*      | 117.9 ± 1.4      | 122.1 ± 1.5       |
| Total intake   | 779.0 ± 12.5*     | 763.4 ± 12.7     | 795.6 ± 13.0      |

* Significantly different between the non-INC and INC groups at P = 0.05, as indicated by the t-test.
...and proteins in the non-INC group were higher than those of
the INC group, whereas the percentage of energy from fat in the
INC group was 4.2% higher than that of the non-INC group
(17.7% vs. 21.9%, respectively). Instant noodle consumption
contributed 24.8% to total energy intake, 38.4% of fat intake,
31.0% of sodium intake, 41.7% of thiamine intake, and 34.6% of
the riboflavin intake in the INC group.

A similar pattern was observed when the groups were divided
into men and women. Both men and women in the INC group
had a higher intake of total energy, fat, sodium, thiamine, and
riboflavin but a lower intake of protein, calcium, phosphorus,
iron, potassium, vitamin A, niacin, and vitamin C when compared
with those in the non-INC group. The percentages of energy from
carbohydrate and protein in both men and women of the non-INC
group were higher than those in the INC group, whereas the
percentage of energy from fat in the INC group was approximately
4% higher than that in the non-INC group.

Table 4 shows a comparison of the nutrient intake of the INC
and non-INC groups in Korea to that of the KDRI. The percentage
comparisons to the KDRI for total energy, sodium, thiamine, and
riboflavin in the INC group were higher than those of the
non-INC group. In contrast, the percentage comparisons to
the KDRI for protein, calcium, phosphorus, iron, potassium,
vitamin A, niacin, and vitamin C in the INC group were lower
than those of the non-INC group. Among them, the intake of
calcium, potassium, and vitamin C were lower than the KDRI
reference values. Sodium intake in the INC group was 4.52 times
higher than that of the KDRI, whereas that of the non-INC group
was 3.93 times higher. Instant noodles provided 139.1% of the
sodium KDRI in the INC group. Thiamine and riboflavin from
instant noodles provided 63.3% and 36.8% of the KDRI,
respectively. Similar patterns in men and women with those in
the total population were observed for various nutrients; the
calcium, potassium, and vitamin C values in the INC group were
lower than the KDRI reference values in men (calcium, 75.7%
vs. 89.6%; potassium, 60.9% vs. 71.5%; vitamin C, 79.2% vs.
116.3%, respectively). In women, the INC group showed lower
percentages in comparison with the KDRI for calcium, iron,
potassium, niacin, and vitamin C than those in the non-INC
group, whereas the percentage comparisons to the KDRI for
energy, sodium, thiamine, and riboflavin were higher than those
of the non-INC group.

Discussion

This study revealed that INC consumed significantly lower
amounts of potatoes and starchy foods, sugars, seeds and nuts,
vegetables, fruits, beverages, seasonings, oils and fats, meats and
fishes than those in the non-INC group, with the exception of
cereals and grain products, legumes, seaweeds, eggs, and milk
dairy products. The INC group showed significantly higher
intake of energy, fat, sodium, thiamine, and riboflavin; however,
the INC group showed a significantly lower intake of calcium,
phosphorus, iron, potassium, vitamin A, niacin, and vitamin C
when compared to those in the non-INC group.

It is rare to find peer-reviewed studies that have evaluated the
relationship between instant noodle consumption and nutritional
status, although public concerns regarding this food source are
high. To our knowledge, this is the first nationwide study to
examine the relationship between instant noodle consumption and
nutritional status in Koreans. However, several interventional
studies have reported that noodle consumption by children in
Korea affects their nutrient intake [8-11]. But, the association
between instant noodle consumption and nutritional status has
rarely been examined in the adult population.

People typically prefer instant noodles to other convenience
foods or fast foods when eating time is a constraint [12,13].
College students consume the largest amount of bowl-type instant
noodles among various convenience foods in Korea [12]. These
preferences are more strongly observed in people with time
constraints. In addition, the preferred type of fast food for
working men is instant noodles [13]. Women instant noodle
consumers are younger and have a higher socio-economic status
than those of other consumers [14]. Similarly, participants who
consume instant noodles in this study tended to be younger
(20-49 years), mostly in the middle or high income group, and
with a level of education greater than high school. Indeed,
participants aged 20-49 years consumed 22.2 g instant noodles
per day compared to the consumption of persons aged 50-64
years or 65 years and older (7.6 g or 5.8 g, data not shown).
Additionally, men consumed more instant noodles than women.
Men consumed 23.7 g instant noodles per day, whereas women
consumed 11.1 g per day (data not shown). Gender differences
in instant noodle consumption have also been observed in
previous studies; boys prefer instant noodles to other fast foods,
and middle-school male students consume more noodles than
girls [15].

Thirty percent of the total sales of instant noodles in Korea
are bowl-type instant noodles consumed as a snack [1]. The fat
content of instant noodles is in the range of 12-15.8% for the
bag-type, and 17.8-26.0% for the bowl-type, with few exceptions
[5]. A study reported that energy intake from fat accounts for
30.8% and 34.1% of the energy available from the bag-type and
bowl-type noodles, respectively [16]. Increased consumption of
the bowl-type of instant noodles is expected due to convenience,
and, thus, a higher consumption of energy and fat intake is
expected for the same amount of instant noodle consumption.
In this study, instant noodle consumption included the consumption
of both the bag-type and the bowl-type and was calculated
separately with individual nutritional composition tables. Individuals
who consume the bowl-type of instant noodles need to be
cautious regarding the fat and calorie intake of this food. Thus,
nutritional education would be helpful to reduce the fat and total
calorie intake and to select the appropriate meal combination of
other dishes required to achieve balanced nutritional status.
Dietary patterns together with instant noodle consumption have seldom been reported. One study in Korea reported that INC (middle school students, n = 385) added eggs and onions and often consumed noodles along with kimchi, steamed rice, radish pickles, or dried laver [17]. This limited consumption of side dishes with instant noodles was related to the lower consumption of potatoes and starches, seeds and nuts, vegetables, fruits, and seasonings. Interestingly, individuals who consume instant noodles consume more cereals and grain products, which was coincident with a previous result [17].

In the present study, the sodium intake in the INC group was > 6.4 g per day, which was 3.2 times higher than the recommended KDRI value. Instant noodle consumption contributed approximately 30% of the total sodium intake (2,032.2 mg per day). The salty taste of the soup base is favored by many consumers. Fortunately, Koreans do not prefer salty and greasy tastes [18]. A study was conducted to reduce sodium levels in instant noodles; that study reported that 20% of the sodium content, approximately 350 mg, from not eating the soup base without changing taste and flavor [19]. Recently, the Ministry of Health and Welfare in Korea announced “Dietary Guidelines for Korean Adults”, which suggest ten dietary goals, six dietary guidelines, and 23 actual guidelines, including consuming a balanced energy intake and < 5 g sodium intake in the diet [20]. The Korea Food & Drug Administration has recently established a guide to “the right food selections for Korean kids” to ensure healthy dietary habits in later life. The Toyama Birth Cohort Study in Japan recently reported that junior high school students who frequently consume instant noodles (at least 3 days/week) from the age of 3 show a higher risk for a lower quality of life (odds ratio [OR], 1.49; P = 0.007) [21]. Children who have a preference for salty food tend to maintain and reinforce this tendency in their later life, so nutritional education programs promoting proper sodium consumption should be conducted early in life.

Several studies have been conducted to examine the association between gastric cancer, diabetes, and blood lipid profiles and instant noodle consumption [14,22,23]. Instant noodle consumption is associated with a higher risk for gastric cancer compared with that of plain noodles (n = 105; OR, 4.76; P < 0.01) [22]. However, instant noodle consumption lowers blood glucose in healthy adults compared to consumption of steamed rice (n = 30, P < 0.05) [23]. Middle-aged women (40-64-years-of-age; n = 1,308) who consumed instant noodles show relatively healthier lipid profiles in KNHANES II than those who do not consume instant noodles [14]. They also reported that these instant noodle consumers were relatively younger and had a higher socioeconomic status (SES). Similarly, although the INC group consumed significantly higher amounts of fat and calories, no significant difference in BMI was observed between the two groups. The present study also showed similar characteristics with a previous study for age and SES. However, a change in nutritional status may cause an anthropometric change in later life. Thus, fat and calorie consumption should be monitored by INC and management of consumption should be promoted through nutritional education.

Recently, instant noodles in southeast Asia have been fortified with vitamin A, thiamine, riboflavin, niacin, vitamin B6, folic acid, iron, zinc, and iodine [24]. Many studies have reported the retention rate and stability of fortified nutrients including thiamine, riboflavin, and folate [25-27]. Since the fortification of instant noodle began in developing countries in 1994, southeast Asian countries including Indonesia, Thailand, the Philippines, and Vietnam have voluntarily fortified with micro-nutrients. The efficacy of fortifying instant noodles has not been fully determined yet, but some results have been reported for these countries. A study in Indonesia found that there is a benefit for vitamin A and iron status of pregnant women and children < 5 years of age who consumed instant noodles fortified with 750 μg (2,500 IU) vitamin A and 9 mg iron/100 g for 3 months, compared with a control product [24]. In Thailand, seasoning powder fortified with zinc (5 mg), iron (5 mg), vitamin A (270 μg), and iodine (50 μg) per serving enhanced levels of hemoglobin, zinc, and iodine in children (n = 569) aged 5.5-13.4 years [6]. In the present study, the iron intake of the INC group was 87.1% of the recommended KDRI intake in women, whereas intake in the non-INC group was 110.2% that of women. Iron intake should be encouraged through nutritional education in individuals consuming instant noodles; the fortification of iron is not suitable for Korean adults due to the result that iron levels were 87.1% of the recommended value. Thus, nutrition education is an appropriate means for improving the intake of iron and vitamin C in Korean adults.

Choosing the appropriate form of a fortificant is important to minimize nutrient-nutrient as well as nutrient-food interactions and any resulting adverse effects. Furthermore, the fortification strategy should then be arranged by stakeholders, manufacturers, and the local government. In Korea, thiamine and riboflavin are fortified as part of the manufacturing process [5], which contributed to 41.7% and 34.6% of the total consumption, respectively, in this study. Instant noodles contribute a good source of these nutrients in Koreans. Recently, calcium and dietary fiber have become fortified as part of the manufacturing process, whereas sodium content has been reduced by 20-30% [28]. In addition, instant noodles for children fortified with dietary fiber (0-3 g), calcium (250-275 mg), iron (6 mg), and an oil mixture (w-6: w-3 = 6:1, 0.6 g) and contain less sodium (550-1,380 mg), fat (0.6-5 g) and calories (305-365 kcal) per package (88-93 g) by means of a non-frying process have been launched by one of the leading manufacturers [28]. We hope that manufacturers continue to pursue these efforts, and that these efforts are extended to other products for adults. Further studies are needed to clarify the effectiveness of fortification or reformulation on the nutritional status of the Korean population using updated food composition tables and new, reformulated instant noodle products.
Some limitations of this study should be considered. The main limitations of this study were its cross-sectional design, and that dietary data were collected for 1 day. As single-day dietary recalls are imprecise at the individual level, the typical dietary intake in individual subjects may not have been assessed precisely.

This study revealed that consuming instant noodles may lead to an excessive intake of calories, fats, and sodium but may also lead to an increased intake of thiamine and riboflavin. Therefore, nutritional education should be implemented to help adults choose a balanced meal while consuming instant noodles. Additionally, instant noodle manufacturers should consider nutritional aspects when developing new products.

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