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Effects of sitting time and smoking on perceived stress in adults under 65 years of age

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Purpose: Sitting time, smoking, and perceived stress strongly influence physical health independent of physical activity. However, the associations among perceived stress, sedentary behavior, and smoking are poorly understood. Therefore, we examined the relationships between sitting time, smoking, and perceived stress in Korean adults aged < 65 years.
Methods: We analyzed data from the seventh National Health and Nutrition Survey. In this cross-sectional study, data from 6,890 Korean adults aged < 65 years were analyzed. Complex-sample logistic regression was used to examine the relationships between sitting time, smoking, and perceived stress.
Results: The group with a high sitting time (≥ 8 h/day) and those who smoked had significantly higher odds of experiencing stress than the low sitting time (< 8 h/ day) and non-smoking groups (odds ratio: 1.88, 95% confidence interval: 1.42-2.50).
Conclusion: Perceived stress was positively correlated with current smoking status and increased sitting time. High sitting time (≥ 8 h/day) and current smoking were associated with a higher risk of perceived stress in Korean adults aged < 65 years.

Key Words: Sedentary time; Smoking; Stress

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INTRODUCTION

Stress is unavoidable in today's fast-paced life, and its management significantly impacts physical and mental health and quality of life [1]. Interest in and the importance of managing mental and physical health are increasing worldwide. Psychological stress has been reported to be detrimental to engagement in healthy behaviors [2-5]. Further, prolonged sitting can diminish the anxiety- or stress-reducing effects of physical activity, leading individuals to perceive tremendous stress [6,7].

Sitting is an inactive behavior that consumes less than 1.5 metabolic equivalents of task of energy while awake [8]. Screen time, such as watching television or using a computer, playing board games, sitting, lying down, or leaning, is representative of inactive behaviors. The time involved in these sitting actions is called sitting time [9]. Sitting time has negative effects on mental health, making individuals prone to anxiety [10], depression [11], and poor emotional well-being [12,13], which are often associated with mental health problems [14]. Several studies have associated long sitting times with high levels of perceived stress [15,16].

Smoking is a risk factor for diseases that threaten multiple aspects of life by causing severe complications, such as lung cancer and other cancers, and cardiovascular diseases [17]. Smokers often perceive smoking as an easy way to relieve stress. According to the American Psychological Association, smoking directly causes stress rather than reducing it, contrary to the arguments of smokers [18]. Thus, the effect of smoking on stress, with an emphasis on smoking cessation to improve the quality of life, is an object of interest.

People who smoke are more likely to be physically inactive or have unhealthy habits [19]. Recent studies have noted that sit-

ting is an unhealthy behavior comparable to smoking and that smokers are less likely to be physically active than non-smokers; however, little is known about the interaction between smoking status and sitting behavior [20].

The World Health Organization suggests physical inactivity as a risk factor for non-infectious diseases, including heart disease, cancer, chronic respiratory disease, and diabetes [21]. According to the Korea Centers for Disease Control and Prevention (KCDC), sedentary behavior is one of the factors that reduces physical activity [22]. As a disease risk factor, it is also recognized as a major health assessment indicator [23]. Previous studies examining stress-related factors in adults have found associations between perceived stress and age group, depression diagnosis, health checkups, non-metropolitan medical care, eating frequency, physical activity, drinking frequency, and smoking [24]. Based on the results of previous studies, this study was intended to analyze it as a correction factor that can be effectively confirmed in the primary medical environment using sitting time and smoking, is expected to be used as structured data for systematic stress treatment.

Previous studies conducted univariate analyses of the relationships between sitting time, smoking, and stress [25-29]. Nonetheless, few studies have examined the relationship between sitting time, smoking, and perceived stress. Therefore, this study aimed to identify and analyze the relationship between sitting time, smoking, and perceived stress using data from the 7th National Health and Nutrition Survey (2016-2018). Moreover, it aimed to provide primary data for developing interventions to manage stress in daily life and improve health and quality of life by considering individuals with high sitting and smoking habits.

METHODS

1. Research design

This study analyzed secondary raw data from the 7th National Health and Nutrition Survey (2016-2018) conducted by the KCDC to identify and compare stress perception based on sitting time and smoking status in adults aged < 65 years.

2. Participants

The 7th National Health and Nutrition Survey used a two-stage stratified colony sampling method. This study analyzed 6,890 individuals aged 18 to 65 years who responded to perceived stress, sitting time, and smoking status from 32,419 participants in the 7th National Health and Nutrition Survey (2016-2018).

3. Variables

1) Demographic and sociological factors and health behavior

Demographic and sociological characteristics included gender, education, and household income. Health behaviors included drinking, body mass index (BMI), aerobic physical activity, subjective health status, and sleep time.

Educational level was classified as elementary school graduate or lower, middle school graduate, high school graduate, or college graduate or higher. Household income levels were classified as high, medium-high, medium-low, low based on quartiles.

Drinking was classified as when asked about the frequency of drinking for a year, if you answered "about once a month," "about two to four times a month," "about two to four times a week," and "about four or more times a week," you were classified as Yes. If you answer "less than once a month", it's classified as NO. BMI was calculated using the weight (kg) and height (m) data provided, and those with BMIs < 25 kg/m^2 and ≥ 25 kg/m^2 were classified into no obeses groups and obese groups, respectively. The aerobic physical activity was classified as “Yes” if you did medium-intensity physical activity for more than 2 hours and 30 minutes a week, high-intensity physical activity for more than 1 hour and 15 minutes, or mixed medium-intensity physical activity, and “No” if not met. Subjective health status is “What do you think about your usual health status?” According to the question, very good, good, and usually not bad were classified as not bad, and bad and very bad responses were classified as bad. Sleep time was analyzed by classifying the average sleep time on weekdays and weekends into less than 6 hours and more than 6 hours.

2) Perceived stress

The 7th National Health and Nutrition Survey collects data on stress perceptions in daily life. Daily stress perception data were collected through responses to the question, “How much stress do you feel in your daily life?” The possible replies are “I feel a great deal,” “I feel a lot,” “I feel a little,” and “I hardly feel it.” This study used this to classify the groups as “I feel a lot of stress” (“I feel a great deal” and “I feel a lot”) and “I feel less stress (“I feel a little” and “I hardly feel it”).”

3) Sitting time

Overall daily sitting time was estimated using long-term versions of International Physical Activity Questionnaires [30,31] and evaluated by the following questions: how much time do

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you usually spend a day working at your desk or computer, sitting with a friend, driving, reading, writing, watching TV, playing games, internet, listening to music, or sitting or lying down? Based on a meta-analysis of the Helseundersøkelsen i Nord-Trøndelag study [32], we classified groups of 8 hours or more and less than 8 hours or less based on daily sitting time.

4) Smoking

Smoking status was divided into "currently smoking" and "currently not smoking."

4. Data analysis

The composite sample design data analysis was conducted according to the raw data analysis guidelines of the National Health and Nutrition Survey, and a weighted analysis plan file was generated using SPSS Windows software version 28.0 (IBM Corp., Armonk, NY, USA).

In this study, the characteristics of the variables were identified using unweighted and complex sample frequency analyses. The effects of smoking and sitting time on stress perception were analyzed using a complex sample logistic regression analysis. The frequencies and percentages of participants were calculated for each of the categorized variables included in the study. The variables included in the analysis were all categorical, those that were not initially categorical were converted into categories. The chi-square test was performed to assess the chi-square differences between the groups within each categorized variable. Odd ratios were calculated for sitting time, smoking and stress using the following methods: simple multinomial logistic regression with complex sampling (unadjusted Model 1); multinomial logistic regression with complex sampling adjusted for gender and education (Model 2); multinomial logistic regression with complex sampling adjusted for model 2 plus, BMI, subjective health status, and sleep time (Model 3).

The significance level for the analysis was set at $p < .05$.

5. Ethical consideration

This study was approved by the KCDC Research Ethics Review Committee (2018-01-03-P-A, 2018-03-2C-A). Informed consent was waived because this study was a secondary data analysis using anonymized data.

RESULTS

1. Characteristics of participants

The participants included 5,808 men and 1,082 women, for a total of 6,890 participants. The general characteristics differed significantly according to the perceived stress of the participants in this study, except for household income, drinking, and aerobic exercise practice rates. Men (88.9%), those who thought their subjective health was not bad (86.1%), those with more than 6 hours of sleep (91.4%), and those with a normal BMI (96.3%) said they were under less stress, while those who were college graduates (45.1%) were reported to be under a lot of stress (Table 1).

2. Description of sitting time, smoking habits, and perceived stress

Table 2 shows the frequency and estimated ratio by dividing the sitting time (8 h/day) and current smoking status set in this study by category. Analyzing the estimated ratio of each variable according to perceived stress, individuals who sat for more than 8 hours (59.4%) and those who currently smoked (58.4%) answered that they were stressed.

3. Relationship between sitting time, smoking, and perceived stress

Sitting time showed significant differences in perceived stress in Models 1 as 1.22 (95% confidence interval [CI], 1.12-1.33), Model 2 as 1.17 (95% CI, 1.03-1.33), and Model 3 as 1.12 (95% CI, .94-1.34) compared to groups with more than 8 hours of sitting time. Smoking was found to have significant differences in perceived stress in Model 1 at 1.48 (95% CI, 1.29-1.70), Model 2 at 1.65 (95% CI, 1.45-1.88), and Model 3 at 1.54 (95% CI, 1.27-1.87) compared to the current smoking group. Groups with a sitting time of more than 8 hours and who were currently smoking had significant differences in perceived stress of 1.37 (95% CI, 1.15-1.63), 1.40 (95% CI, 1.12-1.67), and 1.36 (95% CI, 1.06-1.74) in Models 1, 2, and 3, respectively, compared to those with more than 8 hours sitting times and who were not smoking. The group that spent more than 8 hours sitting and was currently smoking showed significant differences in perceived stress 1.99 (95% CI, 1.62-2.43), 2.04 (95% CI, 1.65-2.53), and 1.88 (95% CI, 1.42-2.50) in Models 1, 2, and 3, respectively, compared to those with less than 8 hours sitting times and who were not smoking (Table 3).

DISCUSSION

This study attempted to provide primary data and suggestions for reducing stress in adults aged < 65 years by confirming the relationship between sitting time, smoking, and per-

Table 1. Demographic Characteristics of Participants (N = 6,890)

Characteristic		Perceived stress		χ^2	*p*
		Low (n = 4,964)	High (n = 1,926)		
		n (%)	n (%)		
Gender	Men	4,356 (88.9)	1,452 (78.2)	134.59	< .001
	Women	608 (11.1)	474 (21.8)		
Education	≤ Elementary school	793 (10.8)	231 (7.8)	25.59	< .001
	Middle school	598 (10.4)	182 (8.1)		
	High school	1,716 (37.2)	712 (39.0)		
	≥ University	1,849 (41.6)	798 (45.1)		
Household income	Low	933 (14.6)	304 (13.0)	7.12	.185
	Medium–low	1,230 (23.6)	485 (24.5)		
	Medium–high	1,361 (30.1)	582 (32.4)		
	High	1,430 (31.8)	552 (30.1)		
Drinking	No	1,237 (23.1)	462 (22.7)	0.17	.728
	Yes	3,575 (76.9)	1,417 (77.3)		
Subjective health status	Bad	787 (13.9)	571 (27.5)	180.38	< .001
	Not bad	4,177 (86.1)	1,355 (72.5)		
Sleep time (hr)	< 6	455 (8.6)	235 (11.4)	12.81	.002
	≥ 6	4,493 (91.4)	1,684 (88.6)		
Aerobic physical activity	No	2,793 (53.0)	1,072 (53.7)	0.30	.642
	Yes	2,163 (47.0)	852 (46.3)		
BMI	No obesity	2,927 (96.3)	1,039 (91.6)	38.61	< .001
	Obesity	118 (3.7)	84 (8.4)		

BMI = body mass index.

Table 2. Descriptive Analysis of Sitting Time, Smoking Habits, and Perceived Stress (N = 6,890)

Characteristic		Perceived stress		χ^2	*p*
		Low (n = 4,964)	High (n = 1,926)		
		n (%)	n (%)		
Current smoking	No	2,881 (53.6)	853 (41.6)	83.27	< .001
	Yes	2,083 (46.4)	1,073 (58.4)		
Sitting time (hr)	< 8	2,275 (45.4)	808 (40.6)	13.46	.002
	≥ 8	2,689 (54.6)	1,118 (59.4)		
Category A	Low sitting time/Currently smoking	983 (46.7)	472 (42.6)	4.90	.052
	High sitting time/Currently smoking	1,100 (53.3)	601 (57.4)		
Category B	High sitting time/Not smoking	1,589 (54.7)	517 (43.5)	41.13	< .001
	High sitting time/Currently smoking	1,100 (45.3)	601 (56.5)		
Category C	Low sitting time/Not smoking	1,292 (49.0)	336 (31.9)	82.67	< .001
	High sitting time/Currently smoking	1,100 (51.0)	601 (68.1)		

ceived stress using data from the 7th National Health and Nutrition Survey (2016-2018). This study found that people who spent a lot of time sitting and currently smoked received 1.987 times higher perceived stress in Model 1, 2.042 times in Model 2 after adjusting for significant gender, education, and 1.883 times in Model 3 after adjusting for significant gender, education, BMI, subjective health status, and sleep time compared to those with less than 8 hours sitting times and who were not smoking. The study also found that young and middle-aged adults who spent less time sitting and were nonsmokers were less likely to experience stress. These results highlight the importance of physical activity and smoking cessation in reducing

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Table 3. Relationships Between Sitting Time, Smoking Habits, and Perceived Stress

Variable	Reference group (OR = 1)	Comparison group	Model 1† OR (95% CI)	Model 2‡ OR (95% CI)	Model 3§ OR (95% CI)
Sitting time	Low sitting time	High sitting time	1.22 (1.12–1.33)*	1.17 (1.03–1.33)**	1.12 (0.94–1.34)
Smoking	Not smoking	Currently smoking	1.48 (1.29–1.70)**	1.65 (1.45–1.88)**	1.54 (1.27-1.87)**
Category A	Low sitting time/ Currently Smoking	High sitting time/Currently smoking	1.17 (.98–1.40)	1.13 (.96-1.35)	1.01 (.79–1.29)
Category B	High sitting time/Not smoking	High sitting time/Currently smoking	1.37 (1.15–1.63)**	1.40 (1.12–1.67)**	1.36 (1.06–1.74)**
Category C	Low sitting time/Not smoking	High sitting time/Currently smoking	1.99 (1.62–2.44)**	2.04 (1.65–2.53)**	1.88 (1.42–2.50)**

OR = odds ratio; CI = confidence interval.
†None; ‡Gender, education; §Gender, education, body mass index, subjective health status, and sleep time.
*$p < .01$; **$p < .001$.

stress risk.

A previous study examined the relationship between sitting time and mental health [33]; however, no study has identified a connection between smoking, sitting time, and perceived stress. Thus, it is difficult to make accurate comparisons with previous studies. The study found that stress levels increased significantly with sitting time. Existing studies on the relationship between stress and sitting time do not have consistent results. According to a study analyzing the sitting time and perceived stress of adults over 50 years of age in six low- and middle-income countries, the longer the sitting time, the higher the perceived stress [25]. In a 6-year prospective cohort study of Spanish university graduates, the Seguimiento Universidad de Navarra (University of Navarra Follow-up) study reported a vital link between physical activity and sedentary behavior in the development of mental illness [26]. A study with Australian adults conducted by Rebar et al. [27] found no association between overall sitting time and stress. Furthermore there are studies on the beneficial effects of physical activity on stress [34], however people may think that sedentary behavior is more beneficial in the short term [35]. Prospective studies are limited, and further confirmation of the temporal nature of these associations is needed through longitudinal studies.

This study found that stress levels increased significantly with current smoking. A study of 41 countries that provided data for the World Health Survey reported that perceived stress was significantly associated with increased smoking rates. Among daily smokers, higher levels of self-smoking stress were associated with an increased likelihood of smoking [28]. Furthermore, a study by Han et al. [29] examined the smoking status of professionals and found that smoking provided stress reduction, with stress serving as a motivation to continue smoking. Relieving stress or smoking due to stress is meaningful because it negatively affects mental health as a result. However, although stress and smoking appear to be closely related, there is a limit to explaining the causal relationship in that most studies, including this study, are cross-sectional studies.

In the modern world, individuals spend more than half of their days sitting. Owing to their current form of transportation, work, and automation, they spend most of their lives in a sedentary manner, sitting down for a long time and pursuing sedentary leisure time on days without work, resulting in many negative effects on the human body [36]. Therefore, promoting mild physical activity may be a reasonable strategy to reduce perceived stress and increase smokers' long-term participation in physical activity. This can help prevent the occurrence of numerous comorbidities associated with physical inactivity. Furthermore, promoting physical activity can help promote smoking cessation, because regular physical activity has been shown to reduce nicotine dependence through reduced smoking needs, increased smoking cessation attempts, and successful smoking cessation [37,38]. Moreover, even if sitting time is extended, exercising regularly [daily] is considered suitable for health. However, individuals who sit down most of the day do not have a lower risk of developing diabetes or cardiovascular diseases, even if they exercise regularly. Therefore, an intervention program that involves light exercise every 30 min, rather than walking and getting up every 60 min, is suggested [39].

To the best of our knowledge, this is the first study to reveal the relationship between sitting time and perceived stress according to smoking status in Koreans. It can represent Koreans based on the Korean national health and nutrition survey data. Furthermore, this study lays the foundation for developing a stress reduction and health promotion program for those who sit for a long time and currently smoke. However, several limitations of this study should be considered when interpreting the results. First, a retrospective study should supplement this cross-sectional study [40]. Otherwise, engaging in data collection and inferring the causal relationship between the data is challenging. Second, all the variables were self-reported and

susceptible to response bias.

CONCLUSION

This study aimed to determine the correlation between sitting time, smoking, and perceived stress in Koreans. This study demonstrated that perceived stress positively correlates with sitting for more than 8 hours and smoking. Furthermore, people who do not currently smoke, men, those who think their subjective health is not bad, those who sleep for more than 6 hours, and those who have a normal BMI say they are less stressed. However, those who graduated from college or higher and smoked reported being stressed. Therefore, we suggest that Koreans' long-term sedentary lifestyles and smoking are closely related to stress and that regular physical activity interventions will help mitigate stress.

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CONFLICT OF INTEREST

The authors declared that no conflict of interest.

AUTHORSHIP

HJP and YHK contributed to the conception and design of this study; HJP performed the statistical analysis and interpretation; HJP and YHK drafted the manuscript; HJP critically revised the manuscript; YHK supervised the entire study process. All the authors have read and approved the final version of the manuscript.

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