Journal of Obesity & Metabolic Syndrome 2017;26:281-286
https://doi.org/10.7570/jomes.2017.26.4.281

Original Article

jomes
pISSN 2508-6235
eISSN 2508-7576

The Relationship between Body Mass Index and Smoking Cessation Plans in Korean Adults

Ji Young Lee[1], Seon Mee Kim[1,*], Yoon Seon Choi[1], Yong Gyu Park[2], E Yeon Kim[1], So Jung Yoon[1], Jin Wook Kim[1], Jung Hwan Yoon[1], Man Kim[1], Hye Ran Jeon[1]

[1]Department of Family Medicine, Korea University Guro Hospital, Korea University College of Medicine, Seoul; [2]Department of Biostatistics, College of Medicine, The Catholic University of Korea, Seoul, Korea

Background: Concerns regarding weight gain after smoking cessation may interfere with quitting smoking. This study investigated the association between smoking cessation plans and body mass index (BMI, kg/m^2) in Korean adult smokers.

Methods: Using data from the sixth Korea National Health and Nutrition Examination Survey (2013–2015), 3,000 current smokers aged 19 years or older were selected and divided into four weight groups. The cohorts included an underweight group (BMI, <18.5 kg/m^2), normal weight group (BMI, ≥18.5 to <23 kg/m^2), overweight group (BMI, ≥23 to <25 kg/m^2), and obese group (BMI, ≥25 kg/m^2). The relationship between BMI and smoking cessation plans in Korean adults was analyzed using multiple logistic regression analysis.

Results: Multiple logistic regression analysis showed sex (odds ratio [OR], 0.723; 95% confidence interval [CI], 0.556–0.939), high-risk drinking (OR, 0.796; 95% CI, 0.634–0.998), aerobic physical activity (OR, 1.326; 95% CI, 1.092–1.612), and hypertension (OR, 1.387; 95% CI, 1.034–1.860) were the significant factors related to smoking cessation plans. According to the BMI categories, the ORs of smoking cessation plans were numerically higher in the normal weight group than the other three groups. However, the difference was not statistically significant.

Conclusion: Normal weight subjects tended to have a greater number of smoking cessation plans than the other three weight groups, but the difference was not statistically significant. In the clinic, it is necessary to consider not only BMI but also other factors associated with a smoking cessation plans.

Key words: Obesity, Smoking cessation, Body mass index

Received June 16, 2017
Reviewed July 11, 2017
Accepted September 21, 2017

*Corresponding author
Seon Mee Kim

https://orcid.org/0000-0002-1957-2928

Department of Family Medicine,
Korea University Guro Hospital, Korea University College of Medicine, 148 Gurodong-ro, Guro-gu, Seoul 08308, Korea
Tel: +82-2-2626-3275
Fax: +82-2-837-0613
E-mail: ksmpdh@korea.ac.kr

INTRODUCTION

Several studies have revealed the effects of smoking on health. Smokers have a higher incidence of various diseases compared with nonsmokers, including numerous types of cancer, chronic lung disease, coronary artery disease, and cerebrovascular disease.[1] Furthermore, smokers are known to die prematurely, on average 10 years earlier than nonsmokers.[2-5]

Due to the outcomes mentioned above and several other risk factors, efforts are being made to induce smoking cessation in the form of cigarette advertising restrictions, tobacco price hikes, smoking cessation zones, and smoking cessation clinics. Consequently, according to the Korea National Statistical Office, the smoking rate has decreased by about 10%; from 35.2% in 1998 to 23.2% in 2013, and 70% of smokers want to quit the habit.[6] However, even if attempts are made to stop smoking, due to demographic, sociological, or environmental reasons, the actual success rate is only 3%–5%.[7]

Some studies state that smoking cessation may increase body weight.[8,9] Various responsible mechanisms have been suggested for weight gain after smoking cessation, such as associated changes in the serum concentrations of the appetite hormones, leptin and ghrelin.[10] Moreover, the action of nicotine is associated with inef-

fective metabolic pathways of anabolic action in smokers compared to nonsmokers and is related to altering metabolic processes in a way that encourages energy consumption.[11] Smoking is a considerably greater health risk than that associated with weight gain. Nonetheless, weight gain after cessation cannot be ignored[12], particularly given concerns related to weight gain that may interfere with smoking cessation.[2,10,13,14]

Weight gain after smoking cessation is influenced by body mass index (BMI), although this varies according to sociodemographic characteristics.[15] According to Krukowski et al.[15], weight gain after smoking cessation is significantly increased in normal weight and overweight people. Therefore, there is a need to consider BMI in relation to smoking cessation plans. However, there is little research on the difference in actual plans for smoking cessation between obese smokers and normal weight smokers.

This study investigated the association between smoking cessation plans and BMI in Korean adult smokers using epidemiological data from the sixth Korea National Health and Nutrition Examination Survey (KNHANES).

METHODS

Study participants

This study retrospectively analyzed data from the sixth KNHANES VI-3 (2013–2015). Approval for the study was obtained from the research ethics committee of the Korea Centers for Disease Control and Prevention (IRB No. 2013-07CON-03-4C, 2013-12EXP-03-5C). The informed consent was waived.

Education levels and disease items were investigated through interviews; smoking, drinking, and exercise were assessed by self-report. The examination was conducted by direct measurement of the body by the investigator. Of the total respondents, 18,034 persons aged ≥ 19 years were included, of whom 3,028 were smokers. Fourteen patients with cancer were excluded. Also, smokers who did not respond to the questionnaire on smoking cessation and for whom height and weight were not measured were excluded. Thus, 3,000 smokers were included in the study.

Definitions of variables

Participants were classified into four groups based on their BMI (body weight [kg]/square of height [m^2]), according to the criteria of the World Health Organization's Asia-Pacific region and the Korean Society of Obesity. Thus, underweight (BMI, < 18.5 kg/m^2), normal weight (BMI, ≥ 18.5 to < 23 kg/m^2), overweight (BMI, ≥ 23 to < 25 kg/m^2), and obese (BMI, ≥ 25 kg/m^2) groups were established.

Participants that answered, "I plan to quit smoking within a month" and yes to, "Do you plan to quit smoking in the next month?" were categorized as having a smoking cessation plan. According to the fourth Health Plan 2020 (National Health Promotion Comprehensive Plan established in Korea every 5 years), high-risk drinking was defined as the consumption of more than seven drinks in one sitting (for men) or five drinks in one sitting (for women) more than twice a week. Aerobic physical activity was defined as moderate-intensity physical activity performed ≥ 2.5 hours per week; a high-intensity activity that was done for ≥ 1.25 hours per week; or a combination of moderate-intensity (2 minutes) and high-intensity (1 minute) physical activity.

Education level was divided into three categories. The first category included participants with less than a middle school education or not knowing or nonresponse. The second and third categories had a middle school education and above, and a high school education and above, respectively. The prevalence of disease was included for those who had been diagnosed by a doctor and those presenting with a disease.

Statistical analysis

The KNHANES is a nationwide, cross-sectional health survey that uses a complex sample design to estimate the behaviors of the target South Korean adult population.

General characteristics were compared with the chi-square test. The degree of the association between smoking cessation plans with BMI and general characteristics were expressed as odds ratio (OR) and 95% confidence interval (CI). Factors associated with smoking cessation plans were analyzed using multiple logistic regression. Sample weights were used for all statistical analyses, which was performed with IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA) and verified using the SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). The significance level was $P < 0.05$.

https://doi.org/10.7570/jomes.2017.26.4.281

RESULTS

Of the 3,000 adult smokers, 1,104 were obese, 1,086 were in the normal weight range, 700 were overweight, and 110 were underweight. The distribution of smokers was different according to their age. Being underweight accounted for a higher percentage in the lower age group ($P < 0.001$). The proportion of men was significantly greater in smokers with higher BMI. There were significantly more women in the underweight group than the other groups, while being underweight represented the least percentage of men. Participants with high-risk drinking accounted for less than half of all the groups. The higher the BMI, the higher was the risk of alcohol consumption. Regarding education, the number of participants with high school education and above was the greatest. The proportion of hypertension was significantly greater in smokers with a higher BMI, but there were no significant differences in the incidence of other diseases (Table 1).

Table 2 shows the results of univariate analysis for the association of smoking cessation plans with BMI and general characteristics. The overweight group had fewer smoking cessation plans (OR, 0.756; 95% CI, 0.584–0.979) than the normal weight group. The group who undertook physical activity had a higher prevalence of smoking cessation plans (OR, 1.298; 95% CI, 1.071–1.572) than the non-physical activity group. Compared to patients without diabetes, diabetic patients had 1.43 times more smoking cessation plans (OR, 1.43; 95% CI, 1.016–2.013).

Table 1. Participant general characteristics (n = 3,000)

Variable	Underweight (n = 110)	Normal weight (n = 1,086)	Overweight (n = 700)	Obese (n = 1,104)	*P**
Age (yr)					< 0.001
19–39	58 (52.7)	396 (36.5)	207 (29.6)	435 (39.4)	
40–60	26 (23.6)	444 (40.9)	333 (47.6)	513 (46.5)	
> 60	26 (23.6)	246 (22.7)	160 (22.9)	156 (14.1)	
Sex					< 0.001
Male	69 (62.7)	878 (80.8)	615 (87.9)	968 (87.7)	
Female	41 (37.3)	208 (19.2)	85 (12.1)	136 (12.3)	
Drinking					0.035
Yes	16 (14.5)	266 (24.5)	186 (26.6)	328 (29.7)	
No	94 (85.5)	820 (75.5)	514 (73.4)	776 (70.3)	
Exercise†					0.905
Yes	51 (47.7)	512 (50.2)	336 (50.5)	503 (48.3)	
No	56 (52.3)	508 (49.8)	330 (49.5)	539 (51.7)	
Education†					0.011
< Middle school‡	22 (20.8)	199 (18.8)	117 (17.1)	174 (16.0)	
≥ Middle school to < high school	15 (14.2)	110 (10.4)	86 (12.6)	83 (7.6)	
≥ High school	69 (65.1)	752 (70.9)	480 (70.3)	828 (76.3)	
Depression†					0.698
Yes	3 (2.8)	28 (2.7)	12 (1.8)	25 (2.4)	
No	104 (97.2)	1,000 (97.3)	657 (98.2)	1,025 (97.6)	
Hypertension†					< 0.001
Yes	5 (4.7)	117 (11.3)	116 (17.2)	211 (19.9)	
No	102 (95.3)	920 (88.7)	559 (82.8)	848 (80.1)	
Diabetes†					0.250
Yes	5 (4.7)	78 (7.5)	56 (8.3)	93 (8.8)	
No	102 (95.3)	959 (92.5)	618 (91.7)	966 (91.2)	
Dyslipidemia†					0.068
Yes	4 (3.7)	55 (5.3)	54 (8.0)	87 (8.2)	
No	103 (96.3)	982 (94.7)	621 (92.0)	972 (91.8)	

Values are presented as number (%).

*P-values were from the chi-square test; †The values include missing values; ‡Participants with less than a middle school education, not knowing, and nonresponse.
Underweight, BMI < 18.5 kg/m^2; Normal weight, BMI ≥ 18.5 to < 23 kg/m^2; Overweight, BMI ≥ 23 to < 25 kg/m^2; Obese, BMI ≥ 25 kg/m^2; BMI, body mass index.

Table 2. Association of smoking cessation plans with BMI and general characteristics

Variable	Smoking cessation plan		*P**
	No. (%)	OR (95% CI)	
BMI (kg/m^2)			0.104
<18.5	23 (20.9)	0.645 (0.375–1.109)	
≥18.5 to <23	267 (24.6)	1 (Reference)	
≥23 to <25	149 (21.3)	0.756 (0.584–0.979)	
≥25	254 (23.0)	0.853 (0.685–1.062)	
Age (yr)			0.700
19–39	245 (22.4)	1 (Reference)	
40–60	302 (22.9)	1.026 (0.833–1.265)	
>60	146 (24.8)	1.138 (0.862–1.502)	
Sex			0.091
Male	575 (22.7)	0.811 (0.637–1.034)	
Female	118 (25.1)	1 (Reference)	
Drinking			0.085
No	535 (24.3)	1 (Reference)	
Yes	158 (19.8)	0.825 (0.663–1.027)	
Exercise			0.007
No	301 (21.0)	1 (Reference)	
Yes	350 (25.5)	1.298 (1.071–1.572)	
Education			0.202
<Middle school†	122 (23.8)	1.182 (0.902–1.550)	
≥Middle school to <high school	74 (25.2)	1.277 (0.922–1.768)	
≥High school	485 (22.8)	1 (Reference)	
Depression			0.353
No	640 (23.0)	1 (Reference)	
Yes	13 (19.1)	0.723 (0.362–1.442)	
Hypertension			0.065
No	538 (22.1)	1 (Reference)	
Yes	122 (27.2)	1.301 (0.984–1.721)	
Diabetes			0.039
No	591 (22.3)	1 (Reference)	
Yes	68 (29.3)	1.43 (1.016–2.013)	
Dyslipidemia			0.137
No	604 (22.6)	1 (Reference)	
Yes	56 (28.0)	1.346 (0.907–1.996)	

*P-values were from the chi-square test; †Participants with less than a middle school education, not knowing, and nonresponse.
BMI, body mass index; OR, odds ratio; CI, confidence interval.

The association between BMI and smoking cessation plans according to sex is shown in Table 3. Compared to the normal weight group, smoking cessation plans of the other weight groups were fewer in both male and female. In the male, the underweight group was the lowest, while in the women, the least number of smoking cessation plans was in the overweight group. However, the interaction between sex and BMI was not significant ($P=0.086$).

Multivariate analysis showed the significant factors were sex (OR, 0.723; 95% CI, 0.556–0.939), high-risk drinking (OR, 0.796; 95% CI, 0.634–0.998), aerobic physical activity (OR, 1.326; 95% CI, 1.092–1.612), and hypertension (OR, 1.387; 95% CI, 1.034–1.860). According to BMI group, the ORs for smoking cessation plans were higher in the normal weight group than the three other groups, but the difference was not statistically significant (Table 4).

DISCUSSION

The purpose of this study was to investigate the relationship between BMI and establishment of a cessation smoking plan in Korean adult smokers. Three thousand Korean adult smokers from the sixth KNHANES were analyzed. Previous studies have shown that

Table 4. Factors associated with smoking cessation plan

Variable	Smoking cessation plan	*P*
BMI (kg/m^2)		0.156
<18.5	0.634 (0.362–1.112)	
≥18.5 to <23	1 (Reference)	
≥23 to <25	0.773 (0.587–1.019)	
≥25	0.904 (0.719–1.137)	
Male (reference, female)	0.723 (0.556–0.939)	0.015
Drinking (reference, non)	0.796 (0.634–0.998)	0.048
Exercise (reference, non)	1.326 (1.092–1.612)	0.005
Hypertension (reference, non)	1.387 (1.034–1.860)	0.029

Values are presented as odds ratio (95% confidence interval) from multivariate analysis by logistic regression and *P*-values.
BMI, body mass index.

Table 3. The association between BMI and smoking cessation plan according to sex

Sex	BMI (kg/m^2)				*P**
	<18.5	≥18.5 to <23	≥23 to <25	≥25	
Male	0.519 (0.249–1.081)	1 (Reference)	0.755 (0.571–1.000)	0.844 (0.663–1.073)	0.100
Female	0.867 (0.374–2.009)	1 (Reference)	0.817 (0.420–1.589)	0.996 (0.566–1.754)	0.924

Values are presented as odds ratio (95% confidence interval).
*P-values were from the chi-square test.
BMI, body mass index.

https://doi.org/10.7570/jomes.2017.26.4.281

smokers have a significant weight gain after smoking cessation.[3,16-20] However, there are relatively few studies on obese smokers and normal weight smokers with regard to having a smoking cessation plan.[21,22]

Therefore, it is significant that this study was focused on the association between smoking cessation plans according to BMI in Korean adult smokers. The results revealed a difference in smoking cessation plans according to smoker's BMI. In the normal weight group, smoking cessation plans were made most often, while the other groups had fewer plans for smoking cessation. However, the ORs were not statistically significant. Thus, although previous studies showed that anxiety pertaining to weight gain after smoking cessation was higher in overweight or obese smokers[13,23,24], the current findings suggest that normal weight smokers are more likely to have a smoking cessation plan.

The marginally significant values of overweight groups in the univariate analysis were not significant in the multivariate analysis. This finding is interpreted as a result of adjusting what was hidden by other significant factors. Significant factors were hypertension, aerobic physical activity, high-risk drinking, and being male. Hypertension and aerobic physical activity in smokers were linked to more smoking cessation plans compared to the reference group. In contrast, males and high-risk drinking smokers had fewer plans for smoking cessation plans. These results show that individual health behaviors are important considerations when planning smoking cessation.

This study investigated smokers that planned to cease smoking within 1 month. In the preparation stage of smoking cessation, the transtheoretical model of change that describes the dynamic nature of health behavior changes was applied. Each step of the transtheoretical model explains the effects that cognitive and behavioral change processes, decision balances, and self-efficacy have on behavioral change.[25] In this study, we only evaluated general characteristics. Therefore, it does not elaborate on the relationship between the cognitive and motivational elements of the transtheoretical model. This drawback can be regarded as a primary limitation of using secondary data. It can be said that generalization in Korean adult smokers is possible because representative standardized data are presented in the KNHANES.

Although cessation of smoking can lead to post-cessation weight gain, some benefits are attenuation of hypertension and diabetes.[26,27] Also, increased weight gain after smoking cessation is associated with muscle mass, muscle strength, and bone density, which may have positive effects on skeletal muscle growth and bone mineral density.[19] Therefore, the benefits of smoking cessation are great. Consideration should be given to lowering weight gain associated with smoking cessation planning. Diet, exercise, and pharmacotherapy for weight control should be considered together as smoking cessation aids. In particular, it is desirable that comprehensive lifestyle habits be improved, given that weight gain after smoking cessation is large in over-drinking and over-smoking subjects.[28]

In conclusion, this study investigated the relationship between BMI and smoking cessation plans, in Korean adults. Although no significant association was found, it is expected that further research will be done, considering the limitations of this study. Nevertheless, the data suggest that in a clinical setting, it is necessary to consider not only BMI but also other factors associated with a smoking cessation plan.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Burns D. Nicotine addiction. In: Kasper DL, Braunwald E, Fauci AS, Hauser S, Longo D, Jameson JL, editors. Harrison's principles of internal medicine. New York: McGraw-Hill; 2005. p. 2573-6.
2. Chinn S, Jarvis D, Melotti R, Luczynska C, Ackermann-Liebrich U, Antó JM, et al. Smoking cessation, lung function, and weight gain: a follow-up study. Lancet 2005;365:1629-35.
3. Hatsukami DK, Stead LF, Gupta PC. Tobacco addiction. Lancet 2008;371:2027-38.
4. Benowitz NL. Nicotine addiction. N Engl J Med 2010;362:2295-303.
5. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ 2004;328:1519.
6. Centers for Disease Control and Prevention (CDC). Cigarette

smoking among adults and trends in smoking cessation: United States, 2008. MMWR Morb Mortal Wkly Rep 2009;58:1227-32.

7. Son JH, Kim SA, Kam S, Yeh MH, Park KS, Oh HS. Factors related to the intention of participation in a worksite smoking cessation program. Korean J Prev Med 1999;32:297-305.
8. Ahn SR, Lee S, Min HG, Choi SH, Kim YJ, Kim YJ. Change of body weight and body composition after smoking cessation in males. J Korean Acad Fam Med 2003;24:994-1002.
9. Kim JH, Kim HY, Song CH, Lee KM, Jeung SP. The effects of cigarette smoking on abdominal fatness. J Korean Acad Fam Med 2000;21:1172-9.
10. Yoon C, Goh E, Park SM, Cho B. Effects of smoking cessation and weight gain on cardiovascular disease risk factors in Asian male population. Atherosclerosis 2010;208:275-9.
11. Beser E, Baytan SH, Akkoyunlu D, Gul M. Cigarette smoking, eating behaviour, blood haematocrit level and body mass index. Ethiop Med J 1995;33:155-62.
12. Weekley CK 3rd, Klesges RC, Reylea G. Smoking as a weight-control strategy and its relationship to smoking status. Addict Behav 1992;17:259-71.
13. Beebe LA, Bush T. Post-cessation weight concerns among women calling a state tobacco quitline. Am J Prev Med 2015;48(1 Suppl 1):S61-4.
14. Comstock GW, Stone RW. Changes in body weight and subcutaneous fatness related to smoking habits. Arch Environ Health 1972;24:271-6.
15. Krukowski RA, Bursac Z, Little MA, Klesges RC. The relationship between body mass index and post-cessation weight gain in the year after quitting smoking: a cross-sectional study. PLoS One 2016;11:e0151290.
16. Lee H, Joe KH, Kim W, Park J, Lee DH, Sung KW, et al. Increased leptin and decreased ghrelin level after smoking cessation. Neurosci Lett 2006;409:47-51.
17. Shimokata H, Muller DC, Andres R. Studies in the distribution of body fat. III. Effects of cigarette smoking. JAMA 1989;261:1169-73.
18. Lee CM. Longitudinal effect of smoking cessation on visceral obesity [dissertation]. Seoul: Seoul National University; 2013.
19. Rom O, Reznick AZ, Keidar Z, Karkabi K, Aizenbud D. Smoking cessation-related weight gain: beneficial effects on muscle mass, strength and bone health. Addiction 2015;110:326-35.
20. Williamson DF, Madans J, Anda RF, Kleinman JC, Giovino GA, Byers T. Smoking cessation and severity of weight gain in a national cohort. N Engl J Med 1991;324:739-45.
21. Kwon JE, Jang YK, Kim SW, Lee WT, Shin DL. Association of obesity with smoking cessation in Korean female. Korean J Fam Pract 2016;6:604-9.
22. Smith PH, Kasza KA, Hyland A, Fong GT, Borland R, Brady K, et al. Gender differences in medication use and cigarette smoking cessation: results from the International Tobacco Control Four Country Survey. Nicotine Tob Res 2015;17:463-72.
23. Levine MD, Bush T, Magnusson B, Cheng Y, Chen X. Smoking-related weight concerns and obesity: differences among normal weight, overweight, and obese smokers using a telephone tobacco quitline. Nicotine Tob Res 2013;15:1136-40.
24. Kim YK, Cho YG, Kang JH, Park HA, Kim KW, Hur YI, et al. Weight control methods related to cotinine-verified smoking among Korean adult women: Korea National Health and Nutrition Examination Survey, 2008-2011. Korean J Fam Med 2015;36:72-81.
25. Kim HK. Development of health communication strategies for health behavior change: application of social ecological models to smoking cessation intervention. Korean J Health Educ Promot 2010;27:177-88.
26. Janzon E, Hedblad B, Berglund G, Engström G. Changes in blood pressure and body weight following smoking cessation in women. J Intern Med 2004;255:266-72.
27. Nilsson P, Lundgren H, Söderström M, Fagerström KO, Nilsson-Ehle P. Effects of smoking cessation on insulin and cardiovascular risk factors: a controlled study of 4 months' duration. J Intern Med 1996;240:189-94.
28. Lee SY. Smoking, obesity and metabolic syndrome. Korean J Obes 2014;23:162-3.

https://doi.org/10.7570/jomes.2017.26.4.281