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Evaluation of nutrient intake and diet quality of gastric cancer patients in Korea

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Abstract

This study was conducted to identify dietary factors that may affect the occurrence of gastric cancer in Koreans. Preoperative daily nutrition intake and diet quality of patients diagnosed with gastric cancer were evaluated. Collected data were comparatively analyzed by gender. The results were then used to prepare basic materials to aid in the creation of a desirable postoperative nutrition management program. The subjects of this study were 812 patients (562 men and 250 women) who were diagnosed with gastric cancer and admitted for surgery at Soonchunhyang University Hospital between January 2003 and December 2010. Nutrition intake and diet quality were evaluated by the 24-hr recall method, the nutrient adequacy ratio, mean adequacy ratio (MAR), nutrient density (ND), index of nutritional quality (INQ), dietary variety score (DVS), and dietary diversity score (DDS). The rate of skipping meals and eating fast, alcohol consumption, and smoking were significantly higher in males than those in females. The levels of energy, protein, fat, carbohydrate, phosphorous, sodium, potassium, vitamin B_1, vitamin B_2, niacin, and cholesterol consumption were significantly higher in males than those in females. Intake of fiber, zinc, vitamin A, retinol, carotene, folic acid were significantly higher in females than those in males. MAR in males was significantly higher (0.83) than that in females (0.79). INQ values were higher in females for zinc, vitamin A, vitamin B_2, vitamin B_6, and folic acid than those in males. The average DVS was 17.63 for females and 13.19 for males. The average DDS was 3.68 and the male's average score was 3.44, whereas the female's average score was 3.92. In conclusion, males had more dietary habit problems and poor nutritional balance than those of females. Our findings suggest that proper nutritional management and adequate dietary education for the primary prevention of gastric cancer should be emphasized in men.

Key Words: Gastric cancer, dietary habit, nutrient intake, diet quality

Introduction

Gastric cancer incidence has been decreasing and the rate of complete recovery is increasing due to early detection and treatment. However, gastric cancer is still a frequently occurring cancer in Korea and is ranked second in terms of cancer mortality [1]. Although the global incidence of gastric cancer is decreasing gradually, gastric cancer will still display an absolute increasing trend until 2050 [2].

Factors contributing to the development of gastric cancer include hereditary and endocrinological, immunological, and environmental factors including diet [3]. Studies on nutrition and gastric cancer have suggested the relevance of dietary factors. Certain habits including smoking and drinking have been associated with the outbreak of gastric cancer [4]; and sufficient intake of fresh vegetables, fruits, and nutrients such as carotene, vitamin E, vitamin C and selenium, known as anticancer nutrients, lower the risk of gastric cancer [5]. In contrast, frequent consumption of meat [6] and foods with high salt content increase the risk for gastric cancer [7].

Studies assessing food and nutrient intake of local residents [8] and comparing certain patients against control groups in terms of diet [9] were actively conducted in the 1990s, and the early 2000s in Korea. Since then, studies have been carried out mainly on various nutritive conditions. However, there are an insufficient number of studies on dietary habits of different populations in comparison to countries where gastric cancer incidence is high. Additional intake of salt by 1 g daily increases gastric cancer incidence by approximately 18%, but the same result was not produced in a number of cohort studies [10]. Pham *et al.* [11] concluded that excessive dairy products in the diet lowers gastric cancer mortality only in males. A new study by Kim *et al.* [12], which compared Korean and Japanese populations, suggested that only the consumption of fermented beans increases gastric cancer incidence. Thus, fundamental studies need to be conducted continuously to prevent overlooking the causes of gastric cancer

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based on dietary factors that are already known.

Following a gastric cancer operation, the nutritive intake goals of a patient is set by analyzing the nutritive conditions, size of meals, and dietary balance of the patient prior to the operation. An overall assessment of diet quality is necessary together with a determination of excessive or insufficient supply of individual nutrients rather than simply identifying the dietary habits of the patient. However, related studies have not been conducted targeting patients with gastric cancer.

Accordingly, this study evaluated the nutrition intake and diet quality by surveying the daily dietary habits and food intake of patients with gastric cancer before a gastric cancer diagnosis. The dietary differences between men and women were also analyzed.

We attempted to establish desirable nutritional intake guidelines by assessing the preoperative dietary condition of the patients to aid in the management of their postoperative nutrition.

Subjects and Methods

Subjects and period

A total of 948 patients were hospitalized and underwent surgery following a diagnosis of gastric cancer at Soonchunhyang University Hospital Bucheon from January 2003 to December 2010. In total, 812 patients with gastric cancer who received sufficient explanation of the objectives and methods of this study (in accordance with the Institutional Review Board) and who provided informed consent to participate in the study were included. Information on patients were entered prospectively in The Gastric Cancer Patient Registry of the research institute, and some of these data were used in this study. All investigations were made based on daily diets without any changes in food intake or dietary habits caused by the gastric cancer diagnosis. All data were classified by gender (562 men and 250 women) and were analyzed accordingly.

Contents and methods

Anthropometric measurements

Patient weight and height were measured using an automatic body composition analyzer (Biospace In-body 3.0, Seoul, Korea) and their body mass index (BMI) was calculated. Triceps skin fold thickness (TSF) was measured using a large skin fold caliper (All-Tech Medical, Cleveland, OH, USA). A tape measure was used to measure the thinnest part between the ribs and pelvis while the patient was standing up for the waist measurement.

Dietary habit and nutrient intake survey

A self-reported questionnaire was used to examine the dietary habits of the patients with items focusing on appetite, meal regularity, skipping meals, eating speed, alcohol intake, smoking, exercise and taste preferences.

Skilled clinical nutritionists interviewed patients using photographs of food items and a booklet containing eye measurement data as aids for the nutrient intake survey. Data on dietary intake amount were collected using the 24-hr recall method and were analyzed with the CAN program (The Korean Nutrition Society, ver. 3.0).

Diet quality assessment

The nutrient adequacy ratio (NAR) and mean adequacy ratio (MAR) were calculated to assess the appropriateness of nutrient intake by patients. Nutrient density (ND) was calculated by standardizing the nutrient intake per 1,000 kcal based on the individual's intake amount. The index of nutritional quality (INQ), a comparison of the patient's nutrient intake against 12 nutrients, in which the required amounts are set by the Dietary Reference Intakes for Koreans, was analyzed. The dietary variety score (DVS) was calculated to examine the patient's dietary diversity. The food items consumed were categorized into five food groups (grain and starch, meat and poultry, vegetables, milk, fruits). The dietary diversity score (DDS) was investigated by giving a score of 1 point each to an intake of the minimum amount or higher out of a total score of 5.

NAR = nutrient intake of an individual/recommended dietary allowance (RDA) of the nutrient

MAR = sum of the nutrient adequacy ratio (NAR) for each nutrient/number of nutrients

INQ = amount of nutrients in 1,000 kcal/RDA in 1,000 kcal

Statistical analysis

Means and standard deviations were calculated using SPSS software program ver. 18.0 (SPSS, Inc. Chicago, IL, USA). Frequency per item, significance between discontinuous frequencies, and a comparison of the results between genders were analyzed using the frequency test, χ^2-test, and the unpaired *t*-test, respectively. A $P < 0.05$ was considered significant.

Results

Characteristics of the target subjects and anthropometric measurements

The general characteristics of the study targets are summarized in Table 1. Of the 812 patients, the male to female ratio was 69.2:30.8, indicating that male patients were more than twice females. The average age was 57.6 yr and 35.2% of the subjects were ≥ 65 yr. The average height, weight, and body mass index (BMI) were 162.5 cm, 62.0 kg, and 23.5 kg/m^2, respectively, indicating significant differences between males and females. BMI distributions corresponding to underweight, normal, and overweight were 5.8%, 44.8%, and 49.4%, respectively, which indicated that most patients were of normal weight or were overweight prior to the operation. The average waist measure-

Table 1. General subject characteristics

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Age (yrs)	57.6 ± 12.3[4]	57.9 ± 11.6	56.7 ± 13.9	0.184
< 65	526 (64.8)[5]	371 (66.0)	155 (62.0)	0.270
≥ 65	286 (35.2)	191 (34.0)	95 (38.0)	
Height (cm)	162.5 ± 8.6	166.3 ± 9.4	154.2 ± 6.8	< 0.001
Weight (kg)	62.0 ± 15.5	66.5 ± 21.9	56.6 ± 16.4	< 0.001
BMI (kg/m^2)[1]	23.5 ± 8.4	25.3 ± 9.2	23.8 ± 7.8	0.046
< 18.5	47 (5.8)	32 (5.7)	15 (6.0)	0.810
18.5-23.0	364 (44.8)	215 (45.4)	109 (43.6)	
≥ 23.0	401 (49.4)	275 (48.9)	126 (50.4)	
WC (cm)[2]	85.2 ± 8.5	88.2 ± 12.6	78.5 ± 9.3	< 0.001
TSF (mm)[3]	14.9 ± 6.2	15.4 ± 6.5	13.0 ± 5.4	0.002

[1] BMI, body mass index
[2] WC, waist circumference
[3] TSF, triceps skin fold thickness
[4] Mean ± SD
[5] Number (%)

ment and TSF were 85.2 cm and 14.9 mm. These measurements were significantly higher in males than those in females.

Dietary habit

The results of the investigation into dietary habits and lifestyle are summarized in Table 2. A total of 42.1% and 50.1% of participants responded that their appetite was good and average before the operation, respectively. Approximately 56% responded that their meal intake was irregular. Although irregularity was more severe in females, no significant difference was observed between genders. As many as 46.6% responded that they skipped meals. The rate of skipping meals was 55.3% in males and 27.2% in females, indicating a significantly lower rate of skipping meals in females. Approximately 42% responded that they skipped breakfast, which was the meal most often skipped. For eating speed, 46.7% responded that their eating speed was fast. The habit of eating fast was reported by 53.2% of males and 32.0% of females. The rates of alcohol intake and smoking were significantly higher in males than those in females. Surprisingly, 88.8% responded that they did not exercise, which was similar in males and females.

As for taste preference, 41.3% of the respondents liked a salty taste. A large difference in taste preference was observed between genders, as 51.8% of males and 17.6% of females responded that they liked salty taste. The results of sweet taste preference by gender was the reverse of the above. A spicy taste was liked by 69.4% of males and 56.4% females, whereas 42.9% of males and 61.2% of females responded that they liked a sour taste. The preference for salty and spicy tastes was higher in males than those in females, whereas the preference for sweet and sour taste was higher in females than those in males. These results indicated significant differences in preferences for salty, spicy, sweet, and sour tastes between genders. About 39% of all respondents disliked a bitter taste, and no significant difference was observed between genders.

Table 2. Dietary habits of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Appetite				
Good	342 (42.1)[1]	231 (41.1)	111 (44.4)	0.299
Average	407 (50.1)	291 (51.8)	116 (46.4)	
Poor	63 (7.8)	40 (7.1)	23 (9.2)	
Meal regularity				
Regular	360 (44.3)	254 (45.2)	106 (42.4)	0.254
Irregular	452 (55.7)	308 (54.8)	144 (57.6)	
Skipping meals				
None	433 (53.3)	251 (44.7)	182 (72.8)	< 0.001
Breakfast	339 (41.7)	285 (50.7)	54 (21.6)	
Lunch	35 (4.3)	22 (3.9)	13 (5.2)	
Dinner	5 (0.6)	4 (0.7)	1 (0.4)	
Meal speed				
Fast	379 (46.7)	299 (53.2)	80 (32.0)	< 0.001
Medium	390 (48.0)	245 (43.6)	145 (58.0)	
Slow	43 (5.3)	18 (3.2)	25 (10.0)	
Alcohol consumption				
Yes	544 (67.0)	502 (89.3)	42 (16.8)	< 0.001
No	268 (33.0)	60 (10.7)	208 (83.2)	
Smoking				
Yes	487 (60.0)	459 (81.7)	28 (11.2)	< 0.001
No	325 (40.0)	103 (18.3)	222 (88.8)	
Exercise				
Yes	91 (11.2)	58 (10.3)	33 (13.2)	0.140
No	721 (88.8)	504 (89.7)	217 (86.8)	
Salty taste				
Very like	150 (18.5)	144 (25.6)	6 (2.4)	< 0.001
Like	185 (22.8)	147 (26.2)	38 (15.2)	
Neutral	345 (42.5)	199 (35.4)	146 (58.4)	
Dislike	111 (13.6)	64 (11.4)	47 (18.8)	
Very dislike	21 (2.6)	8 (1.4)	13 (5.2)	
Sweet taste				
Very like	163 (20.1)	110 (19.6)	53 (21.2)	< 0.001
Like	197 (24.3)	96 (17.1)	101 (40.4)	
Neutral	333 (41.0)	249 (44.3)	84 (33.6)	
Dislike	108 (13.2)	98 (17.4)	10 (4.0)	
Very dislike	11 (1.4)	9 (1.6)	2 (0.8)	
Spicy taste				
Very like	147 (18.1)	126 (22.4)	21 (8.4)	< 0.001
Like	384 (47.3)	264 (47.0)	120 (48.0)	
Neutral	167 (20.6)	97 (17.3)	70 (28.0)	
Dislike	97 (12.0)	58 (10.3)	39 (15.6)	
Very dislike	17 (2.0)	17 (3.0)	0 (0.0)	
Sour taste				
Very like	152 (18.7)	114 (20.3)	38 (15.2)	< 0.001
Like	242 (29.8)	127 (22.6)	115 (46.0)	
Neutral	328 (40.4)	257 (45.7)	71 (28.4)	
Dislike	66 (8.1)	54 (9.6)	12 (4.8)	
Very dislike	24 (3.0)	10 (1.8)	14 (5.6)	
Bitter taste				
Very like	71 (8.7)	54 (9.6)	17 (6.8)	0.073
Like	91 (11.2)	55 (9.8)	36 (14.4)	
Neutral	335 (41.3)	260 (46.3)	75 (30.0)	
Dislike	284 (35.0)	166 (29.5)	118 (47.2)	
Very dislike	31 (3.8)	27 (4.8)	4 (1.6)	

[1] Number (%)

Nutrient intake

Nutrient intakes derived through the patient diet are analysis of all target are shown in Table 3. The average calorie intake was 1,949.1 kcal, and the intake amounts of protein, fat, sugar, and fiber were 75.3 g, 50.8 g, 282.3 g and 15.9 g, respectively. With the exception of fiber, the intake of nutrients was significantly higher in males. Intake of calcium, phosphorous, iron, and salt was significantly higher in males than those in females. The intake of potassium and zinc was higher in females than those in males. The intake of vitamin B_1, vitamin B_2, vitamin B_6, niacin, and vitamin C was higher in males than those in females, whereas the intake of vitamin A, retinol, carotene, folic acid, and vitamin E was higher in females than those in males. Significantly different amounts of nutrients ingested between genders were seen for vitamin A, retinol, carotene, vitamin B_1, vitamin B_2, niacin, and folic acid. The average cholesterol intake was 235.1 mg, and males consumed a significantly higher amount than that in females.

Diet quality

NAR and MAR

The results of comparing the NAR and MAR per nutrient are shown in Table 4. Most nutrients produced values of 0.7-0.9. NAR and MAR of phosphorous and iron were significantly higher in males than those in females. The values for vitamin A were lower in males than those in females. The MAR for males was 0.83 and for females it was 0.79, which was a significant difference. Nutrients ingested that were lower than the MAR were calcium, vitamin A, vitamin B_1, and vitamin B_2 for males and calcium, iron, and vitamin B_2 for females.

Table 3. Mean daily nutrient intakes of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Energy (kcal)	1,949.1 ± 419.8[1)]	2,128.7 ± 352.1	1,645.4 ± 541.1	< 0.001
Protein (g)	75.3 ± 20.3	77.6 ± 21.2	66.2 ± 16.9	< 0.001
Fat (g)	50.8 ± 28.7	51.9 ± 29.3	45.2 ± 20.0	0.010
Carbohydrate (g)	282.3 ± 82.2	299.4 ± 81.7	243.9 ± 59.3	0.001
Fiber (g)	15.9 ± 6.7	12.6 ± 6.7	16.7 ± 8.5	0.019
Ash (g)	20.4 ± 8.6	22.1 ± 8.6	16.5 ± 6.8	0.001
Calcium (mg)	476.2 ± 253.4	482.6 ± 350.9	431.6 ± 258.4	0.759
Phosphorous (mg)	951.5 ± 339.8	1,069.9 ± 349.9	887.6 ± 207.3	0.002
Iron (mg)	10.4 ± 4.1	10.8 ± 4.0	9.3 ± 6.8	< 0.001
Sodium (mg)	5,937.4 ± 1806.7	6,488.5 ± 1,877.0	5,372.9 ± 1,493.8	< 0.001
Potassium (mg)	2,448.8 ± 785.9	2,488.0 ± 795.0	2,660.7 ± 859.3	0.033
Zinc (mg)	7.4 ± 2.6	5.4 ± 2.6	7.1 ± 2.4	0.041
Vitamin A (mg)	643.5 ± 535.7	532.1 ± 484.7	692.9 ± 550.1	0.031
Retinol (μg)	55.6 ± 42.2	43.3 ± 49.8	61.1 ± 52.4	< 0.001
Carotene (μg)	2,596.6 ± 2165.5	1,840.7 ± 1,940.9	2,710.2 ± 2,123.3	0.025
Vitamin B_1 (mg)	1.0 ± 0.6	1.2 ± 0.6	0.9 ± 0.5	< 0.001
Vitamin B_2 (mg)	1.1 ± 0.5	1.1 ± 0.2	0.9 ± 0.5	0.001
Vitamin B_6 (mg)	1.3 ± 0.7	1.3 ± 0.7	1.2 ± 0.7	0.451
Niacin (mg NE)	15.4 ± 7.5	17.3 ± 8.1	13.3 ± 5.3	< 0.001
Vitamin C (mg)	95.9 ± 98.5	97.3 ± 69.7	92.9 ± 97.3	0.562
Folic acid (μg)	226.1 ± 121.5	190.8 ± 112.2	248.4 ± 125.5	0.004
Vitamin E (mg)	10.9 ± 6.3	10.8 ± 6.7	11.1 ± 6.1	0.106
Cholesterol (mg)	235.1 ± 164.8	246.0 ± 203.9	198.5 ± 103.0	< 0.001

[1)] Mean ± SD

Table 4. Comparison of nutrient adequacy ratio (NAR) and mean adequacy ratio (MAR) of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Protein	0.91 ± 0.19[1)]	0.93 ± 0.13	0.89 ± 0.17	0.063
Calcium	0.70 ± 0.17	0.71 ± 0.24	0.73 ± 0.12	0.134
Phosphorous	0.93 ± 0.16	0.95 ± 0.11	0.88 ± 0.20	0.021
Iron	0.79 ± 0.20	0.83 ± 0.19	0.75 ± 0.16	< 0.001
Vitamin A	0.81 ± 0.21	0.75 ± 0.28	0.83 ± 0.24	0.044
Vitamin B_1	0.80 ± 0.18	0.80 ± 0.16	0.82 ± 0.14	0.232
Vitamin B_2	0.76 ± 0.15	0.76 ± 0.13	0.77 ± 0.19	0.170
Niacin	0.90 ± 0.13	0.91 ± 0.18	0.89 ± 0.11	0.396
Vitamin C	0.84 ± 0.22	0.85 ± 0.29	0.83 ± 0.19	0.125
MAR	0.82 ± 0.16	0.83 ± 0.19	0.79 ± 0.12	0.013

[1)] Mean ± SD

ND and INQ

ND and the INQ of male and female patients are shown in Tables 5 and 6. In males, there were no nutrients in which the ND was significantly higher. In females, the ND of fiber, calcium, potassium, zinc, vitamin A, retinol, carotene, vitamin B_6, vitamin C, folic acid, and vitamin E were higher than those in males.

Table 5. Comparison of the nutrient density (ND) of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Protein (g)	38.63 ± 8.32[1)]	35.40 ± 9.81	39.23 ± 9.30	0.169
Fat (g)	25.12 ± 9.60	24.56 ± 9.90	23.56 ± 10.33	0.231
Carbohydrate (g)	145.81 ± 36.73	144.61 ± 38.40	149.36 ± 42.12	0.110
Fiber (g)	7.80 ± 2.56	6.96 ± 3.03	9.45 ± 3.84	0.026
Ash (g)	11.57 ± 3.33	11.28 ± 4.01	10.01 ± 3.13	0.175
Calcium (mg)	264.56 ± 102.50	245.91 ± 117.90	270.50 ± 147.10	0.018
Phosphorous (mg)	489.27 ± 123.61	456.46 ± 162.43	509.56 ± 186.80	0.064
Iron (mg)	5.55 ± 2.90	5.18 ± 1.70	5.64 ± 2.01	0.258
Sodium (mg)	3,087.28 ± 769.40	3,101.55 ± 908.09	2,709.18 ± 661.00	0.361
Potassium (mg)	1,246.01 ± 438.90	1,167.37 ± 370.59	1,336.02 ± 461.58	0.007
Zinc (mg)	3.98 ± 1.12	2.64 ± 1.12	4.41 ± 1.40	0.002
Vitamin A (mg)	312.29 ± 246.04	248.30 ± 225.47	423.67 ± 314.41	< 0.001
Retinol (μg)	27.40 ± 23.27	21.05 ± 21.60	37.15 ± 30.85	0.039
Carotene (μg)	136.46 ± 140.30	853.98 ± 801.15	1,349.94 ± 1,090.77	< 0.001
Vitamin B_1 (mg)	0.57 ± 0.20	0.55 ± 0.28	0.58 ± 0.26	0.424
Vitamin B_2 (mg)	0.55 ± 0.10	0.53 ± 0.80	0.53 ± 0.30	0.365
Vitamin B_6 (mg)	0.71 ± 0.38	0.62 ± 0.32	0.74 ± 0.23	0.047
Niacin (mg NE)	7.70 ± 6.81	8.14 ± 6.24	8.08 ± 5.22	0.163
Vitamin C (mg)	48.20 ± 34.30	45.80 ± 33.76	58.49 ± 49.15	0.009
Folic acid (μg)	115.30 ± 60.69	95.64 ± 42.70	150.21 ± 76.29	< 0.001
Vitamin E (mg)	5.48 ± 3.60	5.19 ± 3.06	7.60 ± 3.91	0.011
Cholesterol (mg)	119.84 ± 80.81	110.87 ± 85.60	118.97 ± 62.52	0.407

[1)] Mean ± SD

Table 6. Comparison of the index of nutritional quality (INQ) of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
Protein	1.62 ± 0.30[1)]	1.70 ± 0.41	1.47 ± 0.36	0.175
Calcium	0.85 ± 0.33	0.93 ± 0.32	0.79 ± 0.28	0.026
Phosphorous	1.45 ± 0.21	1.54 ± 0.16	1.31 ± 0.23	0.111
Iron	1.38 ± 0.39	1.46 ± 0.25	1.37 ± 0.33	0.230
Zinc	1.01 ± 0.25	0.77 ± 0.13	1.26 ± 0.21	0.007
Vitamin A	1.16 ± 0.62	0.98 ± 0.47	1.27 ± 0.50	0.018
Vitamin B_1	1.03 ± 0.50	1.04 ± 0.34	0.95 ± 0.41	0.361
Vitamin B_2	0.86 ± 0.34	0.88 ± 0.28	0.79 ± 0.25	0.044
Vitamin B_6	0.99 ± 0.28	0.95 ± 0.35	1.10 ± 0.43	0.052
Niacin	1.33 ± 0.57	1.35 ± 0.69	1.24 ± 0.46	0.419
Vitamin C	1.10 ± 0.48	1.11 ± 0.58	1.05 ± 0.39	0.353
Folic acid	0.86 ± 0.46	0.79 ± 0.34	1.03 ± 0.51	0.002

[1)] Mean ± SD

Table 7. Comparison of the dietary variety score (DVS) and dietary diversity score (DDS) of the subjects

Variables	Total (n = 812)	Male (n = 562)	Female (n = 250)	*P*-value
DVS	16.67 ± 5.15[1)]	13.19 ± 8.08	17.63 ± 6.32	0.022
DDS	3.68 ± 0.52	3.44 ± 0.63	3.92 ± 0.24	< 0.001
Grain & starch	3.31 ± 1.16	3.40 ± 1.18	3.35 ± 1.03	
Meal, poultry	3.17 ± 0.58	3.38 ± 0.92	2.97 ± 0.20	
Vegetables	5.94 ± 3.03	4.64 ± 3.58	6.56 ± 2.17	
Milk	0.60 ± 0.55	0.52 ± 0.81	0.85 ± 0.34	
Fruit	1.22 ± 1.10	1.01 ± 0.43	1.57 ± 1.06	

[1)] Mean ± SD

No significant differences were observed between gender for the other nutrients. The INQ of zinc, vitamin A, vitamin B_2, vitamin B_6, and folic acid were higher in females than those in males. The INQ was higher in males than that in females for the other nutrients. Qualitatively significant differences were observed between males and females in terms of their calcium, zinc, vitamin A, vitamin B_2, and folic acid intake. Six nutrients of males and three of females had an INQ $\leq$1.0. The ND of females was higher than that in males and the intake of nutrients more closely complied with the Korean average requirements in females.

DVS and DDS

The results of the DVS and DDS are shown in Table 7. The average DVS was 16.67. The DVS was 17.63 for females and 13.19 for males, indicating that females had more variety in their diet. The average DDS was 3.68. This result also indicated that females had a higher diversity of food in their diet than that of males.

Discussion

The dietary habits, nutrient intake, and diet quality of patients with gastric cancer were investigated, and the results were compared between genders. According to the Nationwide Gastric Cancer Report 2009 conducted by the Korean Gastric Cancer Association [13], the male to female ratio for gastric cancer incidence has increased gradually from 1.67:1 in 1999 to 2.03:1 in 2009. The male to female ratio among target patients was 2.25:1, indicating that gastric cancer incidence is higher in males than that in females. The average age of a patients with gastric cancer reported by the Nationwide Gastric Cancer Report 2009 [13] was 58.9 yr, which was similar to the 57.6 yr found in the present study. A study conducted by Yang *et al.* [14] in 1993 reported that the average BMI of patients with gastric cancer was 20.6 kg/m^2. It appears that the BMI of patients with gastric cancer has been increasing annually, as a recent study by Jo *et al.* [15] in 2010 reported that the average BMI was 23.3 kg/m^2, which was almost the same as the BMI of 23.5 kg/m^2 found in the present study. In Japan, where gastric cancer incidence is high, BMI has been increasing gradually as a result of improvement in overall physical condition of patients. The average BMI of Japanese patients before the operation increased from 20.8 kg/m^2 in 1971 to 22.6 kg/m^2 in 2001 [16]. BMI is a key factor among the nutritional evaluation indices and is widely used as an indicator to express the degree of obesity. Yoshikawa *et al.* [17] reported that the incidence of postoperative complications, and mean blood loss of an obese group were significantly higher than those of a normal group. Murphy *et al.* [18] reported that underweight patients experience delays in recovery of their nutritive condition after a surgical operation and that overweight patients with a BMI $\geq$ 30 kg/m^2 have a high incidence of complications. Therefore, it is very important to maintain a normal BMI in patients with gastric cancer. In this study, 44.8% of patients had a normal weight and 49.4% were overweight or obese. The BMI distribution was similar in male and female patients.

A number of studies [8,9] have reported the relevance of an irregular meal schedule and the habit of eating fast on gastric cancer outbreak. In this study, the rates of irregular meal intake, skipping meals, and eating fast were 55.7%, 46.6% and 46.7%, respectively. As a whole, dietary habits of males were poorer than those of females. The increased risk of developing gastric cancer with alcohol intake is explained by the carcinogenic effects of acetaldehyde, a product of alcohol metabolism [19]. A cohort study by Steevens *et al.* [4] reported that consuming 30 g of alcohol daily is highly relevant to the incidence of gastric cancer and that there were differences between gender and the type of alcohol consumed. In the present study, 89.3% of males and 16.8% of females drank alcohol, indicating a large difference between genders. Smoking, one of the more important factors contributing to cancer deaths, is a widely known risk factor for gastric cancer. Smoking in the past or at present has strong relevance to gastric and esophageal cancer [4]. A study by Shin *et al.* [3] reported that the smoking rate among patients with gastric cancer was 63.8%, which was significantly different from the 49.7% in the control group. In our study, the overall smoking

rate was 60.0% and there was a significant difference between genders. The smoking rate among males was 81.7% and that in females was 11.2%. A cohort study conducted in Europe [20], reported that physical activity, among dietary and health-related factors, had no relevance on the outbreak of gastric cancer. In the present study, only 11.2% of target patients exercised regularly and no difference between genders was found. It may be necessary to emphasize the importance of wholesome dietary habits to prevent gastric cancer, particularly among Korean males,.

Continued intake of salty and spicy flavors can irritate the stomach wall and increase the risk of developing gastric cancer. In particular, salty food increases the risk of gastric cancer in men more than that in women by 1.1 times [10]. In our study, 51.8% of males and 17.6% of females responded that they preferred a salty taste, indicating a large difference between genders. The preference for spicy taste was > 50% in both genders. A large number of studies have been conducted about gastric cancer and taste preferences. However, none have quantitatively investigated the amount of preferred type of food consumed, as affected by the preference for a particular taste, in relation to gastric cancer. It may be meaningful to pursue a study on the effect of limiting the intake of salty or spicy food items on gastric cancer incidence.

The average calorie intake of patients in this study was 1949.1 kcal. Males consumed approximately 500 kcal more than that of females. This was similar to the 2,076.0 kcal reported by Suh *et al.* [8] in Korea. Referring to the estimated calorie requirements of 2,200 kcal for males and 1,800 kcal for females aged 50-64 yr, as specified in the 2010 Dietary Reference Intakes for Koreans [21], a patient's daily caloric intake in this study was appropriate for males, but slightly lower for females; although the difference was not large. The average protein intake was 75.3 g, which was higher than the recommended intake of 50 g for males and 45 g for females. The average intake of calories and protein were similar compare to the 2008 Korean National Health and Nutrition Examination Survey [22]. The average fiber intake was 15.9 g. Fiber intake by females was significantly higher than that by males. Fiber intake was very low when compared to the recommended intake of 25 g for males and 20 g for females. Bravi *et al.* [23] reported that high fiber intake lowers gastric cancer incidence by 0.47 times. In particular, that study reported that insoluble and soluble fiber lower gastric cancer incidence by 0.39 and 0.50 times, respectively. They also reported differences according to the type of food item, such as vegetables, fruits and cereals, as a source of dietary fiber. Even if the nutritive conditions for minerals are satisfactory before an operation in patients with gastric cancer, their conditions may deteriorate, as overall nutritive condition become poorer after the operation due to insufficient meal intake, weight loss, and loss of appetite. In addition, intake of minerals through the diet can also change. Therefore, it is recommended that patients with gastric cancer and an inferior mineral balance before after an operation must be actively treated [24]. The total calcium intake was 476.2 mg, which was much lower than the recommended intake of 700 mg. Intake of phosphorous and iron were in excess of the recommendation. Additionally, the average intake of calcium, phosphorus, and iron were lower than the result of the 2008 Korean National Health and Nutrition Examination Survey [22]. The average amount of Na intake was 5937.4 mg per day. Male patients took in 6,488.5 mg per day which was higher than that of females, and was almost three times the recommended intake of 2000 mg. This result was also higher than the result of the 2008 Korean National Health and Nutrition Examination survey [22]. Therefore, lowering of Na in the diet must be strongly emphasized. Intake of sodium by both men and women was higher in comparison to the Korean average intake. Vitamin C, carotene, vitamin E, selenium, falconoid and leucopenia are widely known antioxidant nutrients that can help in preventing gastric cancer [18]. Compared to the 2010 Dietary Reference Intakes for Koreans [21] the intake of vitamin A, vitamin B, vitamin C, niacin, and vitamin E by the study patients was slightly insufficient. Carotene, falconoid, and vitamin E, contained in fresh vegetables and fruits, suppress carcinogenic substances and prevent them from converting to mutable substances in the gastro-intestinal tract. The intake of green and yellow vegetables by patients with gastric cancer in Korea is generally low [9]. Cholesterol has been tagged as a factor in the development of gastric cancer, colon cancer, rectal cancer, lung cancer, breast cancer, renal cancer, and gall bladder cancer [25]. In particular, as the level of cholesterol intake increases, so does the risk of prostate cancer [25]. In this study, cholesterol intake by males was 246.0 g, which was significantly different from the 198.5 g by females. These results were higher than the 191.9 mg reported by Suh *et al.* [8]. Eating is a process that supplies all nutrients needed by the body, and numerous diseases can be prevented by a balanced diet [26]. Effort must be exerted to achieve balanced intake of all nutrients to maintain satisfactory nutritive conditions after a surgical operation as well as to prevent gastric cancer. A balanced diet should include an appropriate amount of protein with fiber, vitamins and minerals from vegetables and fruits, and a limit on salt and cholesterol intake.

Various tools were used to analyze diet quality to evaluate the typical daily nutrition and the food intake status of patients diagnosed with gastric cancer prior to surgery. The MAR of subjects was measured as 0.82. Significant difference was found between men (0.83) and women (0.79). Nutrients below MAR included calcium and vitamins A, B_1 and B_2 for men and calcium, iron, and vitamin B_2 for women. Phosphorus and iron were significantly higher in men than those in women, whereas vitamin A was low; thus, showing a difference according to nutrient. Nutrient density, which is a measure of nutrition intake per 1,000 kcal, reports individual calorie intake variations. According to the results, had presented a significantly lower intake of most nutrients, in particular anti-oxidative nutrients, such as fiber, zinc, vitamin, and folic acid than that of men. Thus, greater emphasis

must be placed on intake of food products that possess high densities of the above nutrients. In addition, according to the INQ analysis, which was performed as a qualitative assessment of nutrients excluding the effect of calories, the INQ value was < 1 for calcium and vitamins B_1 and B_2 among women and calcium, zinc, and vitamins A, B_2, B_6, and folic acid among men. By comparing the nutrients that were significantly different by gender, it men had significantly higher INQ values in calcium and vitamin B_2, whereas women showed significantly higher values in zinc, vitamin A, and folic acid. Based on these results, the quantitative increase in the diet and sufficient intake of deficient nutrients must be achieved in both men and women. The DVS and DDS were analyzed to assess diet diversity. DVS is based on the fact that various nutrients can be absorbed in meals as provided by a large number of food products. Previous results indicate that the number of absorbed food products and the diversity of food products are both significantly higher in women than those in men. Thus, the assessment of diet quality showed gender differences according to the tools used in this study and continuous research must be conducted to gain accurate results. Diet quality investigations have been conducted on a variety of targets, and Studies are being conducted on diverse diseases centering on metabolic syndrome [27], diabetes [28], atopic dermatitis [29], and Parkinson's disease [30].

The limitations of this study are as follows. This study surveyed preoperative daily dietary habits and nutrition intake of patients with gastric cancer who were in need of surgical treatment, and because there was no control group, it was difficult to draw definite conclusions on factors having a direct effect on gastric cancer occurrence. Nevertheless, as there have been few studies on the preoperative daily food intake of patients with gastric cancer in contrast to the various studies that have been conducted on postoperative nutritional condition, it is necessary to survey patient preoperative daily nutrition intake and evaluate their typical daily diet quality to develop a desirable postoperative dietary management program.

This study showed that male patients had more undesirable dietary habits and had more unbalanced nutrition intake than those of females. Accordingly, adequate nutrition management is necessary for both men and women to prevent cancer, and the importance of education on healthy dietary life should be emphasized particularly for men. In addition, evaluations should be made continuously to prevent poor preoperative nutrition from continuing postoperatively, and this effort should be supplemented by an analysis of various aspects of the case including age and pre/post/intra operative factors.

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