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RESEARCH ARTICLE

Effects of Sedentary Behaviors on Stress and Suicidal Ideation: Occupation-Based Differences

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Abstract:

Background:

The study of examining the effects of sedentary behavior on stress level and suicidal ideation is crucial, but existing research on the topic is insufficient.

Objective:

This study aimed to identify the effect of sedentary behaviors, with respect to the occupation type on stress and suicidal ideation among Korean adults.

Methods:

This descriptive correlational study used raw data from the 6th Korea National Health and Nutrition Examination Survey (KNHANES VI), conducted in 2015. The survey sampled 7,380 adults, of whom 3,714 were included in this analysis. Sedentary time, stress level, and suicidal ideation were measured. The data were analyzed using a homogeneity test, and logistic regression.

Results:

As sedentary time increased, stress (OR=1.036; p=0.001) and suicidal ideation (OR= 1.065; p=0.006) also increased significantly, irrespective of the gender, age, household income, education level, job, and marital status. Regarding occupation, stress level increased significantly with an increase in sedentary time for managers; professionals and related workers; clerks; and craft, equipment, machine-operating, and assembly-line workers, while skilled agriculture, forestry, and fishery workers experienced less stress. A significant increase in suicidal ideation was observed in craft, equipment, machine-operating, and assembly-line workers as their time spent on sitting increased.

Conclusion:

This study found a significant association between average sedentary time, and stress and suicidal ideation. There is a need for interventional programs that can reduce sedentary behaviors for preventing mental health problems.

Keywords: Mental health, Occupations, Psychological stress, Sedentary behaviors, Suicidal ideation, Health hazards.

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1. INTRODUCTION

Although advances in modern civilization and science have made lives more convenient than ever before, they have also resulted in the reduction of physical activity, which poses a number of health hazards. According to the World Health Organization (WHO), morethan 60% of the world's population do not participate in physical activity for at least 30 minutes per day, which is the minimum recommended amount [1]. Furthermore, the last 50 years have seen a rapid expansion in computer usage in work settings, as well as the use of computer games, smartphones, televisions, and public trans-portation, which have all resulted in a large increase in sedentary behaviors [2].

Sedentary behavior is defined as "any waking behavior characterized by low-energy expenditure while in a sitting or reclining posture [3]." Adults surveyed in 20 countries spent an

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average of 5.8 hours per day sitting [4], and studies conducted in the United States, Canada, and the United Kingdom have indicated that the average amount of time spent on sitting was 9 to 11 hours [5 - 7]. In high-income countries, automatization and computerization have minimized physical demand at work [8]. Some studies indicated that workers who sit at work are likely to spend their leisure time sitting as well [9, 10]. Other studies indicated that physically demanding jobs are associated with more sitting during leisure time [11]. The relationship between occupation type and sedentary behavior is unclear. Thus, it is necessary to assess the effects of sitting time on health, based on differences in occupation.

Sedentary behavior has been recognized worldwide as a significant health hazard that deserves attention. Governmental efforts have been undertaken to establish guidelines, projects, and policies to reduce sedentary behavior in countries such as Australia, Switzerland, the United States, and the United Kingdom [12, 13]. Obesity, type-2 diabetes, reduced bone density, cardiovascular conditions, and endometrial cancer have been found to be more prevalent among those with a predominantly sedentary lifestyle, compared to those with a more active lifestyle [2, 14 - 17]. Meanwhile, there is a lack of studies on the effects of sedentary behavior on mental health [2]. Additionally, there are conflicting studies on the effects of sedentary behavior on psychological distress and mental disorders, with some studies arguing that there is a strong association between sedentary behavior and mental health [18, 19], while others argue that there is no such association [20]. Furthermore, there is a lack of studies assessing the influence of sedentary behaviors on suicidal ideation, a variable of mental health that has significant implications on society as a whole [21].

As of 2016, the average time spent working in Korea was 2,069 hours per year, which was the highest among the Organization for Economic Co-operation and Development (OECD) countries; the second was in Mexico with 2,255 hours which exceeded the OECD average of 1,764 hours [22]. A study [23] reported that 29.9% of South Korean adults in their 20s to 50s experienced excessive stress. Since 2003, South Korea has had the highest suicide rate among OECD countries, with 28.7 out of 100,000 persons committing suicide [24]. A study that examines the effects of sedentary behavior on stress level and suicidal ideation is crucial in an environment with long working hours, such as South Korea, but existing research on the topic is insufficient. Hence, this study aims to study the effects of sedentary behavior on stress level and suicidal ideation based on occupation.

2. MATERIALS AND METHODS

2.1. Research Design

This study is a descriptive correlational study using secondary data analysis.

2.2. Data Resource

This study used raw data from the Sixth Korean National Health and Nutrition Examination Survey (KNHANES VI), which was conducted from 2013 to 2015 on Korean citizens above the age of one to assess their health, health behavior, and food and nutrient's intake. KNHANES has been conducted since 1998 in three-year intervals to collect data necessary for the development and evaluation of the national health plan, programs, and policies [25]. However, data for average sedentary time per day were collected in 2014 and 2015, and data for suicidal ideation were collected in 2013 and 2015 (stress level, however, is evaluated every year). Therefore, this study used 2015 data from KNHANES VI only.

2.3. Data Preparation

A total of 22,948 persons were sampled in KNHANES VI, of which 7,380 persons responded. Among these, 4,397 were adults between the ages of 19 and 64. After excluding those who did not answer questions on sedentary time, the total number of respondents reduced to 3,742, which further reduced to 3,714 after excluding those who did not answer questions on suicidal ideation.

2.4. Measure

Sedentary time was measured by combining the average time spent on sitting during work, travel, and leisure per day, with age set as the continuous quantitative variable. Stress level and suicidal ideation were both measured as binary variables. The stress level was measured on a scale from "feeling a lot of stress" to "feeling little stress," and suicidal ideation was measured by the occurrence of suicidal thoughts in the past year. Gender was classified as male and female. Education level was classified as elementary school or below, middle school, high school, and college or above. Marital status was classified into married or single (Table **1**). Occupation was classified into the following seven categories, according to the Korean standard job classification by Statistics Korea: managers, professionals, and related workers; clerks; service and sales workers; skilled agricultural, forestry, and fishery workers; craft, equipment, machine-operating, and assembly-line workers; elementary workers; or unemployed (home-maker, student, *etc*.). For household income, the actual household income (KRW 10,000) was converted into the equivalent monthly average household income and divided into quartiles (low 25% (low), 25-50% (mid-low), 50-75% (mid-high), and 75-100% (high)).

2.5. Data Quality

The survey investigated households and household members, selected *via* a complex sample design (stratified two-stage cluster sampling) to represent the Korean population. The target relative standard error of this survey was 0.88%, and the target relative bias was within 2%. Therefore, at 95% confidence level, the sampling error was ±0.86% *p*.

2.6. Ethical Considerations

The study was approved by the Institutional Review Board of the Researcher's University (IRB No. 1041231-171024-HR-064-01). Ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy were monitored by the author.

Table 1. General characteristics of the sample.

Variables		% mean ± SD
Gender	Male	49.8
	Female	50.2
Household Income	Low (<25 percentile)	9.6
	Low–middle (≤25–49.9 percentile)	22.4
	Middle–high (≤50–74.9 percentile)	32.4
	High (≤50–100 percentile)	35.6
Education Level	Elementary school or below	7.4
	Middle school	8.0
	High school	41.2
	College or above	43.4
Occupation	Managers, professionals, and related workers	18.3
	Clerks	13.4
	Service and sales workers	14.3
	Skilled agricultural, forestry, and fishery workers	2.5
	Craft, equipment, machine-operating, and assembly-line workers	12.9
	Elementary workers	7.8
	Unemployed (homemaker, student, etc.)	30.8
Marital Status	Married	71.9
	Single	28.1
Age		41.3 ± 12.8
Sedentary time (hours/day)		7.9 ± 3.6
Stress (yes)		31.9
Suicidal ideation (yes)		4.9

Note. % = Proportion; SD = standard deviation.

2.7. Data Analysis

Weights were analyzed by applying the values provided in the KNHANES. Differences in stress level and suicidal ideation according to the general characteristics (gender, age, marital status, household income, education level, and occupation) were analyzed using homogeneity test and logistic regression. To examine the effects of daily average sedentary time on stress recognition and suicidal ideation, logistic regression was performed, with stress recognition and suicidal ideation as dependent variables, and daily average sedentary time as the independent variable. In the first model, a simple logistic regression analysis was performed while, in the second model, multivariate logistic regression was performed with general characteristics such as gender, age, marital status, household income, education level, and occupation as control variables. In the third model, multivariate logistic regression was performed according to the job categories (seven), with gender, age, marital status, household income, and education level as control variables.

3. RESULTS

3.1. Stress and Suicidal Ideation According to General Characteristics

Using a weighted value, it was determined that among the 3,714 respondents, 49.8% were male and 50.2% were female; 9.6%, 22.4%, 32.4%, and 35.6% of respondents had low, low-middle, middle-high, and high household income, respectively; 7.4%, 8.0%, 41.2%, and 43.4% had education levels of elementary school or below, middle school, high school, and college or above, respectively; and 71.9% were married and 28.1% were single (Table **1**).

Occupation, an important variable in this study, was divided into seven categories based on the Korean Standard Classification of Occupation (Table **1**): managers, professionals, and related workers (18.3%); clerks (13.4%); service and sales workers (14.3%); agricultural, forestry, and fishery workers (2.5%); craft and related trade workers; equipment, machine-operating, and assembly-line workers (12.9%); elementary workers (7.8%); and unemployed, including homemakers and students (30.8%). The average age of respondents was 41.3 years (41.3±12.8), and the average sedentary time per day was 7.9 hours (7.9±3.6).

After analyzing stress level based on the general characteristics to assess the relationship between the control and dependent variables, significant differences were found based on age, household income, and marital status. Stress odds were reduced by a multiple of 0.98 with a one-year increase in age, and the stress level of low-income participants was 10% higher than those with middle to high income. In terms of occupation, clerks and skilled agriculture, forestry, and fishery workers experienced a high level of stress, while elementary workers experienced relatively less stress. Single respondents experienced more stress than married couples by at least 8% (Table **2**).

After analyzing suicidal ideation according to the general characteristics, statistically significant differences were found. Suicidal thoughts occurred more frequently in women than in men, by 2%, and the odds of suicidal ideation increased by a multiple of 1.016 with a one-year increase in age. Suicidal ideation occurred more frequently in respondents having low household income compared to middle or high household income, by at least 8%, and was more prevalent in those with lower education levels. In terms of occupation, craft, equipment, machine-operating, and assembly-line workers; elementary workers; and unemployed had relatively more suicidal thoughts, while professionals and related workers experienced less suicidal ideation (Table **2**).

3.2. Effects of Sedentary Time on Stress and Suicidal Ideation: Occupational

Two types of logistic regression models were used to analyze the effects of average sedentary time per day on stress level and suicidal ideation. In Model 1, the average sedentary time was set as an independent variable, and stress level and suicidal ideation were set as dependent variables. In Model 2, gender, age, marital status, household income, education level, and occupation were set as control variables, and the occupation variable was divided into seven categories for a more comprehensive assessment.

The influence of average sedentary time per day on stress level was found to be statistically significant. In the simple model (Model 1), stress odds were increased by a multiple of 1.055 with every additional hour spent sitting and, in the

Table 2. Stress and suicidal ideation according to general characteristics.

	Stress		Suicidal ideation	
	%/ OR	χ^2, Wald (p)	%/OR	χ^2, Wald (p)
Gender		0.010 (0.944)		7.145 (0.008)
Male	31.8		3.9	
Female	31.9		5.8	
Household income		14.625 (0.002)		71.596 (<0.001)
Low (<25 percentile)	40.6		13.5	
Low–middle (≤25–49.9 percentile)	30.9		5.8	
Middle–high (≤50–74.9 percentile)	30.0		4.0	
High (≤50–100 percentile)	31.9		2.9	
Education level		3.062 (0.382)		114.513 (<0.001)
Elementary school or below	30.3		14.9	
Middle school	30.7		11.0	
High school	30.8		5.0	
College or above	33.4		1.9	
Occupation		29.634 (<0.001)		35.737 (<0.001)
Managers, professionals, and related workers	32.8		2.4	
Clerks	41.3		1.8	
Service and sales workers	29.5		4.1	
Skilled agricultural, forestry, and fishery workers	36.2		5.3	
Craft, equipment, machine-operating, and assembly-line workers	29.1		6.3	
Elementary workers	26.0		7.3	
Unemployed (homemakers, students, etc.)	30.8		6.9	
Marital status		24.724 (<0.001)		0.767 (0.399)
Married	29.5		5.1	
Single	37.9		4.4	
Age	0.981	48.234 (<0.001)	1.016	6.771 (0.009)
Note. % = proportion; OR = odds ratio; Wald = Wald test.				

saturated model (Model 2), by a multiple of 1.036. When assessed by occupation, stress odds of managers, professionals and related workers; clerks; and craft, equipment, machine-operating, and assembly-line workers increased by multiples of 1.061, 1.094, and 1.064, respectively. Stress odds of skilled agriculture, forestry, and fishery workers reduced by a multiple of 0.784.

The average sedentary time in a day also had a significant statistical association with suicidal ideation. While the simple model (Model 1) displayed no statistical implications, the saturated model (Model 2) indicated that odds of suicidal ideation increased by a multiple of 1.065 with an additional hour of sedentary time. In terms of occupation, craft, equipment, machine-operating, and assembly-line workers' suicidal ideation, odds were multiplied by 1.145 with a one-hour increase in sedentary time, but other occupations indicated no significant differences.

4. DISCUSSION

The results of this study revealed that, each day, a Korean adult spends 7.9 hours sitting, including weekdays and weekends as well as during working hours, travel, and leisure activities. This is longer than 5.8 hours per day reported by 49,493 adults from 20 countries, including the United States, Canada, and Australia [4], and longer than 5.84 hours per day observed in 1,064 adults from the Netherlands [14]. One reason why Korean adults spend more time on sitting than those in other countries is because average working hours in Korea are the longest among OECD countries [22]. A study by Chau *et al*. [26] indicated that one's mortality risk was increased by 5% when sedentary time exceeded seven hours per day; additionally, in a cohort study with adults, after six years, a group spending seven hours per day sitting was found to have a 25% higher rate of mental disorders than a group with 2.5–4 hours sedentary time per day [19]. A recent study [27] defined the sedentary time of 7 hours 30 min or above as "high sedentary time," which caused a high risk of adverse health outcomes. Korean adults' sedentary time is higher than that of other countries, putting them at a higher risk of illnesses. Thus, governmental efforts, intervention, and guidelines are necessary.

The study also found that stress level increased significantly with the amount of time spent on sitting. Existing studies, which have addressed the relationship between stress and sedentary time, do not have consistent findings. A study with 1,843 Australian adults, conducted by Rebar *et al*. [28], found no strong association between overall sedentary time and stress. However, a study on UK college students, conducted by Endrighi *et al*. [29], indicated that a group who lengthened

Table 3. Effects of sedentary behaviors on stress and suicidal ideation: Occupational analysis.

Model Group (job) Dependent variable statistics		Model 1[a)]	Model 2[b)]	Model 3[c)]						
		Total	Total	Managers, professionals, and related workers	Clerks	Service and sales workers	Skilled agricultural, forestry, and fishery workers	Craft, Equipment, machine operating, and assembly-line workers	Elementary workers	Unemployed (homemaker, student, etc.)
Stress	Sedentary time OR (95% CI)	1.055 (1.035, 1.075)	1.036 (1.014, 1.058)	1.061 (1.011, 1.115)	1.094 (1.029, 1.163)	1.024 (0.968, 1.083)	0.784 (0.623, 0.987)	1.064 (1.004, 1.127)	0.997 (0.903, 1.101)	1.014 (0.976, 1.054)
	Wald (p)	29.516 (<0.001)	10.587 (0.001)	5.673 (0.017)	8.244 (0.004)	0.696 (0.404)	4.287 (0.038)	4.326 (0.038)	0.003 (0.955)	0.530 (0.467)
	Cox and Snell's R^2	0.008	0.031	0.034	0.044	0.017	0.088	0.073	0.121	0.033
	Nagelkerke's R^2	0.011	0.043	0.046	0.057	0.025	0.143	0.099	0.187	0.047
	χ^2 (p)	29.516 (<0.001)	111.016 (<0.001)	20.471 (0.015)	18.769 (0.043)	9.448 (0.490)	9.430 (0.492)	29.835 (0.001)	32.645 (<0.001)	37.649 (<0.001)
	Concordant (%)	50.7	60.5	61.0	59.0	57.4	68.5	63.1	66.8	61.1
Suicidal ideation	Sedentary time OR (95% CI)	1.023 (0.981, 1.066)	1.065 (1.019, 1.114)	1.007 (0.867, 1.168)	1.170 (0.937, 1.461)	1.055 (0.926, 1.201)	0.871 (0.546, 1.392)	1.145 (1.034, 1.267)	1.112 (0.936, 1.321)	1.050 (0.981, 1.124)
	Wald (p)	1.145 (0.285)	7.694 (0.006)	0.008 (0.930)	1.923 (0.166)	0.641 (0.423)	0.332 (0.564)	6.773 (0.009)	1.447 (0.229)	1.971 (0.160)
	Cox and Snell's R^2	0.000	0.037	0.026	0.017	0.031	0.050	0.110	0.099	0.037
	Nagelkerke's R^2	0.001	0.113	0.122	0.099	0.113	0.192	0.268	0.262	0.096
	χ^2 (p)	1.137 (0.286)	129.194 (<0.001)	15.208 (0.085)	6.170 (0.801)	12.280 (0.267)	3.233 (0.975)	30.702 (0.001)	21.300 (0.019)	44.042 (<0.001)
	Concordant (%)	47.9	70.0	74.7	76.6	70.7	74.6	76.5	73.2	70.7

a) Simple logistic regression analysis

b) Gender, age, household income, education level, occupation, and marital status used as control variables

c) Analysis according to occupation, using gender, age, household income, education level, and marital status as control variables

their daily sedentary time by an average of 32 minutes for two weeks experienced increased mental distress and stress-induced inflammatory interleukin-6 (IL-6) responses, compared to the group that did not do so. Although many existing studies have agreed that physical activity can reduce stress [28, 30, 31], few have explored sedentary time and stress, while some have indicated conflicting results. Furthermore, despite evidence of the beneficial effects of physical activity on stress [32], many individuals may find the sedentary activity more rewarding in the short-term [20]. Prospective research is limited, and confirmation of the temporal nature of these associations is required *via* longitudinal studies.

The occupational analysis indicated that stress level increased with sedentary time for managers, professionals, and related workers; clerks; and craft, equipment, machine-operating, and assembly-line workers. A study by Clemes *et al*. [33] found that, for office workers, sedentary time constituted more than 70% of their working hours, but also that their physical activity did not increase nor did the sedentary behavior lessen on nonworking days. This study also found that office workers experienced higher stress levels than other workers, and prolonged sedentary time exacerbated this stress, indicating the need for occupational intervention in workplaces. Conversely, skilled workers in agriculture, forestry, and fishery, who are generally reported to have high stress levels, observed a decrease in their stress level with an increase in their sedentary time. Agricultural, forestry, and fishery workers were 2.4-8.9 times more likely to develop musculoskeletal illnesses due to the nature of their job, which required them to carry heavy objects and involved prolonged work hours in uncomfortable positions [34, 35]. For them, sedentary time is equivalent to resting, which would explain why their stress reduced with increased sedentary time. Hence, it is necessary to apply different stress-reducing activities and interventions, depending on the nature of each occupation and type of work.

Suicidal ideation occurs more frequently in people with prolonged sedentary time. This is consistent with the findings of a study by An *et al*. [21], which indicated that prolonged sedentary time (≥7 hours/day *vs*. <4 hours/day) was significantly associated with an increased risk for suicidal thoughts, after adjusting the confounding factors including physical activity. Prolonged sedentary time leads to reduced physical activity, compromising the positive effects of physical activity on one's mental health [14]. It can also isolate individuals by reducing social interaction and interpersonal relationships, creating mental health problems and, ultimately, leading to suicidal ideation [36]. Based on the social withdrawal hypothesis, sedentary behavior increases, resulting in decreased social interactions that in turn result in an

increased risk of mental health problems [37]. Occupational analysis of sedentary time and suicidal ideation indicated that craft, equipment, machine-operating, and assembly-line workers had suicidal thoughts more frequently with an increase in sitting time, which was consistent with the findings of another study [38], where workers who engaged in simple, repetitive work were found to be more mentally unstable than active workers, and a significantly higher mortality rate was observed in workers with less exposure to sunlight. Development of workplace interventions is imperative for craft, equipment, machine-operating, and assembly-line workers in accordance with the nature of their job and work environment. Some ongoing studies are testing the effectiveness of pedometers [14, 39], physical programs [40, 41], "take-a-stand" projects [42], and sit-stand workstations [43]. There is a need for diverse and practical intervention methods to be developed continuously for sedentary workers who are engaged in various types of work.

A limitation of this study is that it was cross-sectional, therefore, causality and direction of relationships could not be determined. Therefore, prospective cohort studies are recommended, which address the effects of sedentary behavior on stress level and suicidal ideation over time. Additionally, this study has a limitation in terms of not controlling physical, psychological, and environmental factors; these have been identified as risk factors for stress and suicidal ideation, when the effects of sedentary behavior on these factors were analyzed. There is a need to investigate influencing factors and paths, such as personality, the level of depression and coping skills, to understand the association of sedentary behavior with stress level and suicidal ideation from various aspects. Lastly, the effects related to sedentary behavior on mental health should be classified into working sitting and non-working sitting (*e.g.*, computer sitting, smartphone sitting, TV sitting, transporting sitting, leisure sitting, *etc*.).

CONCLUSION

This study found a significant association between average sedentary time and stress and suicidal ideation. After analyzing by occupation, professionals and related workers; clerks; and craft, equipment, machine-operating, and assembly-line workers were found to experience more stress as their sedentary time increased. Craft, equipment, machine-operating, and assembly-line workers had more frequent suicidal thoughts than other workers. Such findings will be useful in the development and application of interventions and preventive programs, which will enhance both the physical and mental health of workers who sit for a prolonged time. A prospective study is therefore suggested on an intervention strategy to reduce sedentary behaviors during working hours and recess, and to decrease stress levels and suicidal ideation of workers.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Institutional Review Board of the Researcher's University (IRB No. 1041231-171024-HR-064-01).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent has been obtained from all participants

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the the 6th Korea National Health and Nutrition Examination Survey at https://knhanes.cdc.go.kr/knhanes/sub03/sub03_02_02.do.

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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