Nutrient intake and dietary quality of Korean adults according to chronic obstructive pulmonary disease (COPD): Based on the 2012~2014 Korea National Health and Nutrition Examination Survey*

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ABSTRACT

Purpose: Food intake of COPD patients decreases because of appetite loss, depression, and breathing problems while eating, which increase the likelihood of patients becoming malnourished. This study investigated the nutrient intake and dietary quality of people with and without COPD in Korea. **Methods:** There were 2,160 adults aged 50 and over who participated in the 5~6th Korea National Health and Nutrition Examination Survey. The subjects were divided into the COPD group and non-COPD group according to the rate of forced expiratory volume at 1 second (FEV_1) against forced vital capacity (FVC). Consumption of food and nutrients were calculated based on the nutrition examination survey. Statistical analyses were conducted using SPSS 19.0. **Results:** Among individuals in their 50s, intake of vitamin B_1 in the COPD group was significantly less than the NCOPD group, while intake of sodium in the COPD group was significantly greater than the NCOPD group. Among individuals in their 60s, the energy intake of the COPD group was significantly less than that of the NCOPD group. The COPD group showed significantly less intake of vitamin B_1 and vitamin C, but greater intake of sodium than the NCOPD group. In the group aged 70 and over, The COPD group had significantly less intake of vitamin B_1 than the NCOPD group and showed lower nutrient adequacy ratio values in protein, vitamin B_1, vitamin B_2, and iron than the NCOPD group. **Conclusion:** The COPD group consumed less energy and certain nutrients, and their dietary quality was poor compared to the NCOPD group. Thus, more detailed research is required to understand the concrete relationship between COPD and malnutrition.

KEY WORDS: COPD, food intake, nutritional status, malnutrition, KNHANES

Introduction

Chronic obstructive pulmonary disease (COPD) is a type of obstructive lung disease characterized by irreversible airflow limitation that is induced by damage to airways and lungs caused by chronic inflammation. The most important cause of COPD is smoking; however, there are other factors such as occupational exposure to risk factors, indoor air pollution and infection.[1] A 2014 report by the World Health Organization (WHO) revealed that COPD was the third most common cause of death following ischemic heart disease and strokes.[2] The prevalence of COPD among Koreans aged 40 and over was 14.2% in 2014; however, its awareness and treatment was 2.9% and 1.6%, respectively, which was much lower than that of other chronic diseases.[3]

Medications such as bronchodilators, steroids, and antibiotics have been the primary treatment for COPD; however, the need for and importance of nutrition therapy is currently attracting attention.[4] Patients with COPD need more energy because of the extra effort involved in breathing and generalized inflammatory response; however, their food intake decreases because of loss of appetite, depression, decreased physical activity, and breathing problems while eating, which increase the likelihood of the patients becoming malnourished.[5,6] Nutritional status is an important factor to determine the symptoms and prognoses of COPD patients,[7] and previous research reported malnutrition among COPD patients such as insufficient nutrient intake and weight loss.[8,9] Cochrane[10] reported that 23% of COPD patients were malnourished, that the malnourished group showed poorer lung function

than the normal group and that they experienced difficulties in eating food.

The main purpose of nutrition therapy for COPD is to enhance the function of respiratory muscles by increasing lean body mass and eventually improving the quality of life and life expectancy.[4] When malnourished COPD patients are treated with nutrition therapy, their weight can increase and their lung functions can improve in the short term.[11] Several results reporting that antioxidants such as vitamin A, vitamin C, vitamin E, and flavonoids are effective at preventing COPD have recently been released.[12] However, the positive effects of each individual nutrient have not been sufficiently studied to reach a conclusion.[13]

A carbohydrate based diet is not recommended for COPD patients because it generates more carbon dioxide,[14] but the Korean diet, which mostly consists of carbohydrates, tends to include insufficient protein and fat.[15] Thus, proper nutritional education and nutritional interventions for COPD patients are necessary, but research into nutritional status, dietary status, and dietary quality of COPD patients in Korea is currently insufficient. For this reason, the present study examined and assessed nutrient and food intake and dietary quality of Korean adults aged 50 and over according to COPD, and investigated their nutritional status and nutrient intake by age group.

Methods

Study subjects and design

This study utilized data from the 5~6th Korea National Health and Nutrition Examination Survey. The subjects for this study were 2,160 adults aged 50 and over who participated in the 5th Korea National Health and Nutrition Examination Survey (2012) or the 6th Korea National Health and Nutrition Examination Survey (2013~2014). The subjects were divided into the COPD group and NCOPD group according to the rate of forced expiratory volume at 1 second (FEV_1) against forced vital capacity (FVC), which is the criterion suggested by Global Initiatives for Obstructive Lung Disease (GOLD).[16] Subjects who recorded lower than 70% FEV_1/FVC were classified as belonging to the COPD group, while those who showed 70% or higher FEV_1/FVC and were not diagnosed with any diseases affecting food intake, such as cardiovascular disease, respiratory diseases, neurologic/sensory disorders, urogenital diseases, endocrine metabolic disorders, and cancer, were classified as the NCOPD group.

General and anthropometric characteristics

Fundamental variables for this study include sociodemographic variables (age, sex, residence, educational level, occupation, and household income). Educational level was divided into elementary school or lower, middle school, high school, and college graduation or higher. Occupation was divided into white collar work, blue collar work, and unemployed. Household income was divided into low, middle-low, middle-high, and high according to the quartile of household income.

Body measurements such as height, weight, body mass index (BMI), and waist circumference were analyzed based on the results of a medical examination. BMI measurements were divided into underweight (BMI < 18.5), normal weight ($18.5 \leq$ BMI < 23), overweight ($23 \leq$ BMI < 25), and obese (BMI ≥ 25).[17]

Health-related behaviors

Dietary information such as frequency of eating out was provided through dietary behavior survey items in the nutrition examination survey. Information regarding the frequency of alcohol intake, smoking habits and exercise frequency was provided through a health-related behavior survey.

Clinical indices

The results of the medical examination were used for clinical index analysis. The examination included final systolic blood pressure, final diastolic blood pressure, total cholesterol, HDL-cholesterol, LDL-cholesterol, triglyceride, fasting glucose level, and HbA1c. LDL-cholesterol was calculated using the Freidewald equation[18] {LDL-cholesterol = total cholesterol-HDL-cholesterol-(triglyceride / 5)}.

Dietary intake and dietary quality

Consumption of food and nutrients was calculated based on the raw data of the nutrition examination survey, which used the 24-hour recall method. Briefly, food was divided into 18 groups (cereals and grain products, potatoes and starches, sugars and sweets, legumes and their products, seeds and nuts, vegetables, mushrooms, fruits, meats and their products, eggs, fish and shellfish, seaweeds, milk and dairy products, oils and fats, beverages, seasonings, prepared foods, and others) and consumption of each group

was analyzed.

The nutrient adequacy ratio (NAR) was calculated for nine nutrients (protein, vitamin A, vitamin B_1, vitamin B_2, niacin, vitamin C, calcium, phosphorus, and iron) to assess the adequacy of nutrient intake. The upper limit of the calculated NAR values was set at 1, and if the ratio values were greater than 1, they were regarded as 1. The mean adequacy ratio (MAR) was calculated to assess general nutrient consumption.[19]

NAR = average daily total intake / recommended intake (RI)

MAR = sum of NARs for n nutrients / n

Statistical analysis

All statistical analyses were conducted using SPSS Ver. 19.0 (International Business Machines Corp., Armonk, NY, USA). The chi-squared test was used to test distribution differences of categorical variables in each group, and the independent t-test was used to test the mean differences of continuous variables. When the differences were tested, covariates (age, energy intake) that can affect clinical indices, body measurements, and nutrient and food consumption were included in the analysis model to correct their effects, and the corrected values were presented. Clinical indices and body measurements were adjusted by sex and age, and nutrient and food consumption were adjusted by age, sex and daily energy intake. Participants were divided into three groups: 50s, 60s and 70 and over to identify differences in nutrient intake by age group. When the p-value was lower than 0.05, it was regarded as a significant difference.

Results

General and anthropometric characteristics

The general characteristics of the subjects are shown in Table 1. The average age was significantly higher in the COPD group than the NCOPD group ($p < 0.001$). The higher the age of the subjects, the more likely they would be in the COPD group ($p < 0.001$). Within the NCOPD group, 45.7% of respondents were male and 54.3% were female. In the COPD group, the males consisted of 72.5%

Table 1. General characteristics and anthropometric characteristics of the subjects

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	p-value
Age (yrs)	65.12 ± 0.36[2]	57.15 ± 0.22	< 0.001[***]
50~59	188 (28.7)[3]	683 (72.6)	< 0.001[***]
60~69	404 (38.2)	302 (21.2)	
≥ 70	423 (33.1)	106 (6.1)	
Sex			< 0.001[***]
Male	725 (72.5)	428 (45.7)	
Female	290 (27.5)	663 (54.3)	
Residence			0.103
Urban	759 (75.8)	857 (80.1)	
Rural	256 (24.2)	234 (19.9)	
Educational level			< 0.001[***]
≤ Elementary school	444 (42.8)	296 (22.6)	
Middle school	181 (18.7)	206 (18.3)	
High school	265 (27.2)	365 (36.3)	
≥ College	125 (11.2)	224 (22.8)	
Occupation			< 0.001[***]
White collar	82 (8.3)	155 (16.3)	
Blue collar	428 (48.1)	540 (49.2)	
Unemployed	505 (43.6)	396 (34.5)	
Household income			< 0.001[***]
Low	346 (30.5)	166 (13.1)	
Middle-low	279 (26.9)	282 (24.2)	

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE
3) n (%)   4) Adjusted for age, sex   5) Underweight: < 18.5 kg/m², 18.5 ≤ Normal < 23 kg/m², 23 kg/m² ≤ Overweight < 25 kg/m², Obese: ≥ 25 kg/m²
[*] $p < 0.05$, [***] $p < 0.001$, Significant difference by student's t-test, chi-squared test

Table 1. General characteristics and anthropometric characteristics of the subjects (continued)

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	p-value
Middle-high	198 (21.7)	271 (26.7)	
High	192 (20.9)	372 (36.1)	
Height (cm)	161.82 ± 027	160 ± 0.21	0.016[*4]
Weight (kg)	62.27 ± 0.38	62.06 ± 0.33	0.688
Waist circumference (cm)	83.04 ± 0.31	81.84 ± 0.37	0.014[*]
BMI (kg/m^2)[5]	23.70 ± 0.13	23.91 ± 0.12	0.234
Underweight	16 (1.9)	20 (1.9)	0.985
Normal	390 (38.1)	430 (38.0)	
Overweight	298 (27.6)	298 (27.6)	
Obesity	321 (31.6)	343 (32.4)	

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE
3) n (%)   4) Adjusted for age, sex   5) Underweight: $< 18.5 \text{ kg/m}^2$, $18.5 \leq \text{Normal} < 23 \text{ kg/m}^2$, $23 \text{ kg/m}^2 \leq \text{Overweight} < 25 \text{ kg/m}^2$, Obese: $\geq 25 \text{ kg/m}^2$
[*] $p < 0.05$, [***] $p < 0.001$, Significant difference by student's t-test, chi-squared test

Table 2. Health-related behaviors of the subjects

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	Total (n = 2,106)	p-value
Smoking				< 0.001[***]
Non-smoker	354 (33.2)	715 (61.0)[2]	1,069 (50.8)	
Ex-smoker	401 (39.0)	222 (21.5)	623 (29.6)	
Current smoker	260 (27.9)	154 (17.6)	414 (19.7)	
Alcohol drinking				< 0.001[***]
None (past 1 year)	361 (33.5)	357 (30.2)	718 (34.1)	
< 1/mth	200 (18.4)	336 (29.1)	536 (25.5)	
2~4/mth	161 (16.2)	195 (19.4)	356 (16.9)	
≥ 2/wk	293 (31.9)	203 (21.3)	496 (23.6)	
Frequency of eating out				0.132
< 1/mth	151 (13.1)	74 (5.4)	225 (10.7)	
1~3/mth	334 (32.6)	289 (23.6)	623 (29.6)	
1~2/wk	276 (26.2)	282 (25.0)	558 (26.5)	
3~6/wk	149 (16.4)	238 (24.2)	387 (18.4)	
≥ 1/d	105 (11.8)	208 (21.8)	313 (14.9)	
Days of exercise				0.122
None	204 (19.9)	183 (16.7)	387 (20.3)	
1~2/wk	144 (15.3)	197 (18.3)	341 (17.9)	
3~4/wk	206 (19.9)	255 (22.8)	461 (24.2)	
≥ 5/wk	261 (44.9)	456 (42.3)	717 (37.6)	

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-Chronic obstructive pulmonary disease group   2) n (%)
[***] $p < 0.001$, Significant difference by chi-squared test

Table 3. Clinical indices of the subjects

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	p-value[3]
Systolic pressure	122.66 ± 0.82[2]	120.32 ± 0.59	0.027[*]
Diastolic pressure	75.63 ± 0.53	76.03 ± 0.37	0.552
Total cholesterol (mg/dl)	192.25 ± 1.42	197.91 ± 1.17	0.003[**]
HDL-cholesterol (mg/dl)	51.89 ± 0.55	50.79 ± 0.40	0.123
LDL-cholesterol[4] (mg/dl)	122.30 ± 4.00	120.49 ± 3.36	0.737
Triglyceride (mg/dl)	138.81 ± 4.53	142.26 ± 3.55	0.587
Fasting blood glucose (mg/dl)	102.13 ± 0.79	99.60 ± 0.66	0.023[*]
HbA1c	5.97 ± 0.03	5.85 ± 0.02	0.001[**]

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE
3) Adjusted for age, sex   4) LDL-cholesterol = total cholesterol - HDL-cholesterol - (triglyceride / 5)
[*] $p < 0.05$, [**] $p < 0.01$. Significant difference by Student's t-test

Table 4. Comparison of nutrient intakes and energy distribution (%) of the subjects by age groups

Age group	50s (n = 871)				60s (n = 706)				70 and over (n = 529)			
Variables	COPD[1] (n = 188)	NCOPD[1] (n = 683)	Total (n = 871)	p-value	COPD (n = 404)	NCOPD (n = 302)	Total (n = 706)	p-value	COPD (n = 423)	NCOPD (n = 106)	Total (n = 529)	p-value[3]
Nutrient intake												
Energy (kcal)	2,036.22 ± 66.24[2]	2,158.75 ± 36.34	2,097.49 ± 35.08	NS	1,892.99 ± 41.00	2,132.30 ± 64.90	2,012.65 ± 36.22	**	1,707.14 ± 39.65	1,724.02 ± 61.83	1,715.58 ± 37.37	NS
Protein (g)	75.70 ± 2.37	75.65 ± 1.22	75.67 ± 1.27	NS	63.98 ± 2.02	70.34 ± 2.39	67.16 ± 1.45	NS	57.81 ± 1.83	57.30 ± 1.59	57.56 ± 1.25	NS
Fat (g)	41.47 ± 1.98	42.62 ± 0.94	42.05 ± 1.09	NS	31.86 ± 1.51	34.16 ± 2.07	33.01 ± 1.18	NS	26.73 ± 1.15	26.66 ± 1.74	26.70 ± 1.05	NS
Carbohydrate (g)	340.24 ± 6.79	343.27 ± 3.54	341.75 ± 3.66	NS	320.11 ± 7.14	366.19 ± 11.09	343.15 ± 6.52	NS	314.13 ± 3.95	307.89 ± 5.57	311.01 ± 3.36	NS
Fiber (g)	8.89 ± 0.47	9.97 ± 0.46	9.43 ± 0.32	NS	8.40 ± 0.30	8.97 ± 0.34	8.68 ± 0.24	NS	7.36 ± 0.35	7.29 ± 0.47	7.33 ± 0.30	NS
Vitamin A (μgRE)	945.60 ± 76.75	776.31 ± 30.22	860.96 ± 41.12	*	859.29 ± 154.05	689.78 ± 54.74	774.54 ± 61.66	NS	644.94 ± 76.74	605.65 ± 73.44	625.29 ± 50.30	NS
Vitamin B$_1$ (mg)	1.88 ± 0.07	2.26 ± 0.04	2.07 ± 0.04	***	1.86 ± 0.04	2.15 ± 0.05	2.01 ± 0.03	***	1.58 ± 0.04	1.79 ± 0.06	1.68 ± 0.04	**
Vitamin B$_2$ (mg)	1.37 ± 0.04	1.46 ± 0.03	1.41 ± 0.03	NS	1.25 ± 0.03	1.31 ± 0.03	1.28 ± 0.02	NS	1.01 ± 0.03	1.03 ± 0.05	1.02 ± 0.03	NS
Niacin (mg)	18.42 ± 0.71	17.63 ± 0.31	18.03 ± 0.38	NS	16.22 ± 0.52	15.77 ± 0.35	15.99 ± 0.31	NS	13.11 ± 0.29	13.45 ± 0.51	13.28 ± 0.29	NS
Vitamin C (mg)	119.85 ± 6.65	129.00 ± 5.49	124.42 ± 4.33	NS	118.54 ± 8.30	143.64 ± 10.51	131.09 ± 7.55	*	85.91 ± 4.52	95.11 ± 10.52	90.51 ± 5.79	NS
Calcium (mg)	596.06 ± 41.23	533.85 ± 10.50	564.95 ± 21.07	NS	556.78 ± 25.33	519.41 ± 16.53	538.09 ± 14.63	NS	405.13 ± 17.70	399.51 ± 20.87	402.32 ± 13.73	NS
Phosphorus (mg)	1,248.11 ± 32.07	1,216.15 ± 17.70	1,232.13 ± 17.95	NS	1,164.53 ± 22.63	1,115.04 ± 19.05	1,139.78 ± 15.45	NS	935.89 ± 14.64	920.55 ± 25.89	928.22 ± 15.42	NS
Sodium (mg)	4,949.78 ± 231.40	4,291.17 ± 124.93	4,620.48 ± 133.69	*	4,273.01 ± 155.06	3,793.14 ± 135.64	4,033.07 ± 96.30	*	3,524.96 ± 122.13	3,513.84 ± 212.14	3,519.40 ± 125.11	NS
Potassium (mg)	3,418.20 ± 93.58	3,628.24 ± 77.47	3,523.22 ± 60.01	NS	3,221.13 ± 81.72	3,458.73 ± 102.25	3,339.93 ± 69.35	NS	2,737.30 ± 84.35	2,728.26 ± 111.84	2,732.78 ± 72.70	NS
Iron (mg)	21.09 ± 1.82	20.14 ± 0.49	20.61 ± 0.94	NS	20.97 ± 1.98	19.08 ± 0.51	20.03 ± 0.89	NS	15.48 ± 0.67	16.49 ± 0.73	15.98 ± 0.48	NS
Energy distribution (%)												
Carbohydrate	65.33 ± 1.11	64.80 ± 0.54	65.06 ± 0.58	NS	69.61 ± 0.67	69.23 ± 0.73	69.42 ± 0.50	NS	72.95 ± 0.68	71.40 ± 1.19	72.17 ± 0.65	NS
Protein	13.53 ± 0.37	14.03 ± 0.20	13.78 ± 0.20	NS	13.33 ± 0.27	13.27 ± 0.19	13.30 ± 0.17	NS	12.70 ± 0.28	12.60 ± 0.34	12.65 ± 0.21	NS
Fat	16.57 ± 0.62	17.13 ± 0.34	16.85 ± 0.34	NS	14.18 ± 0.48	14.15 ± 0.57	14.17 ± 0.38	NS	12.36 ± 0.47	12.45 ± 0.81	12.40 ± 0.46	NS

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE   3) Adjusted for age, sex and energy intake (except for energy)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, Significant difference by Student's t-test

and the females 27.5%. Therefore, males showed a significantly higher ratio of COPD than that of females, overall (p < 0.001).

More people lived in urban areas than in rural areas in both groups; however, population size did not differ significantly. There was a significant difference in the educational level between two groups (p < 0.001). Specifically, the rate of higher than high school education in the COPD group (38.4%) was lower than in the NCOPD group (59.1%). Regarding occupation, the rate of white collar workers was greater in the NCOPD group (16.3%) than the COPD group (8.3%), and the rate of unemployed was greater in the COPD group (43.6%) than the NCOPD group (34.5%) (p < 0.001). Comparison of household income revealed that the rate of respondents answering middle-high or high was greater in the NCOPD group (62.8%) than the COPD group (42.6%), while the rate of subjects answering middle-low or low was greater in the COPD group (57.4%) than in the NCOPD group (37.3%) (p < 0.001).

There was no significant difference in weight between groups, but the COPD group had significantly greater waist circumferences than the NCOPD group (p < 0.05). There were no differences in the mean of BMI, or the BMI distribution between the NCOPD group and the COPD group.

Health-related behaviors

Health-related behaviors according to COPD are shown in Table 2. The rate of ex-smokers or current smokers was greater in the COPD group (66.9%) than the NCOPD group (39.1%) (p < 0.001). Additionally, in alcohol drinking, the rate of respondents answering 2-4 times per month or more than 2 or more times per week was greater in the COPD group (48.1%) than the NCOPD group (40.7%) (p < 0.001). There were no significant differences in the frequency of eating out or exercise between groups.

Clinical indices

Clinical indices according to COPD are shown in Table 3. There were no significant differences in diastolic pressure, HDL-cholesterol, LDL-cholesterol, or triglycerides between groups. Systolic pressure (p < 0.05), fasting blood glucose (p < 0.05), HbA1c (p < 0.01) were significantly higher in the COPD group than the NCOPD group, while total cholesterol (p < 0.01) was significantly lower in the COPD group than the NCOPD group.

Nutrient intake and dietary quality

Daily nutrient intake of the subjects by age group is shown in Table 4. Among those in their 50s, the COPD group had significantly less intake of vitamin B_1 (p < 0.001) than the NCOPD group, while the vitamin A (p < 0.05) and sodium intake in the COPD group was significantly greater than in the NCOPD group (p < 0.05). Among those aged 60~69, the average energy intake of the COPD group (1,892.99 kcal) was significantly less than that of the NCOPD group (2,132.30 kcal) (p < 0.01). The COPD group showed significantly less intake of vitamin B_1 (p < 0.001) and vitamin C (p < 0.05), but greater intake of sodium (p < 0.05) than the NCOPD group. Among those aged 70 and over, the COPD group had significantly less intake

Table 5. Comparison of nutrient adequacy ratio (NAR) and mean adequacy ratio (MAR) of the subjects

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	p-value[3]
NAR			
Energy	0.87 ± 0.01[2]	0.88 ± 0.01	0.056
Protein	0.89 ± 0.01	0.91 ± 0.01	0.018[*]
Vitamin A	0.71 ± 0.01	0.72 ± 0.01	0.688
Vitamin B_1	0.91 ± 0.01	0.97 ± 0.00	< 0.001[***]
Vitamin B_2	0.74 ± 0.01	0.78 ± 0.01	0.001[**]
Niacin	0.82 ± 0.01	0.84 ± 0.01	0.087
Vitamin C	0.69 ± 0.01	0.68 ± 0.01	0.921
Calcium	0.59 ± 0.01	0.61 ± 0.01	0.226
Phosphorus	0.95 ± 0.01	0.96 ± 0.00	0.342
Iron	0.96 ± 0.00	0.98 ± 0.00	< 0.001[***]
MAR	0.81 ± 0.01	0.83 ± 0.00	0.012[*]

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE
3) Adjusted for age, sex
[*] p < 0.05, [**] p < 0.01, [***] p < 0.001, Significant difference by student's t-test

Table 6. Comparison of daily food group intake of the subjects

Variables	COPD[1] (n = 1,015)	NCOPD[1] (n = 1,091)	p-value[3]
Cereals and grain products (g)	313.47 ± 5.31[2]	312.27 ± 4.60	0.865
Potatoes and starches (g)	43.43 ± 4.38	58.82 ± 6.01	0.046[*]
Sugars and sweets (g)	10.45 ± 0.74	11.61 ± 0.77	0.293
Legumes and their products (g)	40.31 ± 3.25	47.00 ± 3.06	0.140
Seeds and nuts (g)	8.79 ± 0.99	11.29 ± 1.33	0.105
Vegetables (g)	383.67 ± 11.23	376.01 ± 9.85	0.626
Mushrooms (g)	6.02 ± 1.05	5.87 ± 0.85	0.903
Fruits (g)	191.49 ± 11.37	239.03 ± 11.00	0.003[**]
Meats and their products (g)	71.99 ± 4.93	77.60 ± 4.88	0.430
Eggs (g)	19.69 ± 1.46	19.17 ± 1.21	0.783
Fish and shellfish (g)	90.22 ± 7.18	101.66 ± 6.16	0.219
Seaweeds (g)	18.91 ± 4.21	30.13 ± 4.37	0.065
Milk and dairy products (g)	73.64 ± 5.48	67.16 ± 4.28	0.347
Oils and fats (g)	8.01 ± 0.42	7.20 ± 0.35	0.163
Beverages (g)	191.32 ± 12.77	211.71 ± 13.02	0.291
Seasonings (g)	37.19 ± 2.58	35.13 ± 1.89	0.597

1) COPD: Chronic obstructive pulmonary disease group, NCOPD: Non-chronic obstructive pulmonary disease group   2) Mean ± SE
3) Adjusted for age, sex and energy intake
[*] $p < 0.05$, [***] $p < 0.001$, Significant difference by Student's t-test

of vitamin B_1 ($p < 0.01$) than the NCOPD group. There was no difference in the ratio of carbohydrate, protein and fat intake between groups.

The results of NAR and MAR analysis of the subjects are shown in Table 5. The COPD group showed lower NAR values in protein ($p < 0.05$), vitamin B_1 ($p < 0.001$), vitamin B_2 ($p < 0.01$), and iron ($p < 0.001$) than the NCOPD group. The COPD group showed lower MAR values than the NCOPD group ($p < 0.05$).

With regard to food consumption (Table 6), consumption of potatoes and starches ($p < 0.05$), and fruits ($p < 0.01$) was significantly lower in the COPD than the NCOPD group. There were no statistical significances in other food groups.

Discussion

This study investigated differences in the nutrient/food intake and dietary quality of Koreans aged 50 and over according to whether they were with or without COPD. The Korean Academy of Tuberculosis and Respiratory Diseases divided risk factors for COPD into host factors (genes, age and sex) and external factors (smoking, external harmful substances, socioeconomic level and respiratory infection).[1] Age is an important risk factor for COPD, which is supported by studies conducted in Korea.[20] In this study, revealed that the majority of the NCOPD group

was in their 50s, while the majority of the COPD group was aged 60 and over. Moreover, there was a significant difference between male and female groups. COPD is believed to be more prevalent among men than women, which is usually attributed to higher smoking rates and more frequent occupational exposures of significance for men.[1] Additionally, poverty is an external risk factor for COPD. Previous studies[20,21] have reported that, as the socioeconomic level decreases, the chances of getting lung diseases increases. This study found similar results, but the relationship between socioeconomic level and exposure to indoor/outdoor air pollution, nutrition status or infection is not clear.

The rate of ex-smokers or current smokers was greater in the COPD group than the NCOPD group. The most important and well-known risk factor for COPD is smoking. Among Korean males aged 50 or older, the possibility of getting COPD is 2.1 times higher among smokers and 1.5 times higher among ex-smokers than non-smokers, which means smoking has a significant effect on the likelihood of developing COPD.[22] The main cause of COPD is smoking in Korea and most advanced countries, so quitting smoking is vital to preventing COPD.[2]

There was no significant difference in frequency of exercise between groups. The most noticeable characteristic of COPD is difficulty in breathing and decreased activity. As COPD develops, breathing difficulties become severe

and activity ability decreases, which results in a decrease in exercise.[23] It has been reported that when nutrition therapy and exercise therapy are carried out at the same time by COPD patients, their lean body mass increases and respiratory muscles strengthen.[24] Thus, COPD patients should increase their frequency of proper exercise to rehabilitate their breathing. Moreover, if nutrition therapy is carried out at the same time, this will be more effective.

The COPD group had higher systolic blood pressure than that of the NCOPD group.[25] Considering that hypertension is the most common disease that COPD patients in Korea suffer from (51% of all COPD patients) and that it affects prognosis, blood pressure management seems to be necessary.[1,26] Total cholesterol was greater in the NCOPD group than the COPD group, but the levels of both groups were included in the normal level.[27] Ivanovska[28] reported that total cholesterol and LDL-cholesterol levels of severe COPD patients were significantly higher, which is different from the results of this study. Fasting blood glucose and HbA1c was greater in the COPD group than the NCOPD group, and both groups were pre-diabetic.[29] Diabetes is common in COPD patients, and diabetes can have a negative impact on the prognosis of COPD patients. Thus, it is necessary to systematically regulate blood glucose through adequate nutrient intake, diet improvement, and light physical activity.[1]

The energy intake of the COPD group tended to decrease as age increased. Among those in their 60s, the energy intake of the COPD group was significantly lower than that of the NCOPD group. This was higher than the daily calorie intake of COPD patients reported by Lee[30]; however, considering that the average energy requirements for Koreans aged 50 and over are 2,000~2,200 kcal for males and 1,600~1,800 kcal for females, the energy intake of subjects with COPD is not sufficient.[31] It is common for COPD patients to have difficulty breathing while eating, as well as indigestion, fatigue and depression, and these symptoms are all related to a decrease in energy intake.[4] Thus, proper nutritional intervention is needed for patients with COPD.

There was no significant difference in the daily intake of carbohydrates, proteins and fats or their energy ratio between groups. A previous study[3] suggested that COPD patients should take a maximum of 50% of their energy from carbohydrates because excessive intake of carbohy-drates can increase carbon dioxide production. The present study revealed that the rate of carbohydrate intake in the COPD group was about 70%, indicating that nutritional intervention and education for proper carbohydrate intake is required.

The intake of potatoes and starches, fruits was signifi-cantly lower in the COPD group than in the NCOPD group, and the intake of seaweeds tended to be lower in the COPD group than in the NCOPD group. Insufficient intake of fruits and seaweeds in the COPD group are probably related to insufficient intake of certain vitamins. A previous study[32] reported that the intake of crude fiber, vitamin B_2, folic acid and potassium in all clinical stages of the COPD group fell short of their average requirements, and another study[8] on elderly also showed the COPD group consumed less calcium, phosphorus, folic acid, cholecalciferol, retinol and vitamin B_1 than the same age group. Other studies[12,33] have shown that a diet with sufficient fruits and vegetables can improve generalized infection and help to treat respiratory disease, in particular, to improve pulmonary function. Thus, a diet with plentiful fruits and vegetables should be recommended to COPD patients to encourage them to consume sufficient vitamins and minerals.

Sodium consumption was twice the amount or more than the WHO recommended intake of 2,000 mg in both the COPD group and NCOPD group.[34] Intake of sodium in the COPD group was significantly greater among those in their 50s and 60s group. Excessive sodium consumption can increase the risk of high blood pressure, and hypertension is the most common disease of COPD patients in Korea; thus, the intake of sodium should be carefully controlled.[1,26]

There was no significant difference in calcium intake between the two groups, but the NAR values of the two groups were around 0.6, indicating that the calcium intake is severely insufficient. COPD patients experience a decrease in exercise and weak skeletal muscles, which results in an increase in the risk of developing osteoporosis. As osteoporosis is the main cause of comorbidity in COPD,[1,26] proper nutritional intervention for the COPD group to provide calcium is required.

It is difficult to confirm the causal relationship between COPD prevalence and nutrient intake or diet quality because of the limitations of this cross-sectional study. Moreover, because food intake data used in this study was based on results of a survey conducted using the

24-hour recall method for one day, the data do not represent individuals' daily intakes. However, this study analyzed the relationships between COPD and diet using the Korea National Health and Nutrition Examination Survey data, which best show the characteristics of the Korean diet, and verified that there are differences in nutrient and food intake according to whether the subjects do or do not have COPD. Based on the not-so-severe stage of COPD among study subjects, it is considered that if the GOLD stage of COPD becomes severe, a more distinct lack of nutrient intake and decrease in dietary quality would be observed.[35]

In conclusion, the COPD group consumed less energy and fewer of certain nutrients than the NCOPD group among Koreans aged 50 and over, and the quality of their diet was not appropriate; however, there was not much difference between groups. As age increased, patients with COPD had a poorer and less balanced diet than non-COPD adults. Indeed, in patients with COPD, good diet has been associated with better lung function and reduced mortality.[36] Patients with COPD are at higher risk for malnutrition, these patients undergo careful assessment and screening to identify those who require dietary intervention. Moreover, more detailed research is needed to determine how individual nutrient intake in COPD patients affects their malnutrition.

Summary

This study examined and assessed nutrient and food intake and dietary quality of 2,160 Korean adults aged 50 and over with and without COPD who participated in the Korea National Health and Nutrition Examination Survey. The energy intake of the COPD group tended to decrease as age increased and was significantly less than that of the NCOPD group. Moreover, the ratio of carbohydrate intake in the COPD group was higher than those recommended in COPD patients. The COPD group generally showed lower NAR values than the NCOPD group. The intake of potatoes and starches, fruits was lower in the COPD group than in the NCOPD group. Insufficient intake of fruits in the COPD group is related to low intake of certain vitamins. On the other hand, salt intake was twice that of the WHO recommendations in both groups. Overall, the COPD group consumed less energy and fewer of certain nutrients than the NCOPD group, and the quality of their diet was inadequate; however, there was not much difference between groups. Therefore, it is necessary to study changes in food group intake and nutrient intake due to COPD prevalence. In addition, studies on nutrients that are insufficient in patients with COPD and appropriate intervention are required.

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