# Relationships Among Smoking, Organic, and Functional Voice Disorders in Korean General Population

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**Summary: Objective.** The relationship between smoking and voice disorders is still controversial. This study has investigated the relationship between voice disorders and smoking by using a nationwide representative survey of the Korean population.
**Study Design.** Cross-sectional analysis of a national health survey.
**Methods.** The study sample 7941 Korean adults, aged 19 years or older (3422 men and 4519 women), who participated in the fifth Korea National Health and Nutrition Examination Survey, a nationwide representative survey of the noninstitutionalized population of the Republic of Korea. Laryngeal disorders were classified into functional voice disorders (vocal cord nodule, vocal polyp, Reinke edema, and laryngitis) and organic voice disorders (sulcus vocalis, vocal cyst, laryngeal granuloma, laryngeal keratosis, laryngeal leukoplakia, laryngeal papilloma, and suspected malignant neoplasm of the larynx). Multinomial logistic regression analyses were conducted to examine the association between smoking and voice disorders.
**Results.** Adjusting for covariates (age, gender, education level, occupation, income, alcohol drinking, self-reported voice problems, and self-reported health status), past smokers (odds ratio (OR) = 2.97, 95% confidence interval (CI): 1.14–9.03) and current smokers (OR = 3.22, 95% CI: 1.18–10.25) compared with nonsmokers, were more likely to have organic voice disorders. However, smoking was not associated with functional voice disorders.
**Conclusions.** Smoking is independently associated with organic voice disorders in the Korean general population.
**Key Words:** Dysphonia–Voice disorder–Epidemiology–Risk factor–Smoking–Adult.

## INTRODUCTION

In spite of worldwide nonsmoking campaigns, four of every 10 adults aged older than 19 years in Korea are still smokers, which is the highest ratio in the Organization for Economic Cooperation and Development (OECD) member countries.[1] Therefore, preventing diseases through active inducement of nonsmoking status is a critical issue for the promotion of health to Koreans.

Smoking is known to be a major risk factor for laryngeal diseases. Chronic smoking is a major risk factor in Reinke edema, laryngeal keratosis, and laryngeal leukoplakia, as well as for benign vocal fold lesions.[2–6] On the other hand, there have been reports of studies on the general population or specifically teachers have found that smoking does not have a significant relationship with voice disorders.[7,8] What needs to be noted in these reports is that first, the studies were conducted on professional voice users such as teachers,[5,7] or the studies were performed using clinical data[2–5]; second, there are differences in the definition of voice disorders among the studies; third, it is difficult to investigate the risk factors of voice disorders, because there are few epidemiologic studies on the general population.[8]

To sum up, although the relationship between smoking and voice disorders has been supported by numerous clinical studies, the relationship between smoking and voice disorders in epidemiologic studies on the general population remains a controversial issue. This discrepancy in the results of the studies implies that smoking may have a relationship with only specific types of voice disorders, rather than overall voice disorders. Nevertheless, because there are few epidemiologic studies on the relationship between smoking and voice disorders that have been conducted by etiologically classifying voice disorders, there is lack of clear ground in the explanations of the relationship between smoking and voice disorders. Thus, exploring the relationship of voice disorders with smoking by classifying voice disorders etiologically is a meaningful subject to help us better understand the effect of smoking on voice disorders, and for a scientific evidence-based corroboration, epidemiologic studies that can represent general population are required.

This study investigated the relationship between voice disorders and smoking using a nationwide representative survey of the Korean population.

## METHODS

### Subjects

The subjects of this study were adults, aged 19 years and older, who participated in the fifth Korea National Health and Nutrition Examination Survey (KNHANES V), which was a nationwide representative survey of the noninstitutionalized population in the Republic of Korea and who then participated in an otolaryngology examination.[9] KNHANES is a nationwide cross-sectional survey conducted annually by the Korea Centers for Disease Control and Prevention using a rolling sampling

design that involves a complex stratified multistage probability cluster survey of a representative sample of noninstitutionalized civilians in Korea. The sampling methods of KNHANES are described in detail elsewhere.[10] Briefly, the KNHANES has been redesigned from once every 3 years to every year to provide timely health statistics for monitoring the changes in health risk factors and diseases and developing associated public health policies and health programs. The fifth KNHANES was performed in 2010–2012. KNHANES V composed three component surveys: a health interview, a health examination, and a nutrition survey. The health interview and health examination are performed by trained medical staff, and interviews were performed at the mobile examination center and in participants' households. The KNHANES V was conducted on 31 596 people from 11 400 households, and the participation rate was 80.8% (n = 25 533). The survey was approved by the Institutional Review Board of the Korean Center for Disease Control and Prevention (approval no. 2011–02CON-06). This study targeted 10 134 people who completed both the health survey and laryngoscope examinations. Among them, 1457 people whose laryngoscopic findings could not be determined and 736 nonrespondents for survey on smoking were excluded from the research, and 7941 persons (3422 men and 4519 women) were analyzed.

## Measurement

The level of education and economic activity was determined by individual interviews, and smoking and drinking levels were determined with self-administered questionnaires. Endoscopic laryngeal examinations for laryngeal pathologies were performed by an otolaryngologist with a 70° endoscope on male and female adults aged 19 years and older. Before the research, frequently occurring errors of the criteria were examined through theory education, pretraining, and mock surveys. The index of coincidence evaluation was executed twice, and the quality improvement committee reevaluated the pictures and videos of the otolaryngologists' examinations and computed the results.

Smoking. Participants in the study were classified as current smokers, past smokers, or nonsmokers. According to the definition by the World Health Organization, a current smoker is someone who has smoked more than 100 cigarettes over their lifetime and either sometimes smokes, or smokes every day. A past smoker is defined as someone who has smoked more than 100 cigarettes during their life, but does not currently smoke.

Functional and organic voice disorder. Data on laryngeal disorders diagnosed in otorhinolaryngological examination were reclassified by the author into functional voice disorders (cord nodule, vocal polyp, Reinke edema, and laryngitis) and organic voice disorders (sulcus vocalis, vocal cyst, laryngeal granuloma, laryngeal keratosis, laryngeal leukoplakia, laryngeal papilloma, and suspected malignant neoplasms of the larynx) by referring to Boone et al's etiologic classification standard.[11] According to this classification, functional voice disorders develop from bad habits such as excessive muscular tension without organic or neurologic cause, and

organic voice disorders are defined as voice disorders from congenital deformities, injuries, or infections of the larynx.

Confounding factors. The age, gender, education level, occupation, income, alcohol consumption, self-reported voice problems, and self-reported health status were examined. Education levels were classified as below elementary school graduation, below middle school graduation, below high school graduation, and above college graduation. Occupations were surveyed based on the Korean standard classification of occupations sixth revision[12] and classified into economically inactive population (unemployed persons, housewives, and students), nonmanual worker (managers, clerical workers, and service and sales workers), and manual worker (skilled agricultural and forestry and fishery workers, craft and related trades workers, and elementary occupations). Levels of income for households were classified into four quartiles. Alcohol consumption was classified as less than once per month, more than one time per month. Self-reported health status was classified as good, normal, or bad. Those who currently reported having problems with their voice were classified as having self-reported voice problems.

## Statistical analysis

The general characteristics of nonsmokers, past smokers and current smokers were presented in the form of mean, standard deviation, and percentage, and differences among the groups were identified using a one-way analysis of variance (ANOVA) for continuous variables and by chi-square test for discrete variables. To compare the relationship between smoking and voice disorders, the odds ratio (OR) and 95% confidence intervals (CI) were presented using multinomial logistic regression analysis. Model 1 in this study was adjusted for sociodemographic factors (age, gender, education level, occupation, and income), whereas model 2 was additionally adjusted for health factors (alcohol drinking, self-reported voice problems, and self-reported health status). All analyses were performed using IBM SPSS version 20.0 (IBM, Inc., Chicago, IL).

## RESULTS
### General characteristics of subjects based on smoking

The general characteristics of subjects based on smoking were presented in Table 1. Among 7941 subjects, the number of nonsmokers was 4606 (58.0%), the number of past smokers was 1667 (21.0%). and the number of current smokers was 1668 (21.0%). As the result of one-way ANOVA, ages were higher in the order of past smokers (aged 55.1 years), nonsmokers (aged 50.1 years) and then current smokers (aged 45.9 years) (P < 0.001). As the result of the cross test, it could be seen that, nonsmokers, past smokers, and current smokers had significant differences in their gender, level of education, occupation, income, drinking, and subjective perception on health. The percentage of women who were in the nonsmoker group was high (88.6%), and the number of men in the current smokers group was high (41.6%) (P < 0.001). For their level of education, the number of middle school graduates (23.1%) and