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Association of Coffee Consumption with Sarcopenia in Korean Elderly Men: Using the Korea National Health and Nutrition Examination Survey, 2008-2011

Department of Medicine

GRADUATE SCHOOL

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Abstract

Background: Coffee has abundant biologically active compounds of which some substances (e.g. phenolic compounds) have several pharmaceutical effects including antioxidant and anti-inflammatory effects. These effects have been considered as possible mediators of the mechanism of sarcopenia against oxidative stress or inflammation on skeletal muscle. Sarcopenia refers to an age-related loss of muscle mass, strength, and function. While several animal studies had been demonstrated in regards of the effect of coffee on sarcopenia, human studies are rare on this issue. Therefore, we investigated the effect of coffee consumption on sarcopenia by epidemiological study in Korean elderly men.

Methods: The cross-sectional data were obtained from the Korea National Health and Nutrition Examination Survey 2008-2011, and the study subjects consisted of 1,781 community-dwelling men aged 60 years or older after excluding those with stroke, myocardial infarction, angina, liver cirrhosis, renal failure, and cancer. Coffee consumption data was obtained by using the food frequency questionnaire. Daily coffee consumption amount were categorized into <1 cup; 1 cup; 2 cups; and ≥3 cups. Body composition was measured with the dual-energy X-ray absorptiometry and low muscle mass (sarcopenia) was defined as appendicular skeletal muscle mass divided by height squared (ASM/height^2, kg/m^2) that was less than two standard deviations below the gender-specific mean of young reference adults. Logistic regression analysis was used to assess the relationship between daily coffee consumption and sarcopenia, adjusted for sociodemographics and health-related variables (e.g. age, smoking, alcohol, exercise, education, household income, protein intake and energy intake).

Results: The mean age of the study population was 68.2 years and the mean age was decreased according to coffee consumption (P=0.001) but the means of height, weight, waist circumference, body mass index, appendicular skeletal muscle mass amount, and the amount

of protein intake were not different by coffee consumption (P=0.234, 0.225, 0.854, 0.378, 0.062, 0.113, and 0.243, respectively). In multivariate logistic regression models, adjusting for covariates (age, smoking, alcohol, exercise, education, household income, protein intake and energy intake), compared to the group of daily coffee consumption <1 cup, the sarcopenia was significantly decreased when the daily coffee consumption was ≥3 cups (adjusted odds ratio [aOR], 0.43; 95% confidence interval [CI], 0.20-0.94, P=0.03), while the sarcopenia was not significantly decreased when the daily coffee consumption was 1 or 2 cups (1 cup: aOR, 0.72; 95% CI, 0.40-1.30; P=0.28; 2 cups: aOR, 0.63; 95% CI, 0.33-1.21, P=0.16). The prevalence of sarcopenia was 7% in the study population. The proportions of sarcopenia by coffee consumption status were 9.0% in the group of coffee consumption of <1 cup/day (n=583), 6.8% in the group of 1 cups/day (n=476), 5.1% in the group of 2 cups/day (n=423), and 3.6% in the group of ≥3 cups/day (n=299), respectively (P for trend 0.007). Significant associations were still observed between sarcopenia and coffee consumption amount even after adjustment of covariates (P for trend=0.039).

Conclusion: Using nationally representative data from the 2008-2011 KNHANES, the results of this study suggest that coffee consumption at least three cups per day has the preventive effect on sarcopenia and the coffee consumption amount was inversely associated with sarcopenia in Korean elderly men.

Keywords: Coffee; Sarcopenia; Aged; Koreans

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I. INTRODUCTION

Recently, coffee import market in Korea is increasing continuously. The market size was 590 million U.S. dollars in 2014 and it had grown 15.3% per year in average for 10 years. The estimated yearly coffee consumption per capita was 341 cups in Korea, which increased by 14.4% compared to the data of previous year, 298 cups.[1)]

Coffee contains over a thousand compounds, some of which are phytochemicals and some are changes that occur during roasting. Key compounds of coffee include alkaloids caffeine, phenolic compounds, melanoidins, trigonelline, diterpenes cafestol and kahweol, which are biologically active and may impact human health.[2,3)]

Phenolic compounds of coffee, such as chlorogenic acid and caffeic acid, a major metabolite of chlorgenic acid, have strong antioxidant activity scavenging reactive oxygen species (ROS), and also have antimutagenic and anticarcinogenic activity[4)] as well as anti-inflammatory effect.[3-6)] Also it has been shown to have the potential of autophagy induction.[7)]

Sarcopenia has been defined as the loss of muscle mass and strength[8)] which is progressive, and mainly related to age.[9)] It can result in mobility disorders, physical disability, poor quality of life and even death.[10,11)] Several factors are related to the pathogenesis of sarcopenia. Age-related changes such as decreased anabolic hormone level or sensitivity, lack of physical activity, nutritional deficiencies, and comorbid disease status all affect to the onset and progression of sarcopenia. These changes are leading to modification of inflammation with increased circulating levels of inflammatory cytokines, oxidative stress, suppressed muscle autophagy, and increased apoptosis by altering intra- and extra-cellular

processes.[4,12-15] In addition, oxidative metabolism generates reactive oxygen species, which alters mitochondrial DNA in skeletal muscle and can lead sarcopenia.[16]

For the definition of sarcopenia, SMI could be calculated in 2 methods representatively; ASM divided by height squared (ASM/height^2) or by weight (ASM/weight).[17,18] In addition to various definition of SMI, the cutoff values could be described differently; 1) less than 1 SD below the mean values of healthy adults, 2) less than 2 SDs below the mean values of healthy adults, or 3) the lowest quintile of study populations.[19,20] In this study, we chose the method of ASM/ height^2 to calculate SMI and 2SDs below the mean values of healthy adults for cutoff values of sarcopenia.

An animal trial was conducted with aged mice to examine the effect of coffee on the skeletal muscles. The trial concluded that the coffee treatment attenuated the reduction of age-related muscle weight and muscle power compared to controls, and it also stimulated regeneration of injured muscle.[21] The trial focused on satellite cells which are resident myogenic progenitors in skeletal muscles and play a key role in the growth and regeneration of the skeletal muscles.[22] Pro-inflammatory mediators such as tumor necrosis factor-alpha (TNF-α) and interleukin 6 (IL-6) were decreased after coffee treatment correlated with prevention of the physical and functional declining.[21]

In spite of a few animal studies, human studies are rare in regards of the effect of coffee on sarcopenia. In this epidemiological study, we analyzed the coffee consumption amount to assess its effect on sarcopenia in Korean elderly men.

II. METHODS

1. Study population

Data are from the cross-sectional survey of the second, third year (2008-2009) of the Fourth Korea National Health and Nutrition Examination Survey (KNHANES IV) and the first and second year (2010-2011) of the KNHANES V, conducted by the Korea Centers for Disease Control and Prevention (KCDC). The KNHANES is performed periodically since 1998 as a cross-sectional and nationally representative survey to investigate the general health and nutritional status of Korean population. It used a complex, stratified, multistage, probability-cluster sampling method, which enabled the collection of extensive and representative data. The protocols for the KNHANES IV and V were approved by the Institutional Review Board of the KCDC. The written informed consents were made by all participants before the survey. The survey included a health interview survey, a nutrition survey and a health examination survey. Data were collected via household interviews and direct standardized physical examinations. During the year of 2008-2011, all male subjects of KNHANES were 9,043 and those aged 60 years or older men were 2,451. Among the participants aged 60 years or older men, the individuals with stroke (144), myocardial infarction or angina (153), liver cirrhosis (17), renal failure (12), or cancer (344) were excluded. The final 1,781 subjects were included for the analysis.

2. Assessment of coffee intake

Self-reported coffee consumption data were obtained through dietary interviews. Food frequency questionnaire (FFQ) was used to assess the usual dietary intake over the preceding year. Participants were asked how many cups of coffee they drank during a day, a week or a month. In the questionnaire, the frequency of coffee intake was classified into the ten categories: rarely, 6-11 cups per year, 1 cup per month, 2-3 cups per month, 1 cup per week, 2-3 cups per week, 4-6 cups per week, 1 cup per day, 2 cups per day, and 3 or more cups per day. Four coffee consumption groups were newly assorted into according to the frequency of coffee consumption: less than 1 cup per day (<1 cup), 1 cup per day (1 cup), 2 cups per day (2 cups) and 3 or more cups per day (≥3 cups), because of the excessively small samples and the small differences between data of each section of the four groups. No distinction was made between caffeinated and decaffeinated coffee, or between the individual types of coffee (boiled, filtered, and instant).

3. Definition of sarcopenia

Whole and regional body compositions of participants were measured using dual-energy X-ray absorptiometry (DXA, Discovery-W fan-beam densitometer, Hologic, Inc., MA, USA). According to the definition of sarcopenia proposed by Baumgartner et al.[8] we summed the muscle mass of the four limbs from DXA as appendicular skeletal muscle mass (ASM) and defined a skeletal muscle mass index (SMI) as ASM adjusted by height squared, ASM/height^2 (kg/m^2). The SMI 2 standard deviations (SDs) below the mean SMI of young male reference group was defined as the cutoff value for sarcopenia. Participants were classified as groups with sarcopenia and without sarcopenia.

4. Statistical Analysis

We applied weighted values to represent the whole Korean population. In the present study, the mean, estimated proportion, and standard errors were calculated. Complex sample logistic regression analysis was used to evaluate the relationship between sarcopenia and coffee consumption. Results were considered to be statistically significant when the P-value was less than 0.05. To estimate P for trends, coffee consumption group variable was regarded as a continuous variable in the trend analysis. Data were analyzed using SPSS version 20.0 for Windows (IBM inc; New York, USA).

III. RESULTS

1. The comparison of the groups with and without sarcopenia

The characteristics of the Korean elderly men were calculated by complex sample general linear model and analyzed by complex sample logistic regression method (Table 1). The study subjects were all 1,781 men aged 60 years or older and the mean age was 68.2 years. With the sarcopenia definition as described in the methods, the cutoff point of sarcopenia in men was 6.07kg/m^2. The mean age of the group of sarcopenia was 72.0±0.68 years which was significantly higher than that of the group without sarcopenia, 67.9±0.19 years (P<0.001). The mean height and weight of the group without sarcopenia were 165.8±0.17 cm and 65.5±0.28 kg and those of the sarcopenia group were significantly lower as 163.8±0.57 cm (P=0.001) and 51.1±0.71 kg (P<0.001). The mean of SMI was 7.4±0.03 kg/m^2 in the group without sarcopenia and 5.7±0.04 kg/m^2 in the group with sarcopenia (P<0.001). Smoking status and exercise frequency were significantly different between two groups (P=0.004, P=0.006 respectively) but there was no difference in alcohol consumption frequency (P=0.618).

The proportion of coffee consumption by stratified frequencies were significantly different between two groups (P=0.034). In the group with sarcopenia, the ratio of the number of person who drank coffee less than 1 cup/day and 1 cup/day were relatively higher than those of the group without sarcopenia (43.4% and 28.2% in the group with sarcopenia versus 30.7% and 27.1% in the group without sarcopenia) and the rates were relatively lower as daily coffee consumption frequency was increased by 2 cups and 3 or more cups (18.8% and 9.6% in the group with sarcopenia versus 24.4% and 17.9% in the group without sarcopenia).

Table 1. **Clinical characteristics of the participants with and without sarcopenia.**

		without sarcopenia (N=1656*)	with sarcopenia (N=125*)	P-value
Age (year)		67.9±0.19	72.0±0.68	<0.001
Age (%)	60-69	64.0 (1.3)	38.5 (4.5)	<0.001
	70-79	31.2 (1.2)	49.0 (5.0)	
	≥80	4.8 (0.6)	21.5 (3.6)	
Height (cm)		165.8±0.17	163.8±0.57	0.001
Weight (kg)		65.5±0.28	51.1±0.71	<0.001
Waist circumference (cm)		86.3±0.27	73.9±0.97	<0.001
BMI (kg/m^2)		23.8±0.09	19.0±0.24	<0.001
ASM (kg)		20.4±0.09	15.4±0.16	<0.001
ASM/Height^2 (kg/m^2)		7.4±0.03	5.7±0.04	<0.001
Coffee (%)	<1 cup/day	30.7 (1.4)	43.4 (5.7)	0.034
	1 cup/day	27. 1(1.4)	28.2 (4.5)	
	2 cups/day	24.4 (1.3)	18.8 (4.2)	
	≥3 cups/day	17.9 (1.2)	9.6 (2.8)	
Smoking (%)	Never	16.2 (1.1)	9.1 (2.6)	0.004
	Former	27.8 (1.5)	17.2 (4.1)	
	Current	56.0 (1.7)	73.7 (4.7)	
Alcohol (%)	Never	23.8 (1.2)	27.9 (4.6)	0.618
	≤1/week	35.8 (1.6)	31.0 (6.3)	
	≥2/week	40.4 (1.5)	41.1 (5.7)	
Exercise (%)	None	71.3 (1.6)	85.7 (3.4)	0.006
	≤2/week	14.8 (1.2)	7.5 (2.8)	
	≥3/week	13.9 (1.2)	6.7 (2.2)	

Calculated by complex sample general linear model (CSGLM) and complex sample logistic regression analysis (CSLRA).

Values are presented as mean ± standard error or estimated % (standard error).

All data are weighted to the residential population of Korea.

*Unweighted sample size.

BMI: body mass index; ASM: appendicular skeletal muscle.

2. Baseline characteristics of the subjects according to coffee consumption frequency

Unweighted sample numbers of each subgroup according to coffee consumption were 583 in the group with daily coffee consumption less than 1 cup, 476 in the group with 1 cup, 423 in the group with 2 cups, and 299 in the group with 3 or more cups. The mean ages were decreased as the daily coffee consumption amount was increased (P=0.001). But there were no differences in the means of height, weight, waist circumference, body mass index, and the amount of protein intake, and the frequency of exercise, according to the coffee consumption amount. No significant differences were detected in the means of ASM and SMI by each coffee consumption group (P=0.113, 0.243, respectively). However, except exercise frequency, the planned factors to be adjusted, smoking, alcohol consumption rate, household income, education, and total energy intake amount were significantly different by daily coffee consumption (Table 2).

Table 2. Anthropometric and demographic characteristics according to coffee consumption.

		Coffee consumption (cup/day) (N=1,781*)				
		<1 (N=583*)	1 (N=476*)	2 (N=423*)	≥3 (N=299*)	P-value
Age (year)		68.9±0.33	68.5±0.38	67.9±0.33	66.8±0.42	0.001
Age (%)	60-69	57.5 (2.3)	60.2 (2.8)	64.6 (2.5)	71.1 (3.0)	0.032
	70-79	35.9 (2.2)	33.8 (2.6)	31.0 (2.3)	25.9 (2.9)	
	80-	6.6 (1.2)	6.0 (1.4)	4.4 (1.1)	3.1 (1.2)	
Height (cm)		165.3±0.31	165.6±0.29	166.0±0.33	166.2±3.36	0.234
Weight (kg)		63.7±0.54	64.6±0.51	65.2±0.59	65.2±0.66	0.225
Waist circumference (cm)		85.2±0.48	85.4±0.48	85.8±0.57	85.5±0.65	0.854
BMI (kg/m^2)		23.2±0.16	23.5±0.16	23.6±0.19	23.6±0.23	0.378
ASM mass (kg)		19.8±0.19	20.1±0.15	20.2±0.17	20.5±0.18	0.113
ASM/height^2 (kg/m^2)		7.2±0.06	7.3±0.04	7.3±0.05	7.4±0.06	0.243
Smoking	Never	21.3 (2.0)	14.7 (1.9)	13.3 (2.1)	10.5 (2.2)	0.001
	Former	25.6 (2.2)	26.5 (2.4)	32.9 (3)	22.7 (3.1)	
	Current	53.0 (2.6)	58.7 (2.7)	53.8 (3.3)	66.8 (3.2)	
Alcohol	Never	22.7 (2.1)	22.9 (2.4)	20.8 (2.3)	32.6 (3.4)	0.039
	≤1/week	34.9 (2.7)	37.1 (2.9)	34.5 (2.8)	35.5 (3.6)	
	≥2/week	42.4 (2.8)	40.0 (2.8)	44.7 (2.7)	31.9 (3.3)	
Exercise	None	74.6 (2.3)	71.7 (2.9)	73.0 (2.9)	68.0 (3.5)	0.790
	≤2/week	12.5 (1.6)	15.1 (2.4)	13.4 (2.2)	17.3 (2.8)	
	≥3/week	12.9 (1.9)	13.2 (1.9)	13.6 (2.5)	14.7 (2.8)	
Household income	Low	45.4 (2.7)	40.8 (2.6)	28.8 (2.7)	29.7 (3.4)	<0.001
	Low-moderate	28.5 (2.5)	27.5 (2.2)	31.3 (2.8)	27.1 (3.4)	

	moderate-high	13.8 (1.8)	17.9 (2.1)	21.0 (2.3)	25.9 (2.9)	
	high	12.3 (2.1)	13.8 (2.0)	18.9 (2.4)	17.3 (2.9)	
Education	≤ 6	51.5 (2.7)	40.0 (2.8)	41.5 (3.0)	41.8 (3.8)	0.002
(year)	7-9	20.8 (2.2)	20.6 (2.3)	21.4 (2.6)	22.9 (3.0)	
	10-12	19.6 (2.1)	23.8 (2.2)	19.9 (2.4)	26.8 (3.1)	
	≥ 13	8.1 (1.4)	15.6 (2.0)	17.2 (2.8)	8.6 (2.0)	
Protein intake (g/day)[a]		65.9±1.47	67.9±1.99	71.2±1.97	72.1±2.34	0.062
TEI (kcal/day)[a]		1957±31.5	1994±40.1	2101±44.8	2123±50.2	0.006

Calculated by complex sample general linear model (CSGLM) and complex sample logistic regression analysis (CSLRA).

Values are presented as mean ± standard error or estimated % (standard error).

All data are weighted to the residential population of Korea.

*Unweighted sample size.

[a]Daily energy and protein intakes were assessed using the 24-h recall method of the nutrition Survey of KNHANES.

BMI: body mass index; ASM: appendicular skeletal muscle; TEI: total energy intake.

3. The relationship between coffee consumption and sarcopenia

Compared to the reference group of daily coffee consumption <1 cup, the sarcopenia was significantly decreased when the daily consumption was ≥3 cups (odds ratio [OR], 0.38; 95% confidence interval [CI], 0.18-0.80) while the sarcopenia was not significantly decreased when the daily coffee consumption was 1 or 2 cups (1 cup: OR, 0.74; 95% CI, 0.43-1.26; 2 cups: OR, 0.54; 95% CI, 0.29-1.03) without any adjustment (Model 1 in Table 3). The result consistently continued after adjustment for covariates as shown in Table 3. The sarcopenia was significantly decreased when the daily coffee consumption was ≥3 cups after adjustment for age, smoking, alcohol, exercise, education, household income, protein intake and energy intake (Model 5 in Table 3, adjusted OR, 0.43; 95% CI, 0.20-0.94).

Table 3. Odds ratios and 95% confidence intervals of sarcopenia by coffee consumption.

	Coffee consumption (cup/day)						
	1		2		≥3		
Model	OR(CI)	P-value	OR(CI)	P-value	OR(CI)	P-value	P for trend
1	0.74(0.43-1.26)	0.26	0.54(0.29-1.03)	0.06	0.38(0.18-0.80)	0.01	0.007
2	0.75(0.44-1.28)	0.29	0.59(0.31-1.11)	0.10	0.46(0.22-0.96)	0.04	0.025
3	0.69(0.39-1.22)	0.20	0.55(0.29-1.05)	0.07	0.41(0.19-0.85)	0.02	0.011
4	0.73(0.41-1.29)	0.27	0.60(0.32-1.14)	0.12	0.43(0.20-0.91)	0.03	0.023
5	0.72(0.40-1.30)	0.28	0.63(0.33-1.21)	0.16	0.43(0.20-0.94)	0.03	0.039

Values are presented as prevalence odds ratio (95% confidence interval) compared with the group of coffee consumption less than 1 cup per day in each model.

Model 1: Not adjusted.

Model 2: Univariate adjusted for age.

Model 3: Multivariate adjusted for age, smoking, alcohol, and exercise.

Model 4: Multivariate adjusted for education and household income, in addition to the covariates included in the model 3.

Model 5: Multivariate adjusted for protein intake and energy intake in addition to the covariates included in the model 4.

OR: Odds ratio; CI: Confidence interval.

The prevalence of sarcopenia was 7% (n=125) in the total study population. The estimated rate of sarcopenia in the group with daily coffee consumption <1 cup was 9.0% and those were 6.8% in the group of 1 cup, 5.1% in the group of 2 cups, and 3.6% in the group of ≥3, respectively as shown in Figure 1. We found out that the prevalence of sarcopenia decreased as daily coffee consumption increased (P for trend=0.007). After adjustment for age (Model 2), the estimated prevalence of sarcopenia decreased still significantly as daily coffee consumption increased (P for trend=0.025). This significant pattern continued in the multivariate-adjusted Model 3, 4, and 5 as shown in Table 3 (P for trends=0.011, 0.023, 0.039, respectively).

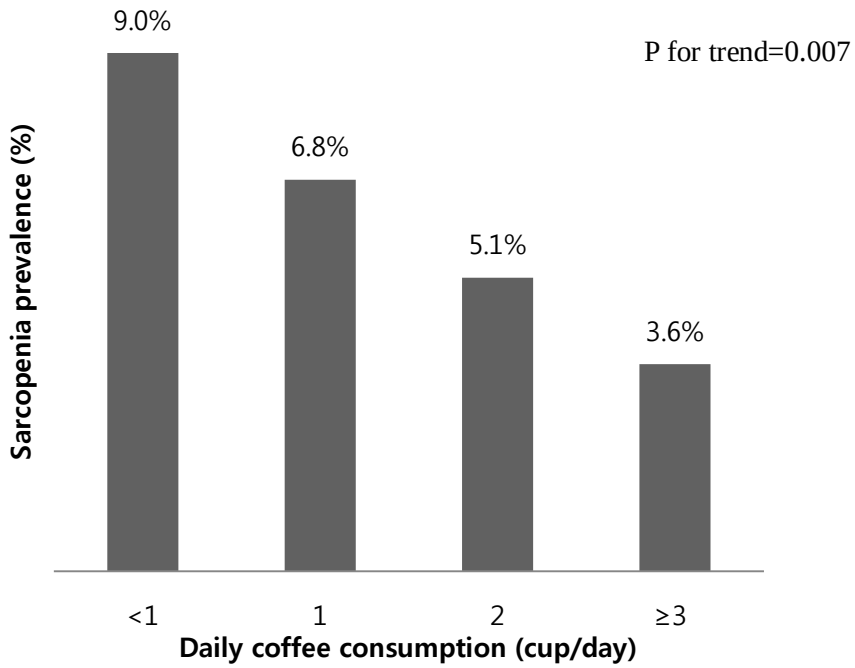

Figure 1. **Prevalence of sarcopenia according to daily coffee consumption. Sarcopenia prevalences (%) are estimated values.**

IV. DISCUSSION

Because sarcopenia is mainly related to aging, we expected the mean age of the group of sarcopenia should be higher than the group without sarcopenia, and the analyzed results were in good accord with the expected results (72.0 years old of the group of sarcopenia versus 67.9 years old of the group without sarcopenia). In the present study, coffee consumption reduced the risk of sarcopenia significantly and the association was independent of age, lifestyle (alcohol consumption, smoking, and exercise), degrees of education and household income, and nutrition status (protein and energy intake). Furthermore, a significant linear trend was observed across the frequencies of coffee consumption. The participants consuming 3 or more cups of coffee per day had a 62% lower risk of the sarcopenia, compared with those consuming less than 1 cup of coffee per day. In addition, coffee consuming 3 or more cups per day had a 57% lower risk of sarcopenia, even after adjustment for covariates mentioned above.

There are some supporting explanations about the preventive effect of coffee on sarcopenia. According to the mitochondrial free radical theory of aging (MFRTA), mitochondrial dysfunction due to oxidative damage to mitochondrial DNA is a major mechanism in the aging process.[23] Autophage is essential for proper renewal of mitochondria and maintenance of muscle mass. Hence autophage rate should be increased by various stresses on muscle cells like exercise or starvation.[24] It has also been shown that autophagy is deficient in aged muscle and may affect to mitochondrial dysfunction, enhanced oxidative stress, and the decline of muscle homeostasis which occurs during the aging process.[14] According to Pietrocola et al, chronic consumption of coffee diluted in the drinking water of female mice stimulated autophagy in the liver, heart, and skeletal muscle in a dose-dependent manner.[25]

Also, polyphenols, the main antioxidant component of coffee, have been shown to induce autophagy.[26] Because of its antioxidant effect, it is easily conceivable that coffee may lower the risk of sarcopenia by reducing oxidative stress of mitochondria of muscle cells.

Considering these pharmacological benefits of coffee, mounting studies have investigated the association between coffee consumption and several clinical conditions. Habitual coffee consumption lowered diabetes or pre-diabetes incidence[27-30] and insulin resistance.[31] Similar data were obtained in other diseases, such as stroke,[32-34] Parkinson's disease,[35] and cardiovascular disease[36] and all-cause of mortality[37-39] and cause-specific mortality.[38] Also, evidences are increasing that coffee consumption is associated with decreased risks of some types of cancer,[17,40] such as liver, kidney, and breast cancers in premenopausal women or BRCA1 and BRCA2 mutation carrier.[41,42] Recently, the data was added that coffee intake 4 cups or more may be associated with significantly reduced cancer recurrence and mortality (Hazard ratio 0.58, CI, 0.34 to 0.99) in patients with stage III colon cancer.[43]

In our study, the overall prevalence of sarcopenia was 7.5% in Korean men aged 60 years or older. We used ASM/height^2 index with 2 SDs below the mean values of healthy adults as cutoff value. According to a meta-analysis in 2015, the various prevalence of sarcopenia in Korean elderly had been reported by study groups.[44] In the observational study by Kim et al,[45] on the association of sarcopenia with cardiometabolic risk factors in elderly aged 65 years or older, the prevalence of sarcopenia was 35.5% in men and 13.4% in women with ASM/height^2 index. When they used ASM/weight index, the prevalence were changed to 37.3% for men and 62.6% for women. In another study, sarcopenia was defined as an ASM adjusted weight index less than 2 SDs below the mean of healthy adults (20-40 years), and prevalence of sarcopenia in participants older than 50 years was 7.8%.[18] The difference of sarcopenia prevalence was due to different cutoff values of SMI and the difference of study

population in age or sex.

Several studies were published offering insight into the role of dietary factors like coffee contributing to strategies to prevent sarcopenia. According to Kim et al., the men in the highest quintile of vegetables, fruits and vegetables and fruits consumption had 52, 70 and 68% lower risk of sarcopenia compared with those in the lowest quintile of vegetables, fruits and vegetables and fruits consumption, in Korean men aged 65 year or older.[46] Their hypothesis was based on the antioxidant effect of vegetables and fruits to prevent sarcopenia. Kim et al demonstrated that vitamin D levels were significantly lower in subjects with sarcopenia compared with those without sarcopenia.[18]

We hypothesized that coffee might reduce the risk of sarcopenia in human through its antioxidant, anti-inflammatory, and pro-autophagy effects supported by previous animal trial[21] and our results were supporting the hypothesis. To our knowledge, this is the first human study to examine the correlation between coffee consumption and sarcopenia. These data supported the putative role of coffee in preventing sarcopenia corresponding to the demonstration in animal study in vivo and vitro[21] and the theoretical mechanism explanation of coffee on sarcopenia.[47] Another strong point of this study is that the study sample was obtained from a reliable nationally representative population database, lending credence to be generalizable of the findings. The results were significant even after adjustment for covariates including demographic and health-related variables, hence the findings were testified to be sturdiness.

This study has some limitations. First, information of coffee consumption was collected by assessing over the preceding year. The data did not take into account any changes of consumption over the life time. Second, because the study was performed using a cross-

sectional design, there is limitation to detect the causal relations or mechanism of action. Third, we cannot exclude the possibility of the associations of sarcopenia with the confounding variables, for example herb tea, green tea, vegetables, fruits, or others which can be the sources of antioxidant.

V. CONCLUSION

In conclusion, this study is the large population-based study to examine the association between coffee consumption and sarcopenia. High consumption of coffee was related with a lower risk of sarcopenia in Korean elderly men.

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VII. **ABSTRACT IN KOREAN**

연구배경: 커피에는 생물학적 활성을 가진 물질들이 다량 함유되어 있고 그 중 일부는 (예: 페놀화합물) 항산화 및 항염작용과 같은 약리학적 효과를 가지고 있는 것으로 알려져 있다. 근육에 산화 스트레스나 염증이 작용하여 발생하는 근감소증의 병인 원리와 연관지어 볼 때 이러한 커피의 항산화 및 항염작용은 근감소증의 진행과 반대되는 작용을 가져 올 수 있을 것이라 기대하고 있다. 근감소증은 연령이 증가함에 따라 근육양과 강도, 기능이 감소하는 것을 말하는데 몇몇 동물실험으로 커피가 근감소증에 미치는 영향에 대하여 보고한 바가 있으나 인간을 대상으로 한 연구는 아직 보고된 바가 없다. 따라서 본 역학연구에서는 한국의 노년 남성에서 커피 섭취가 근감소증에 미치는 영향에 대하여 알아보고자 하였다.

연구방법: 2008년에서 2011년 간의 한국국민건강영양조사로부터 얻은 자료를 이용하여 단면연구를 시행하였다. 지역사회에 거주하는 60세 이상의 남성 중 뇌졸중, 심근경색, 협심증, 간경화, 신장부전, 암 환자를 제외하고 총 1,781명이 분석의 대상이 되었다. 커피 섭취량은 국민건강영양조사에서 음식빈도설문지를 이용하여 조사하였는데, 본 연구를 위하여 하루에 마시는 커피 섭취량을 <1잔, 1잔, 2잔, ≥3잔 군으로 재분류 하였다. 조사 대상의 체성분은 이중에너지방사선 흡수계측기를 이용하여 측정하였다. 근감소증은 사지골격근량의 합을 키의 제곱으로 나누어 계산한 수치가 동성의 젊은 기준 성인의 평균의 2 표준편차 보다 작은 경우로 정의하였다. 커피소비량과 근감소증 사이의 연관성을 알아보기

위하여 사회인구학적 변수와 건강 관련된 변수(예를 들어 연령, 흡연, 음주, 운동, 교육정도, 가계수입, 단백질 및 에너지섭취량 등)로 보정하여 로지스틱 회귀분석을 시행하였다.

결과: 전체 연구대상의 평균연령은 68.2세였으며 하루 커피소비량이 많을수록 평균 연령은 감소하는 경향을 보였다(P=0.001). 신장, 몸무게, 허리둘레, 체질량지수, 사지골격근량 및 단백질 섭취량은 각 커피섭취군간의 차이를 보이지 않았다(각각 P=0.234, 0.225, 0.854, 0.378, 0.062, 0.113, 0.243). 다변량 로지스틱 회귀모형을 이용하여 교란변수(연령, 흡연, 음주, 운동, 교육, 가계수입, 단백질 및 에너지 섭취)를 보정하여 분석한 결과, <1잔군과 비교하였을 때 ≥3잔군에서 근감소증 유병률은 현저히 감소하는 결과를 보였고(교란변수를 보정한 승산비, 0.43; 95% 신뢰구간, 0.20−0.94) 1잔군과 2잔군에서는 유의한 차이를 보이지 않았다 (1잔군에서 보정한 승산비, 0.72; 95% 신뢰구간, 0.40−1.30; P=0.28; 2잔군에서 보정한 승산비, 0.63; 95% 신뢰구간, 0.33−1.21, P=0.16). 전체 연구대상의 근감소증 유병률은 7%로 나타났는데, 각 커피 섭취군에서의 근감소증의 비율은 각각 <1잔군(총 583명)에서 9%, 1잔군(총476명)에서 6.8%, 2잔군(총 423명)에서 5.1%, ≥3잔군(총 299명)에서 3.6%로 나타나 커피섭취량이 증가할수록 근감소증이 감소하는 연관성을 보였고(P for trend 0.007) 교란변수를 보정한 후에도 같은 결과를 나타내었다(P for trend 0.039).

결론: 한국국민건강영양조사 2008년−2011년 자료를 이용한 본 연구에서는 한국의 노년 남성에서 커피의 섭취량이 근감소증과 역의 상관관계가 있음을

보여주었다. 또한 하루 3잔 이상의 커피섭취가 근감소증을 예방하는 효과가 있을 가능성을 제시하고 있다.

Keywords: Coffee; Sarcopenia; Aged; Koreans