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Factors Associated with Current E-Cigarettes Use of Female Workers: Using the 2023 Community Health Survey

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ABSTRACT

Background: The use of e-cigarettes has emerged as a growing public health concern, particularly among females. This study aimed to identify factors associated with e-cigarette use among female workers in Korea.

Methods: A secondary data analysis was conducted using representative data from the 2023 Community Health Survey. A final complete-case sample of 70,511 female workers was included in the analysis. Sociodemographic characteristics, health-related behaviors, and psychological factors associated with current e-cigarette use were identified using complex-samples binary logistic regression analysis.

Results: Compared with females aged ≥40 years, the odds of current e-cigarette use were higher among females aged 19–29 years (odds ratio [OR]=5.58, 95% confidence interval [CI]=4.42–7.03) and 30–39 years (OR=4.28, 95% CI=3.46–5.30). Single females had higher odds of e-cigarette use than married females (OR=2.07, 95% CI=1.73–2.48). Higher odds were also observed among females reporting stress (OR=1.42, 95% CI=1.12–1.78), depressive symptoms (OR=2.26, 95% CI=1.88–2.71), breakfast consumption <3 times/wk (OR=2.18, 95% CI=1.85–2.56), and current alcohol use (OR=2.29, 95% CI=1.94–2.71). Females who were aware of smoke-free areas had lower odds of current e-cigarette use than those who were unaware (OR=0.58, 95% CI=0.49–0.65).

Conclusions: Among Korean female workers, e-cigarette use was significantly associated with younger age, single marital status, psychological distress, and alcohol use. Workplace health promotion and targeted interventions addressing these risk factors may help reduce e-cigarette use among female workers.

Keywords: Electronic nicotine delivery systems, Working women, Health surveys, Logistic models, Sampling studies, Cross-sectional studies

INTRODUCTION

Tobacco smoking remains a leading cause of preventable morbidity and mortality worldwide. It is a major risk factor for cardiovascular and cerebrovascular diseases, chronic obstructive pulmonary disease, lower respiratory infections, tuberculosis, and multiple cancers [1]. Despite continuing tobacco-control efforts, tobacco use remains an important public-health concern in Korea. According to the 2022 Korea National Health and Nutrition Examination Survey, the current smoking rate among Korean adults was 17.7%, with a marked sex disparity (males, 30.0%; females, 5.0%) [2]. Alternative nicotine products have also become increasingly visible. National data reported that liquid-type e-cigarette use among adults increased from 1.1% in

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2013 to 4.5% in 2023, whereas heated tobacco products (HTPs) use changed from 6.2% in 2019 to 6.1% in 2023, indicating a slight decrease or relative stability rather than an increase [3]. E-cigarette aerosols and emissions contain toxicants associated with airway inflammation and cardiovascular risks [4,5], and dual use with conventional cigarettes further complicates cessation [6,7].

Despite growing attention to novel tobacco products, evidence regarding e-cigarette use specifically among employed female workers remains limited. Female workers represent a distinct demographic whose health behaviors are uniquely shaped by workplace environments, occupational stress, and socio-behavioral dynamics [8-12]. Furthermore, female smoking in Korea is frequently underreported due to social stigma, masking the true burden of nicotine reliance in this population [2]. A recent study using the same 2023 Community Health Survey (CHS) examined e-cigarette use among females of childbearing age, identifying employment as a significant risk factor [13]. However, that study encompassed a broad population including non-female workers, limiting specific insights into the working population [13]. By focusing exclusively on economically active females, the present study builds upon these findings to isolate population-specific determinants within the female workforce. Therefore, this study aimed to identify the sociodemographic, psychological, and health-related behavioral factors associated with current e-cigarette use among Korean female workers using representative data from the 2023 CHS.

METHODS

Material

The data for this study were drawn from the 2023 CHS. Established in 2008, the CHS aims to provide comparable regional health statistics and support the planning and evaluation of local public health policies. Conducted annually across all 253 administrative districts in Korea (including cities, counties, and districts), the survey samples approximately 900 individuals per district using a probability proportional to size method to select survey areas. Within each area, households are selected through systematic sampling, and all adults aged 19 years and older in the selected households are surveyed. Data collection took place between May 16 and July 31, 2023, via one-on-one computer-assisted personal interviews conducted by trained interviewers using laptops with the survey program. A total of 231,752 adults participated in the 2023 CHS. Among them, 125,998 were females. In this study, "female workers" were operationally defined as females who responded "yes" to the CHS item assessing economic activity status. Based on this criterion, an initial analytical sample of 70,552 females was identified. Item-specific missing values were observed for marital status (n=11), educational attainment (n=28), and depressive symptoms (n=3). Because some participants had missing data across multiple variables, a total of 41 unique cases were excluded from the multivariable analysis. Missing values were not imputed, and a complete-case analysis approach was applied. Consequently, the final complex-sample logistic regression analysis included 70,511 participants.

Measures

E-cigarette use

In this study, current e-cigarette use was defined as current use of HTPs, including daily or occasional use, and/or use of nicotine-containing liquid-type e-cigarettes on at least 1 day during the past 30 days. Participants who reported either type of use were classified as current users (coded 1), whereas those who reported neither type were classified as non-users (coded 0). The CHS includes separate items for current e-cigarette use, current HTPs use, and use of nicotine-containing liquid-type e-cigarettes during the past month. In the present study, the current HTP-use item and the nicotine-containing liquid-type e-cigarette item were combined to create a single binary outcome variable. Accordingly, the term "current e-cigarette use" in this study refers to the combined current use of HTPs and/or nicotine-containing liquid-type e-cigarettes, rather than to liquid-type e-cigarette use alone. Product-specific use and dual use were not analyzed separately.

Demographic characteristics

Demographic characteristics included age, marital status, and education level. Age was categorized into three groups: 19–29, 30–39, and 40 years or older. Marital status was classified as married or single, and education level was divided into two groups: high school or lower and more than high school.

Health-related characteristics

Health-related characteristics included subjective health status, stress, depressive symptoms, breakfast consumption, current drinking, and awareness of smoke-free areas. These variables were selected based on previous research examining men-

tal-health comorbidity and e-cigarette use [10], health-related behaviors [11], and dietary and smoking-related behaviors [13,14]. The variables were intended to represent complementary domains of perceived health, psychological well-being, daily routine, substance-use behavior, and awareness of tobacco-control policies. Subjective health status was assessed with the question, "How do you perceive your overall health?" Responses were grouped as good (very good, good), moderate (average), and poor (poor, very poor). Stress and depression were dichotomized as "yes" or "no." Stress was measured using the responses "I feel very much," "I feel a lot," "I feel a little," and "I hardly feel." For the present analysis, "I feel very much" and "I feel a lot" were combined and coded as "yes," whereas "I feel a little" and "I hardly feel" were combined and coded as "no." Depression was assessed with the question, "Have you ever felt sadness or hopelessness that interfered with your daily life for two or more consecutive weeks in the past 12 months?" Breakfast consumption was assessed using the question, "On how many days during the past week did you eat breakfast?" Consistent with the categorization used in our previous study [13], responses were categorized as <3 days per week and ≥3 days per week. This cut-off was retained to ensure methodological consistency and comparability across studies. However, the ≥3 days-per-week category represents an operational definition used in the present study and should not be interpreted as a universally validated definition of regular breakfast consumption. Therefore, the term "breakfast consumption ≥3 days per week" was used throughout the manuscript instead of "regular breakfast consumption." Current drinking was defined as consuming alcohol at least once per month over the past year. Awareness of smoke-free areas was assessed using the question, "Do you know that this area is designated as a smoke-free area?" The response options were "I know that it is designated and know the specific area" and "I know that it is designated, but do not know the specific area." Participants who selected either of these responses were classified as being aware of smoke-free areas. Participants who answered that they did not know that the area was designated as smoke-free were classified as unaware. In this item, "this area" refers to the area specified in the 2023 CHS questionnaire.

Data analysis

Data were analyzed using IBM SPSS Statistics version 21.0 (IBM Corp.). All analyses accounted for the complex sampling design of the Korea CHS. The individual sampling weight, stratification variable, and cluster variable (primary sampling unit, represented by the survey-point identification number) provided by the survey were incorporated to obtain population-representative estimates and design-based standard errors. Differences in current e-cigarette use according to participants' characteristics were examined using complex-sample cross-tabulation analysis. Statistical significance was assessed using the second-order Rao–Scott adjusted chi-square test. Weighted percentages and unweighted frequencies were calculated.

Factors associated with current e-cigarette use were examined using complex-sample binary logistic regression analysis. Design-based standard errors were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). Variables significant in the univariable analyses were considered for inclusion in the multivariable model. Education level was also included a priori as a theoretically relevant socioeconomic covariate, regardless of its statistical significance in the univariable analysis, based on previous Korean evidence [14].

Ethical considerations

CHSs were conducted with the approval of the Medical Research Ethics Review Committee of the Korea Disease Control and Prevention Agency. This study was a secondary analysis of publicly available anonymized data and was granted an Institutional Review Board (IRB) exemption (Kunsan National University; IRB approval No. 1040117-202607-HR-047-01). Consistent with the user-signed original data usage agreement, we requested and received raw data from which all personal identification numbers and personal information were deleted. Therefore, participant anonymity was strictly guaranteed as all individual data were handled using designated identification numbers only.

RESULTS

Among the 70,552 female workers, 1,108 participants were classified as current e-cigarette users and 69,444 as non-users. The weighted prevalence of current e-cigarette use was 2.5% (Table 1). Table 2 presents the differences in current e-cigarette use according to participants' characteristics. Current e-cigarette use was significantly associated with age and marital status, but not with educational attainment. Younger participants were more likely to use e-cigarettes: among current e-cigarette users, 46.7%

Table 1. Current e-cigarette use of participants (N=70,552)

Current e-cigarettes use	N (weighted %)
Yes	1,108 (2.5)
No	69,444 (97.5)

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Table 2. Comparison of current e-cigarette use by characteristics of participants (N=70,552)

Variables	Current e-cigarettes use, N (weighted %)		*P*-value
	Yes	No	
Demographic characteristic			
Age (yr)			
19–29	438 (45.7)	6,330 (15.9)	<0.001
30–39	318 (28.1)	8,409 (17.5)	
≥40	352 (26.2)	54,705 (66.6)	
Marital status			
Single	740 (69.3)	23,550 (36.7)	<0.001
Married	368 (30.7)	45,883 (63.3)	
Education			
High school or less	506 (41.1)	41,170 (43.5)	0.157
College or higher	602 (58.9)	28,246 (56.5)	
Health related characteristics			
Subjective health status			
Good	446 (40.6)	27,236 (45.8)	0.008
Moderate	546 (49.5)	32,320 (45.6)	
Poor	116 (9.8)	9,888 (8.6)	
Stress			
Yes	1,007 (91.4)	56,019 (84.4)	<0.001
No	101 (8.6)	13,425 (15.6)	
Depression			
Yes	208 (19.9)	5,341 (8.0)	<0.001
No	900 (80.1)	64,100 (92.0)	
Breakfast consumption (times/wk)			
<3	766 (70.2)	20,772 (39.3)	<0.001
≥3	342 (29.8)	48,672 (60.7)	
Current drinking			
Yes	833 (76.6)	29,514 (50.2)	<0.001
No	275 (23.4)	39,930 (49.8)	
Aware of smoke-free areas			
Yes	523 (49.5)	42,258 (60.7)	<0.001
No	585 (50.5)	27,186 (39.3)	

Values are presented as unweighted frequencies and weighted column percentages. *P*-values were calculated using the second-order Rao–Scott adjusted chi-square test.

were aged 19–29 years, 28.1% were aged 30–39 years, and 26.2% were aged 40 years or older ($P<0.001$). Single females accounted for 69.3% of current e-cigarette users, compared with 30.7% who were married ($P<0.001$).

Among the health-related characteristics, subjective health status was significantly associated with current e-cigarette use ($P=0.008$). Among current e-cigarette users, 40.6% rated their health as good, 49.5% as moderate, and 9.8% as poor. Stress was reported by 91.4% of current e-cigarette users, compared with 84.4% of non-users ($P<0.001$). Depressive symptoms were reported by 19.9% of current e-cigarette users and 8.0% of non-users ($P<0.001$). Breakfast consumption was also significantly associated with current e-cigarette use. Among current e-cigarette users, 70.2% reported eating breakfast fewer than <3 times/wk, whereas 29.8% reported eating breakfast three or more times per week ($P<0.001$). Current drinking was reported by 76.6% of current e-cigarette users, compared with 50.2% of non-users ($P<0.001$). Awareness of smoke-free areas was lower among current e-cigarette users than among non-users: 49.5% of users were aware of smoke-free areas, compared with 60.7% of non-users ($P<0.001$).

Table 3 presents the results of the complex-sample logistic regression analysis examining factors associated with current e-cigarette use among female workers. The final model was statistically significant (Wald $F=101.680$, $P<0.001$) and yielded a Nagelkerke pseudo-R^2 of 0.172. After adjustment for the covariates, marital status, educational attainment, subjective health status, stress, depressive symptoms, breakfast consumption, current drinking, awareness of smoke-free areas, and age group were significantly associated with current e-cigarette use. Age was

Table 3. Logistic regression of factors influencing e-cigarette use (N=70,511)

Variables	OR (95% CI)	*P*-value
Demographic characteristic		
Age (yr), Ref. ≥40		
19–29	5.58 (4.42–7.03)	<0.001
30–39	4.28 (3.46–5.30)	<0.001
Marital status, Ref. Married		
Single	2.07 (1.73–2.48)	<0.001
Education, Ref. College or higher		
High school or less	2.62 (2.20–3.12)	<0.001
Health related characteristics		
Subjective health status, Ref. Good		
Moderate	1.57 (1.35–1.82)	<0.001
Poor	1.87 (1.44–2.45)	<0.001
Stress, Ref. No		
Yes	1.42 (1.12–1.78)	0.003
Depression, Ref. No		
Yes	2.26 (1.88–2.71)	<0.001
Breakfast consumption, Ref. ≥3		
<3	2.18 (1.85–2.56)	<0.001
Current drinking, Ref. No		
Yes	2.29 (1.94–2.71)	<0.001
Aware of smoke-free areas, Ref. No		
Yes	0.58 (0.49–0.65)	<0.001

The final multivariable complex-sample logistic regression model included 70,511 participants. This represents the initial analytic population of 70,552 participants after exclusion of 41 unique cases with missing values in one or more covariates included in the model. Values are presented as OR (95% CI). The final complex-sample logistic regression model was statistically significant (Wald F=101.680, P<0.001) and yielded a Nagelkerke pseudo-R^2 of 0.172. The model incorporated the sampling strata, clusters, and sampling weights.
CI, confidence interval; OR, odds ratio; Ref., reference.

significantly associated with e-cigarette use. Compared with females aged 40 years or older, females aged 19–29 years (OR=5.58, 95% CI=4.42–7.03) and those aged 30–39 years (OR=4.28, 95% CI=3.46–5.30) had higher odds of e-cigarette use (overall P<0.001). Compared with married females, single females had higher odds of current e-cigarette use (OR=2.07, 95% CI = 1.73–2.48, P<0.001). Females with a high school education or less had higher odds of e-cigarette use than those with a college education or higher (OR=2.62, 95% CI=2.20–3.12, P<0.001). Compared with females who reported good subjective health, those reporting poor health (OR=1.87, 95% CI=1.44–2.45) or moderate health (OR=1.57, 95% CI=1.35–1.82) had higher odds of e-cigarette use; the overall effect of subjective health status was statistically significant (P<0.001). Females who experienced stress had higher odds of e-cigarette use than those who did not (OR=1.42, 95% CI=1.12–1.78, P=0.003). Participants who reported depressive symptoms also had higher odds of e-cigarette use (OR=2.26, 95% CI=1.88–2.71, P<0.001). Females who ate breakfast two times or fewer per week had higher odds of e-cigarette use than those who ate breakfast three or more times per week (OR=2.18, 95% CI=1.85–2.56, P<0.001). Current drinkers had higher odds of e-cigarette use than non-drinkers (OR=2.29, 95% CI=1.94–2.71, P<0.001). Compared with females who were unaware of smoke-free areas, those who were aware had lower odds of current e-cigarette use (OR=0.58, 95% CI=0.49–0.65, P<0.001). Overall, current e-cigarette use was associated with younger age, single marital status, lower educational attainment, poorer subjective health, stress, depressive symptoms, infrequent breakfast consumption, and current alcohol use.

DISCUSSION

The present study investigated factors associated with current e-cigarette use among Korean female workers using data from the 2023 CHS. Younger age, marital status, educational attainment, subjective health status, psychological distress, breakfast frequency, current alcohol use, and awareness of smoke-free areas were significantly associated with e-cigarette use. Our findings both align with and meaningfully extend recent research on tobacco use among Korean females [13]. Whereas the previous study focused on females of childbearing age, the present study specifically examined economically active females

and identified population-specific sociodemographic, psychological, and health-related behavioral correlates of e-cigarette use among female workers.

Younger age and single marital status showed strong positive associations with e-cigarette use, consistent with prior evidence highlighting young adults' exposure to social media marketing and social support dynamics [15-20]. Notably, an important methodological finding emerged regarding educational attainment. While bivariate analysis indicated a higher proportion of e-cigarette users among college graduates, multivariate analysis revealed that lower educational attainment (high school or less) was independently associated with substantially higher odds of e-cigarette use. This reversal reflects a suppression effect caused by age and socio-behavioral covariates. In Korea, higher educational attainment is concentrated among younger demographics who also exhibit higher vaping rates. Once age and lifestyle factors were controlled for, lower educational attainment emerged as a true socioeconomic risk factor, aligning with literature on health literacy and resource inequalities [14].

Health status and psychological distress—including self-rated health, stress, and depression—were consistently associated with elevated odds of vaping [21,22]. Female workers facing occupational strain and gendered workplace pressures may utilize e-cigarettes as a coping mechanism. Similarly, health-risk behaviors such as breakfast skipping and current alcohol use were linked to e-cigarette use, underscoring behavioral clustering [22-24]. Conversely, awareness of smoke-free policies served as a protective factor, supporting the rigorous enforcement of workplace tobacco-free policies [1,25].

Study limitations include its cross-sectional design, reliance on self-reports susceptible to social desirability bias [2], and the lack of unmeasured workplace characteristics (e.g., job strain, working hours, shift work). Nevertheless, these findings highlight the need for comprehensive, gender-responsive, and workplace-based interventions targeting vulnerable female workers.

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AUTHOR CONTRIBUTIONS

Dr. Eungyeong KIM had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Author reviewed this manuscript and agreed to individual contributions.

Conceptualization: EK. Writing–original draft: EK. Writing–review & editing: EK.

CONFLICTS OF INTEREST

No existing or potential conflict of interest relevant to this article was reported.

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DATA AVAILABILITY

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

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