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Association between Mental Health and Symptoms of Chronic Rhinosinusitis Based on the EPOS 2020 Guideline: A Nationwide Population-Based Study

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Research Article

Keywords: Chronic rhinosinusitis, Mental health, Stress, Depression, Suicidal ideation

Posted Date: July 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10064099/v1

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Additional Declarations: No competing interests reported.

Abstract

Objective.

This study examined the association between chronic rhinosinusitis (CRS) symptoms and mental health outcomes using a nationwide population-based dataset from the Korea National Health and Nutrition Examination Survey.

Methods.

We analyzed data from 12,920 participants aged 19 years and above in the Korea National Health and Nutrition Examination Survey VIII (2019–2021). CRS was defined according to EPOS 2020 guidelines based on rhinorrhea, nasal congestion, facial pain, or olfactory disorders lasting more than 3 months. Mental health outcomes were assessed using the Patient Health Questionnaire-9 and survey questions on stress perception, depression, and suicidal ideation. Univariate and multiple logistic regression analyses were performed to evaluate associations between CRS symptoms and mental health indicators, adjusting for demographic and socioeconomic variables.

Results.

Of these participants, 581 met the diagnostic criteria for CRS. CRS symptoms were associated with increased odds of perceived stress, depression, and suicidal thoughts. Rhinorrhea and nasal congestion showed significant associations with all mental health outcomes, whereas facial pain and olfactory dysfunction were associated with perceived stress and mental health consultations. Sex-stratified analysis showed that women had higher odds ratios for depression related to CRS symptoms compared with men. Depression severity measured by the Patient Health Questionnaire-9 was positively correlated with the prevalence of CRS symptoms.

Conclusion.

CRS symptoms were significantly associated with adverse mental health outcomes, highlighting the need for comprehensive mental health assessment in these patients. The findings suggest a stronger impact among women and those with severe depression, underscoring the importance of targeted mental health interventions.

Introduction

Chronic rhinosinusitis (CRS) is a common condition characterized by the inflammation of the nasal cavity and paranasal sinuses, leading to nasal obstruction, purulent nasal discharge, reduced sense of smell, and facial pain. Globally, many individuals suffer from discomfort caused by CRS, which leads to

significant direct and indirect costs. [1] CRS is diagnosed based on the criteria outlined in the EPOS guidelines. Clinically, a diagnosis can be made if a patient experiences two or more symptoms, such as nasal obstruction, nasal discharge, postnasal drip, reduced sense of smell, and facial pain, lasting for more than 3 months, and findings consistent with CRS are observed using a nasal endoscope and CT scan. Additionally, according to the EPOS guidelines, CRS is diagnosed when either prolonged rhinorrhea or nasal congestion is present, referred to as "major symptoms". [2]

Research has established that CRS significantly compromises patients' quality of life (QOL) and mental health. It has been found to be associated with depression and anxiety, with a stronger correlation observed as the severity of CRS symptoms increases.[3] The presence of allergic rhinitis has been reported to exacerbate its negative impact on mental health and QOL, and an increase in comorbidities is associated with a higher likelihood of depression.[4] Studies comparing responses to specific items of the SNOT-22 questionnaire with mental health status have identified associations between depression and pain, sleep disorders, and nasal symptoms, with sleep disorders showing the strongest correlation. [5], [6] To date, two nationwide population-based studies have investigated the correlation between CRS and depression, both of which reported an association.[7], [8] However, no nationwide population-based studies have yet reported the impact of each specific symptom of CRS—nasal obstruction, purulent nasal discharge, postnasal drip, reduced sense of smell, and facial pain—on mental health. This study investigates the relation between these factors.

The Korea National Health and Nutrition Examination Survey (KNHANES) began in 1998 and annually provides comprehensive health data on approximately 10,000 individuals aged 1 year and older, including physical and laboratory examinations, health-related questionnaires, and nutrition surveys.[9] The latest KNHANES VIII (2019–2021) included new questions on CRS symptoms (nasal discharge, obstruction, facial pain, and olfactory disorders) lasting more than 3 months. This made it possible to conduct a nationwide study to meet our research goals.

Methods

Data collection and participants

A total of 22,559 participants were included in the 8th edition of KNHANES from 2019 to 2021, of whom 18,691 were adults aged 19 years and above. Participants with missing values for all specified CRS-related symptoms, including rhinorrhea, nasal congestion, facial pain, and olfactory disorders, were excluded from the study. Therefore, data from 12,920 participants were used in the final statistical analysis. (Fig. 1).

Demographic variables and physical activity

Demographic characteristics, including age, sex, education, income, smoking, alcohol use, and physical activity, were collected. Education level was categorized as 'high school or lower' and 'college or higher.'

Smoking status was classified as non-smokers (including former smokers) and current smokers. Alcohol consumption was grouped by frequency: those who drank less than once a month or not at all, and those who drank once a month or more. Income was divided into quartiles based on monthly household income adjusted for household size. Physical activity was categorized based on self-reported aerobic exercise: participants who engaged in at least 2.5 hours of moderate-intensity, 1.25 hours of high-intensity activity, or a combination per week were considered active.

Diagnostic criteria related to the symptoms of CRS

CRS was defined as the presence of two or more symptoms, including rhinorrhea, nasal congestion, facial pain, and olfactory disorders, persisting for more than 3 months, with the stipulation that at least one of the symptoms must include either nasal congestion or rhinorrhea. Each symptom was assessed using a rhinological questionnaire. The assessment was conducted through a survey to ascertain whether the symptoms in each of the four categories persisted for more than 3 months.

Mental health-related variables and Patient Health Questionnaire-9 (PHQ-9)

Perceived stress, depression lasting more than 2 weeks, and mental health events in the past year (suicidal thoughts, plans, attempts, and consultations) were assessed through a survey. Perceived stress level was categorized as 'no' for reports of 'a little' or 'almost none' and 'yes' for 'a lot' or 'very much.' Other variables were dichotomized into 'yes' or 'no.' Depression was assessed using the PHQ-9 tool, which includes nine items rated from 0 to 3 based on frequency over the past 2 weeks: 0 ('not at all'), 1 ('several days'), 2 ('more than a week'), and 3 ('nearly every day'). Scores ranged from 0 to 27, and depression severity was classified as: 0–4 minimal, 5–9 mild, 10–14 moderate, 15–19 moderately severe, and 20–27 severe.

Statistical analysis

Continuous variables were presented as means ± standard deviation, and categorical variables were expressed as frequencies with percentages. The characteristics of the study population are described separately for each group according to the prevalence of CRS-related symptoms. An independent two-sample t-test was used to compare the differences in continuous variables between the two groups. Additionally, to evaluate the independence of categorical variables, the chi-square ($\chi 2$) test was used. Univariate logistic regression analysis was conducted to examine the relation between the prevalence of CRS-related symptoms and mental health-related parameters, with the group exhibiting negative symptoms used as a reference. For the multivariate logistic regression analysis, two models were used to adjust for confounding factors to confirm the adjusted association between mental health-related parameters and CRS symptoms. The first model was adjusted for demographic factors, specifically age

and sex. The second model was adjusted for confounding factors, including socioeconomic factors (education, household economic status, smoking, drinking, and physical activity).

Results

Study participants

Out of a total of 12,920 participants in the study, 581 individuals met the diagnostic criteria for CRS symptoms. Among these participants, 996 had rhinorrhea or postnasal drip, 760 had nasal congestion, 75 had facial pain and pressure, and 322 had olfactory disorders. The study collected data on participants' sex, age, educational level, smoking status, alcohol consumption, income level, physical activity, perceived stress, presence of depression for more than 2 weeks, and various factors within the past year, including suicidal thoughts, plans for suicide, suicide attempts, and consultations for mental health problems.

Chi-square test results showed that the incidence rates of symptoms related to CRS varied by age group. While age was a clearer factor, some differences in the prevalence of CRS-related symptoms were also noted among groups classified by sex, educational level, smoking status, income classification, and physical activity. Details of the number of participants in each group and their p-values are presented in Table 1.

Impact of CRS and symptoms on mental health: univariable logistic regression analysis

To investigate the impact of CRS and its individual symptoms (rhinorrhea, nasal congestion, facial pain, and olfactory disorders) on mental health, a logistic regression analysis was conducted, considering factors, such as perceived stress level, presence of depression for more than 2 weeks, and mental health-related events within the past year, including suicidal thoughts, plans for suicide, suicide attempts, and consultations for mental health problems. Univariate logistic regression analysis revealed that rhinorrhea and nasal congestion were associated with an odds ratio greater than one in relation to all examined mental health factors. Facial pain and olfactory disorders showed an odds ratio greater than one in certain aspects, specifically perceived stress levels and consultations for mental health issues within the past year. In patients categorized as having CRS based on symptoms, an odds ratio greater than one was observed in consultations for mental health problems within the past year. (Table 2)

Multivariate logistic regression analysis was conducted after adjusting for factors, such as sex, age, educational level, smoking status, alcohol consumption, income level, and physical activity. This analysis yielded results consistent with those of the univariate logistic regression analysis for the four symptoms of CRS: rhinorrhea, nasal congestion, facial pain, and olfactory dysfunction. By contrast, in patients categorized as having CRS based on symptoms, an odds ratio greater than one was observed for factors, including perceived stress level, presence of depression for more than 2 weeks, suicidal thoughts, plans for suicide, suicide attempts, and consultations for mental health issues within the past year. (Table 2)

Sex-based subgroup analysis of CRS symptoms and depression

Subgroup analyses were conducted according to sex. Among participants with rhinorrhea or postnasal drip, men showed an odds ratio of 1.193 (0.772–1.842) for experiencing depression lasting more than 2 weeks, whereas women showed an odds ratio of 2.109 (1.635–2.721) for the same symptom. Furthermore, among participants with CRS, men exhibited an odds ratio of 1.154 (0.672–1.982) for experiencing depression lasting more than 2 weeks, whereas women showed an odds ratio of 2.259 (1.629–3.132) for the same symptom. (Table 3)

Correlation between depression severity and CRS symptoms: PHQ-9 analysis

The association between depression severity, as measured by the PHQ-9, and CRS symptoms, including rhinorrhea and nasal congestion, was assessed using data from 5,034 participants who completed the PHQ-9. Compared with those of patients with minimal depression severity, increased odds ratios for CRS, rhinorrhea, and nasal congestion were observed in patients with mild, moderate, moderately severe, and severe depression. The Mantel–Haenszel chi-squared test revealed significant differences in the odds ratios among the severity groups. Furthermore, the Cochran–Armitage trend test indicated a statistically significant increase in the proportion of participants exhibiting each symptom as depression severity increased. (Table 4 and Figure 2)

Discussion

CRS is an inflammatory disease commonly seen in the nasal passages and sinuses, estimated to have a prevalence of approximately 4.5–12% in North America and Europe and 2.1–28.4% in Asian regions. [10], [11] The diagnosis of CRS is based on the EPOS guidelines, which include two or more symptoms of nasal discharge, nasal obstruction, facial pain, and a reduced sense of smell for over 12 weeks, supported by findings suggestive of rhinosinusitis in nasal endoscopy or imaging studies. At least one symptom that the patient complains of must be nasal discharge or obstruction.[2] CRS poses a significant burden, with indirect costs in North America exceeding $10 billion. [11]

Patients with CRS experience mental health problems, such as depression and anxiety.[3], [4], [5], [6] Treating CRS is effective in reducing depressive symptoms and improving mental health indicators. For example, Levy et al. found improvements in mental health-related indicators, such as depression, fatigue, decreased productivity, and difficulty concentrating, following surgical treatment of chronic sinusitis.[12] In addition, Schlosser et al. found that patients with comorbid depression showed improvements in PHQ-2 scores after surgical or medical treatment for chronic sinusitis.[13] However, some studies suggest depression can reduce quality of life and impact treatment outcomes, highlighting the need to address mental health before and after treatment. [14], [15]

In this study, we aimed to identify the association between CRS and mental health problems using a nationwide population-based database. Nationwide population-based studies have been published in Korea and Taiwan to determine the correlation between CRS and depression. However, these studies did

not investigate which CRS symptoms were related to depression or mental health.[7], [8] In this study, we examined how each symptom that constitutes the diagnostic criteria for CRS affects mental health.

In the univariate and multivariate logistic regression analyses presented in Table 2, associations were found between CRS and mental health problems, specifically rhinorrhea, nasal congestion, facial pain, and olfactory dysfunction. Notably, participants with rhinorrhea and nasal congestion showed increased odds of stress-, depression-, and suicide-related events, whereas associations with facial pain and olfactory dysfunction were only found for some items. However, according to the literature referenced in this study, sleep disorders, facial pain, and olfactory dysfunction are strongly associated with depression and mental health.[16] Contrary to previous publications and common expectations, the results of this study suggest that this discrepancy could be due to an insufficient number of participants reporting facial pain or olfactory dysfunction. Further research with a larger sample size is necessary to determine the factors that have a stronger impact.

Interestingly, the subgroup analysis results presented in Table 3 indicate a more pronounced association with mental health problems in women. This finding is consistent with those of other studies and is supported by the fact that most patients with both depression and CRS are women. Additionally, the PHQ-9 analysis shown in Table 4 revealed that as depression severity increased, so did the proportion of participants with CRS symptoms, resulting in a higher odds ratio. Although our data did not include CRS severity measures like SNOT-22 or TNSS, previous studies suggest that more severe CRS symptoms are likely linked to more severe depression.

This study analyzed the association between four symptoms (nasal discharge, obstruction, facial pain, and reduced sense of smell) lasting over 3 months and mental health indicators (stress, depression, suicidal thoughts). We found that persistent nasal discharge and obstruction were strongly linked to poor mental health, with a stronger effect in women.

Women have twice the prevalence of depression than that of men and are more likely to have medical comorbidities.[17] The exact reason for this difference is not clear, but it has been suggested that it may be due to differences in the hypothalamic-pituitary-adrenal axis: at the same level of cortisol, men have higher concentrations of adrenocorticotropic hormone than those of women, suggesting that under normal circumstances, women have a more sensitive adrenal cortex than that of men. In addition, female sex hormones slow cortisol feedback by attenuating the responsiveness of the sympathoadrenal and hypothalamic-pituitary-adrenal axes.[18] These sex-specific biological differences are thought to contribute to differences in depression and stress responses in certain medical conditions, such as CRS.

While previous studies have reported some mental health effects of CRS, analyzing a general population clarified its impact. We also found that the disease's effect on depression and stress was more pronounced in women. Therefore, we suggest considering the possibility of mental health decline, especially depression, in CRS patients, with a focus on women.

In this study, CRS was defined as symptoms lasting over 3 months. Although symptom-based CRS diagnosis has high sensitivity, it has relatively low specificity, meaning some patients without CRS might be misclassified. However, our analysis of participants with nasal discharge and obstruction for over 3 months showed these symptoms were linked to mental health indicators. Since these symptoms are crucial for CRS diagnosis, we believe that more precise diagnostic testing would yield the same result.

Conclusion

Consistent with previous studies, this study confirmed the association between CRS and depression as well as mental health. Such associations were observed not only in participants with facial pain and olfactory dysfunction but also in those with rhinorrhea and nasal congestion. Furthermore, a more pronounced association was identified in women, along with evidence suggesting a stronger correlation between severe depression and CRS. Therefore, this study argues for the necessity of meticulous attention to the mental health of patients with CRS symptoms or those diagnosed with CRS, particularly emphasizing this recommendation for women.

Declarations

Consent for publication: All of the authors have read and approved the manuscript and concur with submission of the manuscript.

Informed Consent Statement: Informed consent was obtained from each participant of the Korean National Health and Nutrition Examination Survey (KNHANES).

Availability of Data and Material: The KNHANES data are open to the public; therefore, any researcher can obtain the raw data by requesting it on the website (https://knhanes.kdca.go.kr/knhanes/eng/main.do).

Ethical Consideration: Informed consent was obtained from each participant, and the Institutional Review Board of the KCDC approved the investigation of the KNHANES (2018-01-03-1C-A, 2018-01-03-2C-A, and 2018-01-03-3C-A)

Competing interests: There are no financial or other issues that might lead to conflicts of interest.

Acknowledgments: This research was supported by the Statistical Support Project for Writing Medical Papers conducted using the Korea National Health and Nutrition Examination Survey (KNHANES) at Korea University Anam Hospital.

Funding Sources: This research was supported by the Basic Science Research Program of the National Research Foundation of Korea and funded by the Ministry of Science and Technology (NRF-2020R1A2C1006398 and RS-2024-00441029), ICT and Future Planning (2017R1A2B2003575 and 2020R1C1C1012288), Korea, under the ICT Creative Consilience program (IITP-2024-2020-0-01819) supervised by the Institute for Information and Communications Technology Planning and Evaluation (IITP), and a grant of the Korea Health Technology R&D Project (HI17C0387) (HR22C1302) through the

Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea. This research was also supported by a Korea University grant and a grant from Korea University Medical Center and Anam Hospital, Seoul, Republic of Korea.

Author contributions: Conceptualization: JHK, JMS, THK. Data curation: JHK, YJJ. Formal analysis: JHK, YJJ. Investigation: SUK. Methodology: JHK, YJJ. Project administration: JMS, THK. Resources: SUK, JMS. Supervision: JMS, THK. Validation: all authors. Visualization: YJJ. Writing–original draft: JHK, YJJ. Writing–review & editing: all authors.

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Tables

Tables 1 to 4 are available in the supplementary files section

Figures

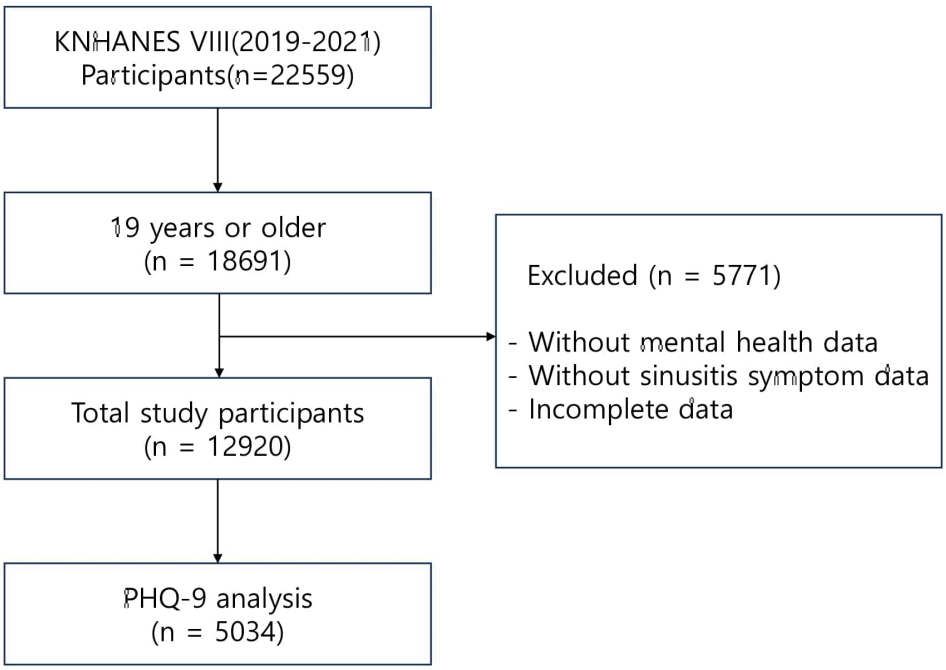


Figure 1

Flow chart used for patient selection, KNHANES: Korean National Health and Nutrition Examination Survey VIII.

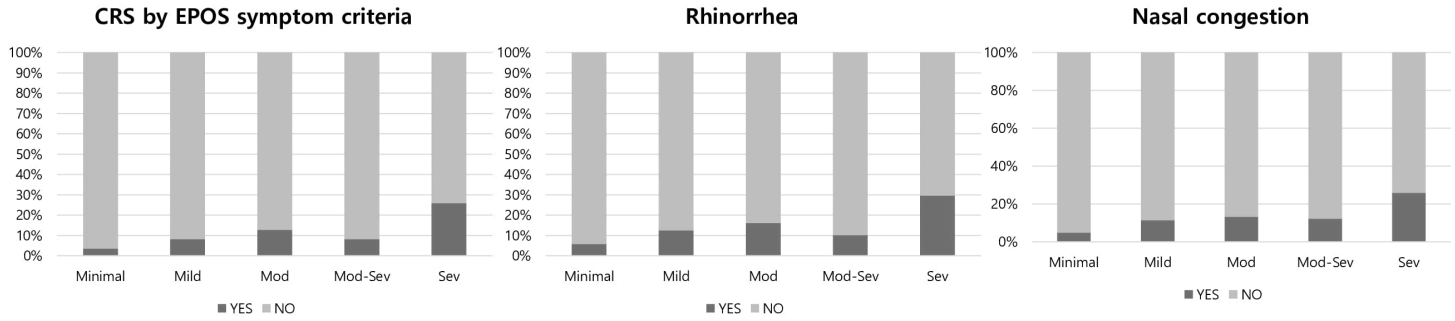


Figure 2

Distribution of CRS patient by levels of depression severity by PHQ-9 score.

Supplementary Files

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