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■ Original Article

Examining the Association between Cigarette Smoking Quantity and Subjective Salt Taste Preference and Salt-Related Eating Behavior

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Background: Smoking can reduce taste sensitivity, the ability to sense various tastes, and diet quality and can increase the incidence of diseases such as hypertension. This study aimed to analyze the association between the smoking amount, subjective salt preference, and salt-related eating behaviors.

Methods: Data of more than 16 million individuals from the Korean Community Health Survey were used. Forest plots were drawn to compare the cumulative odds ratios of salt taste preference and salt-related eating behaviors, adjusted for sex, age, body mass index, education level, household income, marital status, and drinking status at various smoking levels.

Results: Subjective salt preference and salt-related eating behaviors increased with smoking amount; the adjusted odds ratios (AORs) for smoking >20 cigarettes were higher than those for smoking <20 cigarettes. For daily smokers, the AOR was 1.27 (95% confidence interval [CI], 1.22–1.31) for 1–5 cigarettes per day and 1.68 (95% CI, 1.65–1.71) for 16–20 cigarettes per day (P<0.001). Smokers were more likely to have more frequent salt-related eating behaviors than nonsmokers.

Conclusion: The subjective salt preference of smokers was higher than that of nonsmokers. Additionally, smokers used salt or soy sauce and dipped fried food in soy sauce more frequently than nonsmokers, which was also related to smoking amount.

Keywords: Cigarette Smoking; Sodium; Taste; Food Preferences

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INTRODUCTION

Excessive sodium intake is a major risk factor for hypertension, cardiovascular disease, stroke, and kidney diseases.[1-5] In 2017, excessive sodium intake was the leading dietary risk factor for mortality and overall disease burden, as represented by disability-adjusted life-years in East Asia.[6] In 2019, the average Korean consumed 142.9 mmol (3,286.7 mg) of sodium daily.[7] To reduce the incidence of diseases such as hypertension and cardiovascular disease, the World Health Organization recommended a 30% reduction in sodium intake in its Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020.[8] In 2015, Bobowski[9] suggested that a preference for salty foods depends on the average amount of sodium consumed per day, with higher salt consumption associated with a higher preference for salty flavors. However, another study showed that dietary salt intake was not associated with the function and perception of salty flavors, and that hedonic ratings (such as liking and preference) were more likely to be associated with dietary salt intake than thresholds and intensity.[10]

Cigarette smoke is an independent risk factor for several diseases. It is associated with the onset of various diseases, including hypertension, cardiovascular disease, stroke, lung cancer, and type 2 diabetes.[11-14] Cigarette smoke significantly decreases taste sensitivity and affects taste bud shape, abundance, and vascularization, which may reduce taste sensitivity.[11] It also inhibits peroxidase activity in human saliva, indirectly decreasing taste sensitivity.[15] Studies have reported that cigarette smoking can increase sodium intake and reduce dietary quality, making cigarette smokers more prone to certain diseases.[16,17] Many cigarette smokers have taste disorders, the severity of which depends on smoking frequency.[18]

Studies have found a relationship between smoking and salt taste sensitivity.[11-18] However, the relationship between smoking and a preference for salty flavors remains unclear. Therefore, this study aimed to analyze the relationship between cigarette smoking, preference for salty flavors, and salt-related eating behaviors using data from two 4-year Korean Community Health Survey (KCHS) cycles (2010–2013 and 2014–2017).

METHODS

1. Study Population

This study combined data from two 4-year KCHS cycles (2010–2013 and 2014–2017) obtained from the Korea Disease Control and Prevention Agency (KDCA), formerly the Korea Centers for Disease Control and Prevention. The KCHS is a national cross-sectional study with a multistage probability sampling design that includes 227,770 adults every year from 254 community health centers in South Korea. This study was exempted from the ethics committee of Kyungpook National University (IRB examination exemption approval). Because this study analyzed the raw data of the Community Health Survey, the requirement for informed consent from individual patients was omitted.

2. Measurements and Variables

The KCHS has been conducting computer-assisted personal interview surveys, including household and individual surveys, since 2010. The individual survey included health-related information about cigarette

Table 1. Unweighted demographic characteristics of daily cigarette smokers, Korean Community Health Survey 2010–2017 (total=1,390,798)

Characteristic	Nonsmoker	Daily smoker	Occasional smoker	P-value
No. of participants	1,047,527 (75.3)	316,187 (22.7)	27,084 (2.0)	
Male sex	195,963 (18.7)	294,206 (93.0)	21,581 (79.7)	
Age (y)	50.5±17.2	47.3±14.5	45.9±15.7	<0.001
Body mass index (kg/m^2)	22.9±3.2	23.6±3.3	23.5±3.2	<0.001
Education				
<High school	388,922 (82.7)	76,089 (16.2)	5,358 (1.1)	<0.001
High school	281,568 (68.2)	122,520 (29.7)	8,468 (2.1)	
>High school	377,037 (74.2)	117,578 (23.2)	13,258 (2.6)	
Marital status				
Married	696,708 (75.2)	212,582 (22.9)	17,258 (1.9)	<0.001
Separated, widowed, or divorced	182,460 (82.0)	36,644 (16.5)	3,353 (1.5)	
Not married	168,359 (69.6)	66,961 (27.7)	6,473 (2.7)	
Household income (monthly, 1,000 won)				
≤1,000	227,492 (79.4)	54,277 (18.9)	4,740 (1.7)	<0.001
>1,000–3,000	385,725 (72.9)	133,318 (25.2)	10,148 (1.9)	
>3,000–5,000	275,968 (74.4)	87,191 (23.5)	7,608 (2.1)	
>5,000	153,232 (77.6)	39,870 (20.2)	4,442 (2.2)	
Drinking status				
Non-drinker	266,171 (92.1)	21,251 (7.3)	1,713 (0.6)	<0.001
Drinker	781,356 (70.9)	294,936 (26.8)	25,371 (2.3)	
Annual drinker	642,650 (68.6)	270,966 (28.9)	23,408 (2.5)	<0.001
Past drinker	138,706 (84.2)	23,970 (14.6)	1,963 (1.2)	

Values are presented as number (%) or mean±standard deviation.

smoking habits, alcohol consumption, safety awareness, exercise and physical activities, nutrition, obesity and weight control, oral health, mental health, physical checkups and vaccinations, morbidity, and use of medical services. This survey also asked for information about accidents and addictions, movement restrictions, quality of life, use of public health institutions, education, and economic activities. In addition, survey questions may vary across years.

The survey contained three questions on salt taste preferences. The first question was "How high is your usual salt intake level?" for which the respondents were instructed to choose one of the following answers: "very high," "slightly high," "average," "slightly low," and "very low."

The second and third questions pertained to salt-related eating habits. The second question was, "Do you add additional salt or soy sauce to meals?" for which the available answers were "always," "often," "rarely," and "not at all." The third question was "How often do you dip fried foods in soy sauce?" and the available options were "always," "often," and "not at all."

For cigarette smoking variables, the population was divided into ever-smokers and nonsmokers. Ever-smokers included those who smoked >100 cigarettes throughout their lives and were further categorized as daily, occasional, or ex-smokers. Considering that the participants tended to answer in multiples of five for questions regarding the number of days smoked per month and number of cigarettes smoked per day, we divided the daily smoking frequency of daily smokers into nine groups: 1–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31–35, 36–40, and >40 cigarettes per day. For occasional smokers, we used the 5-day smoking frequency as a variable and classified it into the same groups as described above.

3. Data Analysis

Data analysis was performed using the IBM SPSS ver. 25.0 (IBM Corp., Armonk, NY, USA), and strata, clusters, and weights were applied to account for the complex design of the KCHS. The data were cross-analyzed to compare the unweighted general characteristics of the different groups. Additionally, a complex sample ordinal regression analysis was performed to understand the relationship between smoking frequency, typical salt intake, and salt-related eating behaviors. Furthermore, the crude model was not adjusted for any variables. The fully adjusted model was modified based on respondents' sex, age, body mass index (BMI), educational level, marital status, monthly household income, and drinking status.[19] Forest plots were constructed using R software ver. 4.2.2 (The R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

1. Unweighted Characteristics of Cigarette Smokers

Table 1 shows the unweighted characteristics of cigarette smokers. The total number of daily smokers and nonsmokers after removing missing values was 1,390,798. Among the participants, 75.3% were nonsmokers. Among smokers, 22.7% were daily smokers and 1.9% were occasional smokers. Men accounted for 93.0% of daily smokers. The average age of nonsmokers was 50.5 years, which was significantly higher than that of smokers (P<0.001). Daily and occasional smokers had an average BMI of 23.6 kg/m^2 and 23.5 kg/m^2, respectively, both of which were higher than that of nonsmokers (P<0.001).

2. Smoking Frequency and Typical Salt Intake of Daily Smokers

Figure 1 shows the unadjusted and adjusted odds ratios (AORs) between daily smoking amount and salt taste preference. After accounting for various possible confounders, the AORs for daily smokers who smoked 1–20 cigarettes per day were 1.27 (95% confidence interval [CI], 1.22–1.31), 1.41 (95% CI, 1.39–1.44), 1.63 (95% CI, 1.59–1.68), and 1.68 (95% CI, 1.65–1.71; P<0.001). The AORs for those who smoked >20 cigarettes per day were 2.03 (95% CI, 1.84–2.23), 2.12 (95% CI, 2.02–2.22), 1.94 (95% CI, 1.49–2.52), 2.00 (95% CI, 1.88–2.13), and 2.07 (95% CI, 1.73–2.49; P<0.001).

3. Smoking Frequency and Salt-Related Eating Behavior of Daily Smokers

Table 2 shows the ORs between the daily smoking amount and salt-related eating behavior after adding salt to foods. Regarding adding additional salt or soy sauce to foods, based on the fully adjusted model, the AORs for daily smokers who smoked 1–20 cigarettes per day were 1.11 (95% CI, 1.07–1.16), 1.13 (95% CI, 1.11–1.16), 1.23 (95% CI, 1.20–1.27), and 1.22 (95% CI, 1.19–1.24; P<0.001). The AORs for those who smoked >20 cigarettes per day were 1.54 (95% CI, 1.39–1.70), 1.39 (95%

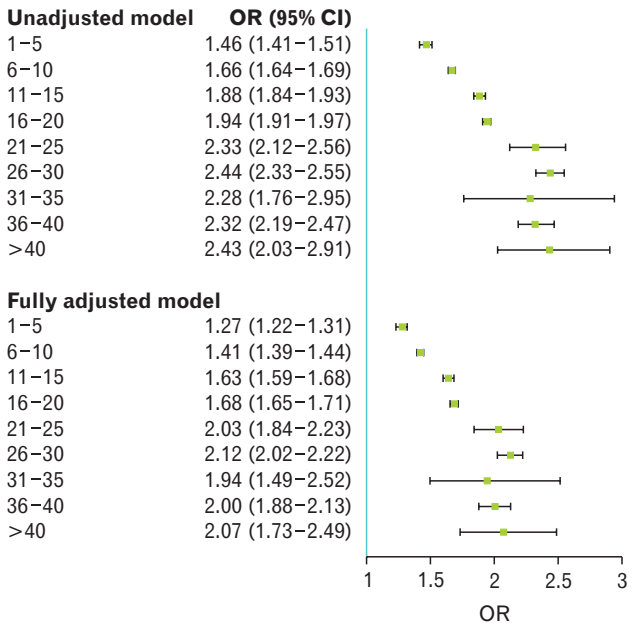

Figure 1. Forest plot of odds ratios (ORs) of the salt taste preference associated with the smoking amount of daily smokers. ORs and 95% confidence interval (CI) of salty taste preference for each smoking volume interval are represented by a square and segments, respectively.

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Table 2. Ordinal regression analysis of daily smokers' smoking amount and salty eating habits

Model	Daily smoking amount	Adding salt or soy sauce at the table	Dipping the soy sauce when eating fried food
Unadjusted model	1–5	1.37 (1.32–1.43)***	1.75 (1.70–1.81)***
	6–10	1.43 (1.40–1.46)***	2.15 (2.11–2.18)***
	11–15	1.53 (1.49–1.58)***	2.43 (2.38–2.49)***
	16–20	1.51 (1.48–1.53)***	2.34 (2.31–2.38)***
	21–25	1.90 (1.72–2.11)***	2.46 (2.25–2.68)***
	26–30	1.68 (1.60–1.77)***	2.47 (2.37–2.59)***
	31–35	1.78 (1.36–2.33)***	2.43 (1.96–3.00)***
	36–40	1.75 (1.65–1.87)***	2.38 (2.24–2.53)***
	>40	1.72 (1.45–2.05)***	2.23 (1.89–2.65)***
Fully adjusted model	1–5	1.11 (1.07–1.16)**	1.23 (1.19–1.28)***
	6–10	1.13 (1.11–1.16)***	1.41 (1.38–1.43)***
	11–15	1.23 (1.20–1.27)***	1.60 (1.55–1.64)***
	16–20	1.22 (1.19–1.24)***	1.65 (1.23–1.68)***
	21–25	1.54 (1.39–1.70)***	1.77 (1.62–1.94)***
	26–30	1.39 (1.30–1.44)***	1.84 (1.75–1.92)***
	31–35	1.43 (1.09–1.87)*	1.77 (1.42–2.20)***
	36–40	1.42 (1.33–1.51)***	1.81 (1.70–1.93)***
	>40	1.37 (1.15–1.64)***	1.72 (1.44–2.05)***

Values are presented as odds ratio (95% confidence interval). Unadjusted model: crude odds ratios are calculated from logistic regression models. Fully adjusted model: multivariable adjusted odds ratios are from ordinal regression models adjusted for age, sex, body mass index, education, family income, marital status, and drinking status. *P<0.05. **P<0.01. ***P<0.001.

CI, 1.30–1.44), 1.43 (95% CI, 1.09–1.87), 1.42 (95% CI, 1.33–1.51), and 1.37 (95% CI, 1.15–1.64; P<0.001).

Table 2 shows the ORs between the daily smoking amount and salt-related eating behavior of dipping fried food into soy sauce. The AORs for daily smokers who smoked 1–20 cigarettes per day were 1.23 (95% CI, 1.19–1.28), 1.41 (95% CI, 1.38–1.43), 1.60 (95% CI, 1.55–1.64), and 1.65 (95% CI, 1.62–1.68; P<0.001). The AORs for those who smoked >20 cigarettes were 1.77 (95% CI, 1.62–1.94), 1.84 (95% CI, 1.75–1.92), 1.77 (95% CI, 1.42–2.20), 1.81 (95% CI, 1.70–1.93), and 1.72 (95% CI, 1.44–2.05; P<0.001).

4. Five-Day Smoking Frequency and Salty Flavor Preference of Occasional Smokers

Figure 2 shows the ORs between the 5-day smoking frequency and preference for salty flavors of occasional smokers based on the unadjusted and fully adjusted models. After accounting for various possible confounders, the AORs for occasional smokers who smoked 1–20 cigarettes per 5 days were 1.19 (95% CI, 1.13–1.26), 1.21 (95% CI, 1.13–1.29), 1.34 (95% CI, 1.23–1.47), and 1.27 (95% CI, 1.15–1.41; P<0.001). The AORs for occasional smokers who smoked 21–30 cigarettes per 5 days were 1.29 (95% CI, 1.07–1.56) and 1.22 (95% CI, 1.08–1.38; P<0.001). Finally, the AORs for those who smoked >30 cigarettes per 5 days were 1.28 (95% CI, 1.10–1.47) and 1.34 (95% CI, 1.20–1.50; P<0.001).

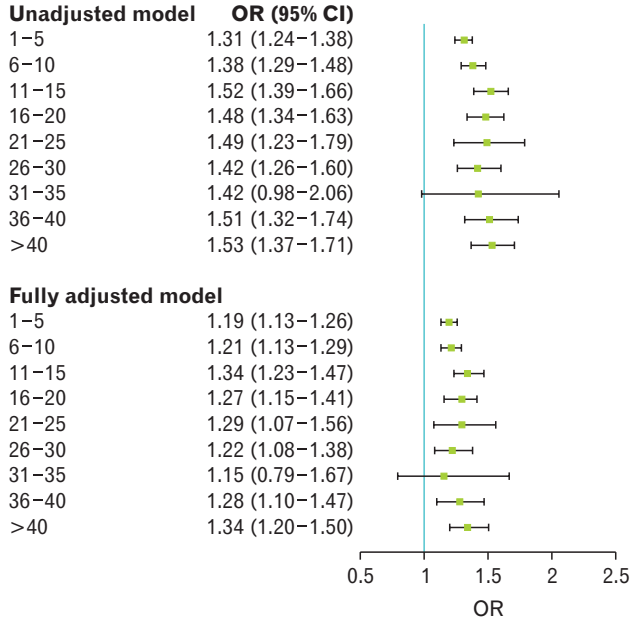

Figure 2. Forest plot of odds ratios (ORs) of salty taste preference associated with the 5-day smoking amount of occasional smokers. ORs and 95% confidence interval (CI) of salt taste preference for each smoking volume interval are represented by a square and segments, respectively.

5. Five-Day Smoking Frequency and Salt-Related Eating Behaviors of Occasional Smokers

Table 3 shows the ORs for the smoking frequency and salt-related eating behaviors of occasional smokers of adding additional salt or soy sauce to meals. After accounting for various possible confounders, the AORs for occasional smokers who smoked 1–20 cigarettes per 5 days were 1.09 (95% CI, 1.03–1.16; P<0.01), 1.12 (95% CI, 1.04–1.20; P<0.01), 1.28 (95% CI, 1.16–1.41; P<0.001), and 1.35 (95% CI, 1.21–1.50; P<0.001). The AORs for occasional smokers who smoked 21–30 cigarettes per 5 days were 1.41 (95% CI, 1.16–1.72; P<0.01) and 1.31 (95% CI, 1.16–1.48; P<0.001). Finally, the AORs for those who smoked >30

Table 3. Ordinal regression analysis of occasional smokers' 5-day smoking amount and salty eating habits

Model	5-Day smoking amount	Adding salt or soy sauce at the table	Dipping the soy sauce when eating fried food
Unadjusted model	1–5	1.28 (1.21–1.36)***	1.93 (1.84–2.03)***
	6–10	1.36 (1.26–1.46)***	1.88 (1.76–2.00)***
	11–15	1.56 (1.42–1.71)***	1.99 (1.83–2.15)***
	16–20	1.66 (1.50–1.85)***	1.77 (1.62–1.93)***
	21–25	1.76 (1.45–2.13)***	2.05 (1.76–2.38)***
	26–30	1.63 (1.44–1.84)***	2.06 (1.86–2.29)***
	31–35	1.56 (1.09–2.23)*	1.88 (1.45–2.43)***
	36–40	1.84 (1.60–2.13)***	2.13 (1.88–2.41)***
	>40	1.92 (1.71–2.15)***	2.07 (1.88–2.27)***
Fully adjusted model	1–5	1.09 (1.03–1.16)**	1.37 (1.30–1.44)***
	6–10	1.12 (1.04–1.20)**	1.29 (1.21–1.38)***
	11–15	1.28 (1.16–1.41)***	1.35 (1.24–1.47)***
	16–20	1.35 (1.21–1.50)***	1.14 (1.04–1.25)**
	21–25	1.41 (1.16–1.72)**	1.37 (1.17–1.60)***
	26–30	1.31 (1.16–1.48)***	1.37 (1.23–1.53)***
	31–35	1.20 (0.84–1.72)	1.17 (0.89–1.53)
	36–40	1.47 (1.28–1.70)***	1.39 (1.22–1.58)***
	>40	1.55 (1.38–1.74)***	1.44 (1.31–1.59)***

Values are presented as odds ratio (95% confidence interval). Unadjusted model: crude odds ratios are calculated from logistic regression models. Fully adjusted model: multivariable adjusted odds ratios are from ordinal regression models adjusted for age, sex, body mass index, education, family income, marital status, and drinking status.
*P<0.05. **P<0.01. ***P<0.001.

cigarettes per 5 days were 1.47 (95% CI, 1.28–1.70) and 1.55 (95% CI, 1.38–1.74; P<0.001).

Table 3 shows the ORs for the smoking frequency and salt-related eating behaviors of occasional smokers when dipping fried food into soy sauce. After accounting for various possible confounders, the AORs for occasional smokers who smoked 1–20 cigarettes per 5 days were 1.37 (95% CI, 1.30–1.44; P<0.001), 1.29 (95% CI, 1.21–1.38; P<0.001), 1.35 (95% CI, 1.24–1.47; P<0.001), and 1.14 (95% CI, 1.04–1.25; P<0.01). The AORs for occasional smokers who smoked 21–30 cigarettes per 5 days were 1.37 (95% CI, 1.17–1.60; P<0.001) and 1.37 (95% CI, 1.23–1.53; P<0.001). Finally, the AORs for those who smoked >30 cigarettes were 1.39 (95% CI, 1.22–1.58) and 1.44 (95% CI, 1.31–1.59; P<0.001).

DISCUSSION

This study used data from the KDCA to determine the relationship between the smoking frequency and salt preferences of current Korean cigarette smokers (daily and occasional smokers). The normal salt intake level of daily smokers was higher than that of nonsmokers and increased according to the daily smoking amount. Daily smokers tended to add salt or soy sauce to foods and dip fried foods in soy sauce more frequently than non-smokers. Furthermore, as the 5-day smoking frequency of occasional smokers increased, their preference for salty foods increased, and they tended to add additional salt or soy sauce to meals and dip fried foods into soy sauce.

Based on our results, smokers tended to prefer a salty taste more than nonsmokers. For daily smokers, the OR increased in accordance with the smoking frequency, making the slope gentler. It is assumed that there is no difference when the smoking frequency exceeds a certain level, dulling the sense of taste. Previous studies have suggested a relationship between smoking habits and decreased ability to taste. For instance, a study analyzing the 2013–2014 National Health and Nutrition Examination Survey data showed that current smokers have weaker salt taste perception than nonsmokers in taste tests.[18] A regional taste-testing study conducted using electrogustometry also showed that smokers have a higher taste threshold than nonsmokers.[17,20] Smoking reduces the number of taste cells and affects the vascularization, size, and density of fungiform taste buds, thereby reducing taste sensitivity.[11,21] Furthermore, exposure to nicotine during smoking affects saliva secretion and quality, which plays an important role in taste sensation and can indirectly affect orosensation.[15,22] Neurologically, in rats nicotine modulates the response of the chorda tympani to salty stimuli by interacting with both the amiloride-sensitive pathway involving the epithelial sodium channel and the amiloride-insensitive pathway involving the TRPV1t (a variant of the transient receptor potential vanilloid-1) channel.[23] Nicotine also affects taste by changing the response of neurons in the nucleus of the solitary tract, which is the principal central relay in the gustatory pathway of taste buds on the tongue.[24] Oliveira-Maia et al.[25] reported that nicotine affects taste by activating the nicotinic acetylcholine receptors present in the taste buds. Nicotine exposure can also alter saliva quality and secretion, which plays a vital role in taste sensation, thereby possibly affecting taste sensation.

In this study, it was found that, current smokers have a habit of adding salt or soy sauce to meals and dipping fried foods into soy sauce. Smokers are believed to have lower quality sodium-related eating habits than nonsmokers and prefer salty foods. The AOR increased with the smoking frequency. According to a 1994 study conducted in the United Kingdom, smokers consumed fewer antioxidant vitamins

and dietary fiber; more dietary cholesterol and alcohol; more saturated fat, butter, and full-fat milk; and preferred salty foods; however, their nutritional knowledge was lower than that of nonsmokers.[26] According to a 2000 study conducted in Japan, smokers consumed fewer vegetables, fruits, and beans, and consumed more salty foods and alcohol than nonsmokers.[27] According to a 2011 study conducted in France, smoking was associated with a preference for high-fat salty and sweet foods.[28] Moreover, the 2020 US Coronary Artery Risk Development in Young Adults study reported that current and ex-smokers had a higher abdominal muscle component adipose tissue volume than nonsmokers, which may be associated with a higher risk of developing cardiovascular and cerebrovascular diseases.[29]

The findings from this national representative survey suggest that smoking frequency is positively correlated with a preference for salty foods and salt-related eating behaviors in South Korea. After adjusting for several variables, we found that smokers prefer salty taste/food and that the salt preference increases as the number of cigarettes and frequency of smoking increases. A limitation of this study was that the self-reported number of smoking days and amount were inaccurate, and most were answered in multiples of five. Among the self-reported salt taste preferences, the degree of normal salt intake cannot be measured, and those who prefer a salty taste may report a lower degree of salt intake when eating bland food than their preferred saltiness. A limitation of this study is that it is not possible to confirm how accurately reflected the actual salt intake is because salt intake was measured as a salty taste preference. This study did not consider the possibility that female smokers might have concealed their smoking status because of societal perceptions of women who smoked. Data, such as the proportion of smokers drinking alcohol and male daily smokers, reached more than 90%, which may have led to biased results. Diseases that affect salt intake, such as high blood pressure, were not included in the confounding variables. Moreover, in this study, smokers were considered current smokers who had smoked >100 cigarettes in their lifetime; those who had quit smoking in the past could not be analyzed because investigating their smoking amount was difficult.

As a result of analyzing the data from the KCHS conducted during 2010–2013 and 2014–2017, the normal salty taste preferences of current smokers were found to be higher than that of nonsmokers, and the degree of salty taste preference increased as the smoking frequency increased. Furthermore, smokers more frequently added additional salt or soy sauce to meals and dipped fried foods into soy sauce than nonsmokers, which was also positively correlated with smoking amount. Our findings suggest that smokers must be cautious about potential excessive sodium intake and that the amount of smoking must be considered when reducing sodium intake.

CONFLICT OF INTEREST

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

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REFERENCES

1. Grillo A, Salvi L, Coruzzi P, Salvi P, Parati G. Sodium intake and hypertension. Nutrients 2019;11:1970.
2. Wang YJ, Yeh TL, Shih MC, Tu YK, Chien KL. Dietary sodium intake and risk of cardiovascular disease: a systematic review and dose-response meta-analysis. Nutrients 2020;12:2934.
3. Li Y, Huang Z, Jin C, Xing A, Liu Y, Huangfu C, et al. Longitudinal change of perceived salt intake and stroke risk in a Chinese population. Stroke 2018;49:1332-9.
4. Deckers IA, van Engeland M, van den Brandt PA, Van Neste L, Soetekouw PM, Aarts MJ, et al. Promoter CpG island methylation in ion transport mechanisms and associated dietary intakes jointly influence the risk of clear-cell renal cell cancer. Int J Epidemiol 2017;46:622-31.
5. Faraco G, Hochrainer K, Segarra SG, Schaeffer S, Santisteban MM, Menon A, et al. Dietary salt promotes cognitive impairment through tau phosphorylation. Nature 2019;574:686-90.
6. GBD 2017 Diet Collaborators. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2019;393:1958-72.
7. Ministry of Food and Drug Safety. Food and nutrition fact book 2019 [Internet]. Cheongju: Ministry of Food and Drug Safety; 2019 [cited 2021 Aug 9]. Available from: https://knhanes.kdca.go.kr/knhanes/sub04/sub04_04_01.do
8. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020 [Internet]. Geneva: World Health Organization; 2013 [cited 2022 Apr 27]. Available from: https://apps.who.int/iris/bitstream/handle/10665/94384/9789241506236_eng.pdf?sequence=1&isAllowed=y
9. Bobowski N. Shifting human salty taste preference: potential opportunities and challenges in reducing dietary salt intake of Americans. Chemosens Percept 2015;8:112-6.
10. Tan SY, Sotirelis E, Bojeh R, Maan I, Medalle M, Chik XS, et al. Is dietary intake associated with salt taste function and perception in adults?: a systematic review. Food Qual Prefer 2021;92:104174.
11. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. The health consequences of smoking: 50 years of progress: a report of the Surgeon General [Internet]. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014 [cited 2022 Apr 27]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK179276/
12. Lee W, Hwang SH, Choi H, Kim H. The association between smoking or passive smoking and cardiovascular diseases using a Bayesian hierarchical model: based on the 2008-2013 Korea Community Health Survey. Epidemiol Health 2017;39:e2017026.
13. Hackshaw A, Morris JK, Boniface S, Tang JL, Milenkovic D. Low cigarette consumption and risk of coronary heart disease and stroke: meta-analysis of 141 cohort studies in 55 study reports. BMJ 2018;360:j5855.

14. Pan A, Wang Y, Talaei M, Hu FB, Wu T. Relation of active, passive, and quitting smoking with incident type 2 diabetes: a systematic review and meta-analysis. Lancet Diabetes Endocrinol 2015;3:958-67.
15. Pavlos P, Vasilios N, Antonia A, Dimitrios K, Georgios K, Georgios A. Evaluation of young smokers and non-smokers with Electrogustometry and Contact Endoscopy. BMC Ear Nose Throat Disord 2009;9:9.
16. Klein I, Nagler RM, Toffler R, van Der Vliet A, Reznick AZ. Effect of cigarette smoke on oral peroxidase activity in human saliva: role of hydrogen cyanide. Free Radic Biol Med 2003;35:1448-52.
17. Alkerwi A, Baydarlioglu B, Sauvageot N, Stranges S, Lemmens P, Shivappa N, et al. Smoking status is inversely associated with overall diet quality: findings from the ORISCAV-LUX study. Clin Nutr 2017;36:1275-82.
18. Cheruel F, Jarlier M, Sancho-Garnier H. Effect of cigarette smoke on gustatory sensitivity, evaluation of the deficit and of the recovery time-course after smoking cessation. Tob Induc Dis 2017;15:15.
19. Chun IA, Park J, Han MA, Choi SW, Ryu SY. The association between smoking, alcohol intake, and low-salt diet: results from the 2008 Community Health Survey. J Korean Diet Assoc 2013;19:223-35.
20. Berube L, Duffy VB, Hayes JE, Hoffman HJ, Rawal S. Associations between chronic cigarette smoking and taste function: results from the 2013-2014 national health and nutrition examination survey. Physiol Behav 2021;240:113554.
21. Pavlidis P, Gouveris C, Kekes G, Maurer J. Changes in electrogustometry thresholds, tongue tip vascularization, density and form of the fungiform papillae in smokers. Eur Arch Otorhinolaryngol 2014;271:2325-31.
22. Fischer ME, Cruickshanks KJ, Schubert CR, Pinto A, Klein R, Pankratz N, et al. Factors related to fungiform papillae density: the beaver dam offspring study. Chem Senses 2013;38:669-77.
23. Lyall V, Phan TH, Mummalaneni S, Mansouri M, Heck GL, Kobal G, et al. Effect of nicotine on chorda tympani responses to salty and sour stimuli. J Neurophysiol 2007;98:1662-74.
24. Simons CT, Boucher Y, Carstens MI, Carstens E. Nicotine suppression of gustatory responses of neurons in the nucleus of the solitary tract. J Neurophysiol 2006;96:1877-86.
25. Oliveira-Maia AJ, Stapleton-Kotloski JR, Lyall V, Phan TH, Mummalaneni S, Melone P, et al. Nicotine activates TRPM5-dependent and independent taste pathways. Proc Natl Acad Sci U S A 2009;106:1596-601.
26. Woodward M, Bolton-Smith C, Tunstall-Pedoe H. Deficient health knowledge, diet, and other lifestyles in smokers: is a multifactorial approach required? Prev Med 1994;23:354-61.
27. Kitagawa Y, Nakaji S, Shimoyama T, Umeda T, Sugawara K, Liu Q, et al. Differences in lifestyle of a smoking and non-smoking population in Japan. Asian Pac J Cancer Prev 2000;1:245-9.
28. Mejean C, Macouillard P, Castetbon K, Kesse-Guyot E, Hercberg S. Socio-economic, demographic, lifestyle and health characteristics associated with consumption of fatty-sweetened and fatty-salted foods in middle-aged French adults. Br J Nutr 2011;105:776-86.
29. Terry JG, Hartley KG, Steffen LM, Nair S, Alman AC, Wellons MF, et al. Association of smoking with abdominal adipose deposition and muscle composition in Coronary Artery Risk Development in Young Adults (CARDIA) participants at mid-life: a population-based cohort study. PLoS Med 2020;17:e1003223.

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