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ORIGINAL RESEARCH

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Changes in smoking behavior and influencing factors in older adults

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Abstract

The increasing aging population has drawn significant attention to the health behaviors of older men, specifically their smoking habits. In this study, we estimated the changes in smoking behavior among elderly men aged 65 years and over and identified the factors that influenced these changes. Using the Korean Longitudinal Study of Aging (KLoSA) data, conducted between 2006 and 2020, we analyzed the smoking behavior of 1741 elderly men who were 65 years-of-age in the first year. The mean smoking quantity showed a decreasing trend over time, from 4.47 cigarettes/day in 2006 to 0.30 cigarettes/day in 2020. The quadratic change model best explained these changes in smoking behavior. The factors that influenced the initial level of smoking behavior included education, residential area, marital status, age and household income. In conclusion, smoking behavior among elderly men in Korea has shown a significant decreasing trend over the past decade. Several sociodemographic factors played a role in influencing these changes and can provide insights for tailoring health promotion strategies for this population group in the future.

Keywords

Smoking behavior; Older adults; Psychological factors; Health interventions; Latent growth model

1. Introduction

Smoking has long been a global health concern with profound implications for public health, especially among older adults [1, 2]. While much attention has been dedicated to the implications of smoking in younger demographics, recent shifts in global aging patterns have necessitated a more concentrated focus on older populations. This is especially poignant as the health implications of smoking in older adults often present unique challenges that are distinct from those faced by younger smokers. In fact, in countries such as South Korea, older adults predominantly engage in traditional cigarette smoking, with a recent trend showing a gradual increase in the use of electronic cigarettes. Furthermore, lifestyle is a major factor that can has significant implications for health [3–5]. In particular, gender is known to exert a significant influence on lifestyle choices; of these lifestyle choices, there is a notable difference in smoking habits when compared between men and women [3–5]. According to previous research, men smoke more cigarettes than women; this leads to an increased and potentially fatal impact on health [3–5].

A vast body of existing literature describes the general trends and factors that influence smoking behaviors. For example, landmark studies by O'Donoghue *et al.* [6] (2016) and Sunseri *et al.* [7] (1983) described how socio-economic, psychological and social factors play significant roles in determining smoking patterns. However, despite these invaluable insights, there is an evident lack of understanding in terms of how these patterns have evolved over time, especially in older adults.

While several comprehensive studies have investigated smoking behaviors across diverse age ranges, cultures and socio-economic backgrounds [8, 9], many of these earlier studies adopted a broad approach. For instance, Schane *et al.* [10] (2008) and Engman (2019) emphasized the increased health risks faced by older smokers, thus highlighting their increased susceptibility to chronic diseases such as chronic obstructive pulmonary disease (COPD) and various cancers [10, 11]. In addition, several studies have highlighted the importance of smoking cessation in old age as a means of reducing these risks and providing a healthier quality-of-life [12–14]. Furthermore, various socio-economic determinants, such as urbanization and educational levels, have been identified as significant influencers of smoking trends in older adults [15, 16]. Yet, the breadth of these research investigations increases the risk of omitting nuances and specificities that are pertinent to elderly smokers.

The severity of smoking in males has been a focus of research attention for many years, predominantly due to its widespread adverse effects on health [17]. In particular, previous studies have demonstrated that male smokers have an increased risk of cardiovascular diseases, various types of cancer, and chronic respiratory ailments [17, 18]. These health issues are known to be exacerbated by the continued use of tobacco [19–21]. As grave as these consequences are, the

implications become even more profound and alarming in when we consider older male adults. The elderly population, already susceptible to a range of health issues owing to their advancing age [22], finds themselves at a crossroads where the adverse effects of smoking significantly magnify. Within this demographic, the habit of smoking can accelerate the deterioration of many physical functions and exacerbate existing health conditions, thus creating a vicious cycle of health decline and a diminished quality-of-life [17, 18]. Furthermore, the increased vulnerability to chronic diseases witnessed in this particular age group, compounded by smoking, necessitates an urgent and focused approach to mitigate these risks, thereby fostering a healthier aging process. This underscores the critical need to develop tailored interventions and policies to curb smoking habits in older male adults to address the specific challenges and health risks involved.

A significant gap in the current literature related to smoking is the paucity of focused longitudinal studies that trace the evolution of smoking behaviors in older adults over extended timeframes. This is especially pertinent given the dramatic socio-economic and urban shifts that have occurred over recent decades. As these shifts unfold, it is becoming increasingly important that we gain a comprehensive understanding of their ramifications on smoking behaviors in elderly males [23].

Given the harmful effects of smoking and the unclear reasons why older males commence, continue or quit smoking, we urgently need to perform studies that more comprehensively analyze the specific factors and details associated with these behaviors. Such studies could provide fundamental knowledge that might offer guidance for the development of effective and targeted interventions. Our present study aimed to fill this gap in existing knowledge by conducting a longitudinal analysis of smoking behavior shifts among elderly males spanning a 14-year period. Our primary focus was to unravel the intricate web of socio-demographic factors that influenced these patterns. Our goal was to provide pivotal insights for the future development of public health interventions tailored meticulously for this age demographic.

2. Methods

2.1 Data

This study investigated changes in smoking behaviors among older adult males aged 65 years and above and identified factors that influenced these changes. Our analysis utilized data from the 1st to the 8th Korean Longitudinal Study of Aging (KLoSA) conducted between 2006 and 2020. The KLoSA aims to produce foundational data for the development of effective socio-economic policies by measuring and understanding the social, economic, psychological, demographic formation and health status of the elderly in Korea.

The Aging Research Panel Survey was conducted every two years starting from 2006, with the survey period typically spanning from August to December. The target population of the Aging Research Panel Survey were citizens residing nationally aged 45 years and older. In the first survey, data was collected from 10,254 individuals. The survey methodology involved Computer-assisted Personal Interviewing (CAPI) and the use of notebooks; participants were selected by a stratified multi-stage sampling protocol. Although the Aging Research Panel Survey is a statistical survey approved under Article 8 of the Statistics Act, it does involve human subjects and personally identifiable information; therefore, it was necessary to review the ethical nature of this data. Upon reviewing the questionnaire of the Aging Research Panel Survey, it was confirmed that assurances of anonymity and confidentiality, based on Article 33 of the Statistics Act, were clearly stated. Information relating to the survey institution, the Korea Employment Information Service, was sufficiently explained, and the contact information of the research team from the Aging Research Panel was also included. The data provided only had unique identification numbers, thus ensuring the anonymity and confidentiality of the participants. Moreover, it was confirmed that training for the surveyors of the Aging Research Panel Survey was conducted over 14 hours in two days. The surveyors were also instructed to record reasons for survey refusal. In cases where there were concerns about personal data exposure or mistrust towards the survey, such cases were considered as “refusal panels”, thereby ensuring that the survey met the ethical guidelines of the Ministry of Health and Welfare.

In this study, we targeted elderly males aged 65 years or above during the first year, with a final cohort of 1741 men; our final analysis focused on the smoking behaviors of these males from the 1st to the 8th surveys.

2.2 Research protocol

After selecting our specific research question, we reviewed previous studies and examined related public data. As a result, we decided to utilize the Aging Research Panel Survey and acquired specific data from the Employment Survey Analysis System (https://survey.keis.or.kr/). After organizing the data, we conducted analysis. Based on our analysis, we were able to derive a series of conclusions.

2.3 Variables

2.3.1 Dependent variable

In this study, smoking behavior was defined as the number of cigarettes smoked per day (unit: cigarettes/day); this represented our key dependent variable.

2.3.2 Independent variables

The independent variables in this study were based on demographic and sociological factors and included education (Elementary School or Below = 0, Middle School and Above = 1), residential area (City = 0, Rural = 1), marital status (Without Spouse = 0, With Spouse = 1), age (a continuous variable), and household income (a continuous variable). Notably, we logged household income to achieve a normal distribution. For the “residential area” factor, areas designated as “dong” were defined as “City” and “Eup and Myeon” areas were defined as “Rural”. For “marital status”, only those who were married were defined as “With Spouse” and those who were widowed, separated, or divorced were all defined as “Without Spouse”.

2.4 Statistical analysis

Data analysis was conducted using SPSS 28.0 (IBM, New York, NY, USA) and M-plus 8.0 (Mplus, Los Angeles, CA, USA) software. First, descriptive statistical analysis was carried out to identify the main characteristics of the key variables. Secondly, latent growth modeling was conducted to identify changes in the smoking behaviors of elderly males. This modeling consisted of two stages. In the first stage, we used an unconditional model to check how the longitudinal data changed over time. In the second stage, we used a conditional model to identify factors that influenced the changing patterns of longitudinal data.

To determine the fit of these models, we considered a range of factors, including insensitivity to sample size, representativeness of the fit index, and simplicity. The Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) were utilized.

3. Results

3.1 Descriptive statistics

The sociodemographic characteristics of the study participants indicated that 862 subjects (49.5%) had received primary school education or less, while 879 subjects (50.5%) had received middle school education or more (Table 1). With regards to place of residence, 1217 (69.9%) lived in urban areas and 524 (30.1%) lived in rural areas. With regards to marital status, 173 participants (9.9%) did not have a spouse, whereas 1568 participants (90.1%) did. The mean age was 72.28 ± 5.74 years (mean ± SD (standard deviation)), and mean household income was $9040.29 ± 15,019.99.

As a result of the descriptive statistical analysis of the main variables (Table 2), the mean number of cigarettes smoked was 4.47 ± 8.11 cigarettes in the 1st round (2006), 3.31 ± 7.02 cigarettes in the 2nd round (2008), 2.37 ± 5.68 cigarettes in the 3rd round (2010), 2.03 ± 5.37 cigarettes in the 4th round (2012), 1.40 ± 4.49 cigarettes in the 5th round (2014), 0.82 ± 3.50 cigarettes in the 6th round (2016), 0.47 ± 2.69 cigarettes in the 7th round (2018), and 0.30 ± 2.25 cigarettes in the 8th round (2020). This data showed a gradual decreasing trend over time.

3.2 Analysis of the research model

In this study, the latent growth model was analyzed in two steps. In the first step, the initial value and rate of change in the smoking behavior of elderly males were estimated using an unconditional model. In the second step, based on the initial values and rates of change obtained in the first step, the relationship between cognitive functional changes and independent variables was examined by conditional model analysis.

3.2.1 Analysis of the unconditional model

Before proceeding with the conditional model, we conducted performed unconditional model analysis to investigate changes in smoking behavior. To determine the optimal pattern of change in the unconditional model, we analyzed the no-change model, linear change model and quadratic change model. The fit of the quadratic change model for smoking behavior was $\chi^2 = 772.579$ ($p < 0.001$), CFI = 0.914, TLI = 0.911, RMSEA = 0.086, which explained the changes in smoking behavior better than the no-change and linear change models. Thus, the quadratic change model was adopted as the final model (Table 3).

When investigating the results of the final selected unconditional quadratic change model (Table 4 & Fig. 1), the mean initial value of smoking behavior in 2006, which indicated the initial smoking behavior, was 4.313 ($p < 0.001$). The linear change rate of smoking behavior was −0.989 ($p < 0.001$), and the quadratic change rate was 0.059 ($p < 0.001$); these variables were all statistically significant. This suggests that the rate of decline in the smoking behavior of elderly adults increased over time, leading to a rapidly reduced level of smoking behavior. In addition, the variances were significant for the initial value at 47.982 ($p < 0.001$), the linear change rate at 4.548 ($p < 0.001$), and the quadratic change rate at 0.051 ($p < 0.001$). This indicated that there were significant differences in the initial levels and rates of change in smoking behavior among elderly adults.

TABLE 1. Sociodemographic characteristics of the study participants (N = 1741).

Variable	Categories	N	%
Education Level			
	Elementary School or Below	862	49.5
	Middle School or Above	879	50.5
Place of Residence			
	City	1217	69.9
	Rural Area	524	30.1
Marital Status			
	Without Spouse	173	9.9
	With Spouse	1568	90.1
Age (M (SD))		72.28 (5.74)	
$ Household Income (M (SD))		9040.29 (15,019.99)	

Key: M: Mean; SD: Standard Deviation.

TABLE 2. Descriptive statistics of main variables (N = 1741).

Variable	Min	Max	M	SD
Amount of Smoking (2006, 1st Round)	0	60	4.47	8.11
Amount of Smoking (2008, 2nd Round)	0	40	3.31	7.02
Amount of Smoking (2010, 3rd Round)	0	40	2.37	5.68
Amount of Smoking (2012, 4th Round)	0	40	2.03	5.37
Amount of Smoking (2014, 5th Round)	0	30	1.40	4.49
Amount of Smoking (2016, 6th Round)	0	30	0.82	3.50
Amount of Smoking (2018, 7th Round)	0	40	0.47	2.69
Amount of Smoking (2020, 8th Round)	0	40	0.30	2.25

Key: M: Mean; SD: Standard Deviation.

TABLE 3. Model fit for the unconditional model.

Model	χ^2	*df*	CFI	TLI	RMSEA
No Growth Model	5336.832***	34	0.320	0.440	0.299
Linear Growth Model	1354.870***	31	0.830	0.847	0.157
Quadratic Growth Model	772.579***	27	0.914	0.911	0.086

****p < 0.001.*
Key: df: degree of freedom; CFI: comparative fit index; TLI: Tucker-Lewis index; RMSEA: root mean square error of approximation.

TABLE 4. Mean and variance of the initial score and rate of change in the unconditional model.

Classification	Mean		Variance	
	Estimate	S.E.	Estimate	S.E.
Initial Score	4.313***	0.187	47.982***	2.098
Linear Rate of Change	−0.989***	0.066	4.548***	0.271
Quadratic Rage of Change	0.059***	0.007	0.051***	0.003

****p < 0.001.*
Key: S.E: Standard Error.

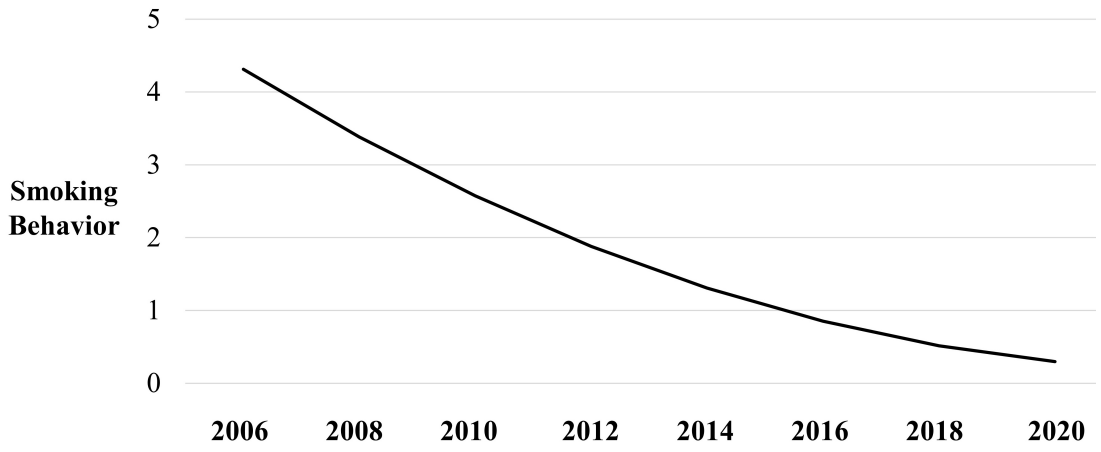

FIGURE 1. Estimated quadratic change model of smoking behavior in elderly male adults.

3.2.2 Analysis of conditional model

In the conditional model analysis, we investigated the effects of independent variables on the initial value and rate of change of smoking behavior in elderly males. As a result of the conditional model fit analysis, $\chi^2 = 799.328$ ($p < 0.001$), CFI = 0.923, TLI = 0.918, and RMSEA = −0.071, indicating that the model was valid. Table 5 shows the factors that influence the initial value and rate of change of smoking behavior (Table 5).

First, when considering the initial value of smoking behavior, education (Coef (coefficient) = −1.416, $p < 0.001$), residential area (Coef. = 1.147, $p < 0.01$), marital status (Coef. = −2.043, $p < 0.01$), age (Coef. = −0.232, $p < 0.001$), and household income (Coef. = 0.109, $p < 0.05$) were found to have a significant impact. This implied that the higher the level of education (from elementary school compared to middle school or higher), residing in a rural area, the absence of a spouse, the younger the age, and the higher the household income, the higher the smoking behavior. When considering the linear rate of change in smoking behavior, marital status (Coef. = −0.557, $p < 0.05$) and age (Coef. = 0.029, $p < 0.05$) had a significant impact. As age increased, smoking behavior decreased gradually over time when considering those with a spouse compared to those without a spouse. In contrast, the younger the age and the presence of a spouse (when compared to those without a spouse), the more significant the reduction in smoking behavior over time. On the other hand, education, residential area and household income did not affect the linear rate of change in smoking behavior. Moreover, none of the independent variables had a significant impact on the quadratic rate of change.

4. Discussion

In the present study, we investigated changes in smoking behaviors among elderly males aged 65 years and above over a 14-year period. Our analysis revealed a significant decline in the smoking behaviors of this cohort, and identified several sociodemographic factors that influenced these changes.

Consistent with the global trend of reduced smoking rates, we observed a significant reduction in the number of cigarettes smoked per day by older adults in South Korea from 2006 to 2020. In particular, the average number of cigarettes smoked daily reduced from 4.47 in 2006 to a mere 0.30 in 2020. The quadratic growth model that best described these changes indicated a rapid acceleration in the decline of smoking behavior over time.

Previous research has shown a reduction in smoking rates across various age groups and demographics in various countries with different cultures [24, 25]. Our findings are in line with these trends, reinforcing the concept that national and global anti-smoking campaigns, health awareness drives, and stricter tobacco regulations might also be exerting positive impact on older populations [26, 27]. Moreover, the factors we identified that influence these changes are somewhat consistent with previous studies, highlighting the importance of sociodemographic characteristics in understanding and predicting smoking behaviors.

Our analysis indicates that a higher level of education re-

TABLE 5. Path coefficients of the study model.

Path between Variables	Coef.	S.E.
Education Level (Ref. Elementary School or Below) → Initial Value of Smoking Behavior	−1.416***	0.386
Residential Area (Ref. City) → Initial Value of Smoking Behavior	1.147**	0.417
Marital Status (Ref. Without Spouse) → Initial Value of Smoking Behavior	−2.043**	0.616
Age → Initial Value of Smoking Behavior	−0.232***	0.033
Household Income (Log) → Initial Value of Smoking Behavior	0.109*	0.051
Education Level (Ref. Elementary School or Below) → Linear Change Rate of Smoking Behavior	0.064	0.140
Residential Area (Ref. City) → Linear Change Rate of Smoking Behavior	−0.159	0.151
Marital Status (Ref. Without Spouse) → Linear Change Rate of Smoking Behavior	−0.557*	0.223
Age → Linear Change Rate of Smoking Behavior	0.029*	0.012
Household Income (Log) → Linear Change Rate of Smoking Behavior	−0.018	0.019
Education Level (Ref. Elementary School or Below) → Quadratic Change Rate of Smoking Behavior	0.020	0.015
Residential Area (Ref. City) → Quadratic Change Rate of Smoking Behavior	0.001	0.016
Marital Status (Ref. Without Spouse) → Quadratic Change Rate of Smoking Behavior	−0.040	0.024
Age → Quadratic Change Rate of Smoking Behavior	0.000	0.001
Household Income (Log) → Quadratic Change Rate of Smoking Behavior	0.000	0.002

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Key: Coef.: Coefficient; S.E: Standard Error.

siding in rural areas, the absence of a spouse, a younger age, and a higher household income are associated with higher initial smoking rates. This underscores the importance of targeted interventions [28–30]. For instance, more educational campaigns can be directed towards those residing in rural areas where access to health education may be limited. Furthermore, the emotional stress of not having a spouse could be a potential trigger for smoking in this age group, thus indicating a need for supportive interventions for the elderly who are widowed or single. This builds on the work of Kobayashi and Steptoe (2018), who reported loneliness as a propellant for smoking in this particular age group [31]. Our results suggest a broader range of emotional triggers, thus indicating that interventions must consider a holistic approach targeted to emotional well-being.

In South Korea, the history of tobacco control policies has evolved over the decades. In the 1950s and 1960s, smoking rates surged, and tobacco-related policies were relatively lax. Tobacco advertising was widespread, and cigarette taxation contributed significantly to the national revenue. During the 1970s and 1980s, the government introduced some regulations, including partial bans on tobacco advertising. In 1980, negotiations between the government and major tobacco companies led to restrictions on tobacco production and sales. The 1990s marked a turning point when health promotion campaigns intensified. Restrictions on smoking in public places were initiated in 1995, and cigarette advertising was banned. In the 2000s, further measures were implemented, including a complete ban on tobacco advertising in 2003 and graphic health warnings on cigarette packs. Sales of tobacco were restricted to individuals aged 19 and older in 2005. In 2015, the prohibition of smoking in private-sector workplaces was introduced, and in 2016, a comprehensive ban on smoking in restaurants, cafes and bars was initiated. Public awareness of the health risks associated with smoking continued to grow over time. In the 2020s, the South Korean government has been strengthening tobacco control policies, particularly with regards to emerging products such as e-cigarettes. It is expected that tobacco regulations will continue to be reinforced to promote a healthier lifestyle and reduce smoking-related health risks. Meanwhile, as our analysis suggests, it would be highly beneficial to promote campaigns for specific target groups.

Interestingly, while age and marital status played a key role in the rate of change of smoking behavior, residential area, education and household income did not significantly impact the linear rate of decline. This suggests that while certain factors may have influenced the initial smoking rates, they might not necessarily have determined the trajectory of smoking cessation or reduction over time.

Furthermore, it is imperative to highlight that both age and marital status play a significant role in influencing smoking habits over the medium to long term. When crafting medium to long-term strategies to address smoking-related issues, incorporating considerations pertaining to age and marital status is vital. For instance, more aggressive interventions might be necessitated at a younger age to curb the onset or continuation of smoking habits. Furthermore, considering the potential vulnerability of elderly individuals without partners, the initiation of sustained smoking cessation programs can be particularly beneficial. Tailoring strategies to these demographic nuances will foster a more precise public health approach while facilitating the promotion of healthier lifestyles and the prevention of potential health complications, thus addressing the distinct needs and circumstances presented across different demographic groups. Specifically, smoking cessation programs could be held in the homes of senior citizens and could be highly beneficial.

While this study has provided valuable insights into the smoking behaviors of elderly adult men in South Korea, it is essential to acknowledge some limitations. Firstly, our findings may not be readily generalizable to other demographic groups or countries, thus emphasizing the need for additional research in diverse contexts. Secondly, the reliance on self-reported smoking data introduces potential biases and inaccuracies, possibly leading to underreported smoking levels due to social desirability biases. Thirdly, a deeper understanding of the factors underlying the decline in smoking rates and the influence of specific sociodemographic factors could be achieved by the analysis of qualitative data, warranting future investigations. Lastly, the scope of our study was limited by the constraints of secondary data, thus preventing the analysis of specific smoking characteristics and a broader range of sociodemographic factors. For instance, distinctions between daily and intermittent smoking were unattainable due to data limitations. Additionally, a more extensive exploration of the sociodemographic variables that might impact smoking behaviors was constrained. These limitations underline the potential for further research to build upon these findings and provide a more comprehensive understanding of the complex landscape of tobacco use among older adults.

Despite these limitations, our findings hold crucial significance. As worldwide populations continue to age, understanding the health behaviors of elderly adults is crucial. The recognition of unique patterns and factors influencing their smoking behavior can lead to the development of tailored interventions, thus increasing their effectiveness [32, 33].

5. Conclusions

Based on our study findings, we conclude that elderly males in Korea have shown a significant reduction in smoking behavior over the past decade. Several sociodemographic factors have influenced these changes. This insight can guide tailored health promotion strategies for this population group. Furthermore, our research highlights the need for more inclusive and targeted health communication strategies that consider the perspectives of elderly adults, their financial constraints, and peer influences. As the global population continues to age, these findings are crucial for shaping future health interventions, policies and community-based initiatives aimed at promoting healthier aging.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

HJC, KJ and HS—designed and conducted the research study. HJC and KJ—collected and analyzed the data; interpreted the data; drafted the manuscript. HJC—revised the manuscript's content. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Semyung University in Korea (SMU-EX-2023-09-002). Informed consent was obtained from all participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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