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Occupational and Environmental Risk Factors for Chronic Rhinosinusitis in Saudi Arabia

Abdullah A. Alarfaj[1*], Khalid A. Alyahya[1], Majd A. Alsaleh[2], Almaha A. Aleidan[2], Alaa A. Alrashed[2], Sarah N. Alshehab[2], Sarah W. Albahar[2], Anwar M. Alsaeed[2]

[1]Otorhinolaryngology unit, Department of Surgery, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia.

[2]College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia.

***Corresponding author:** Abdullah A. Alarfaj, Otorhinolaryngology unit, Department of Surgery, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia.

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is a common disease and varies significantly around the world. The proper management of chronic rhinosinusitis is challenging for otorhinolaryngologists due to the variety of occupational and environmental triggers that patients can expose to which leads to flare up of the symptoms.

Objectives: To assess the occupational and environmental risk factors of chronic rhinosinusitis in Saudi Arabia.

Methodology: A prospective, qualitative, questionnaire-based cross-sectional study took place. Seven hundred and three Saudis and non-Saudi residents from different geographical regions in Saudi Arabia were involved in the study. An online Sino-Nasal Outcome Test-22 (SNOT-22) questionnaire is used to estimate CRS symptoms severity to assess the possible occupational and environmental risk factors of CRS. The obtained data were statistically analyzed using SPSS version 21.

Result: Seven hundred and three participants were involved in the study involving the age group from 12 to more than 60 years old. They were 467 females, and 236 males with a male to female ratio of 1.9:1. Six hundred and one of the participants showed significant symptoms according to the SNOT-22 score. Among the participants, 94.6% who have chronic diseases, and 97.8%who have respiratory diseases showed significant symptoms of CRS. According to occupational risk factors, it is found that working in the health field or exposing to chemicals used in farming, hairdressing, or manufacturing is significantly associated with CRS. According to environmental risk factors, it is found that the method used to cook at home, exposure to a dump environment, exposure to pollution, dust, cleaning products, chemicals, or cigarette smoking is significantly associated with CRS with symptom variation seasonally.

Conclusion: A considerable number of factors included in this study showed significant association with CRS. It would be beneficial to do additional experimental research to clarify the biological mechanisms behind the related aspects. In order to prevent and manage CRS in Saudi Arabia, we advise putting protective measures in place and raising awareness of them.

Keywords: *chemical exposure, chronic rhinosinusitis, environmental risk factor, occupational risk factor, severity*

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INTRODUCTION

Chronic rhinosinusitis (CRS) is a long-term infection of the paranasal sinus mucosa presented as two or more symptoms, one of which should be either nasal blockage, obstruction, congestion, or nasal discharge persisting for more than 12 consecutive weeks.[1,2] Control of the CRS symptoms can't be achieved with the optimal management in many patients, which makes it is a prevalent otorhinolaryngologic condition that is commonly seen in daily practice.[3] CRS prevalence varies significantly over the world, with rates ranging from 1.0 % to 12.1%.[4] CRS is clearly linked to a much lower quality of, decreased productivity in the workplace, and significant medical treatment expenditures.[5,6,7]

CRS can be present with nasal polyps (CRSwNP) or without nasal polyps (CRSsNP), the symptoms of each are overlapping.[1] The most common symptoms of CRS are nasal obstruction, nasal discharge, change in the sense of smell, and facial pain.[8] pathophysiology and potential risk factor associated with CRS was of great interest to many researchers. Anatomic variations in the sinonasal area such as concha bullosa, septal deviation, and deviation of the uncinate process are considered risk factors for CRS.[9]

A previous study reported that workplace exposure to gases, fumes, dust, or smoke was linked to a higher prevalence of CRS.[6] coinciding with similar research found that exposure to various common occupational agents, such as hair-care products, super glue, and wood dust can be linked to rhinosinusitis.[2]

Similarly, a recent systematic review study conducted in 2022, found that, smoking and pesticide exposure were the most aggravating environmental factor. Direct interaction with allergens tends to make CRS symptoms more severe. Therefore, people who work in blue-collar professions, such as firemen, farmers, and fishermen, make up the majority of CRS patients.[10]

Despite the fact that CRS is a very common medical complaint worldwide, the occupational and environmental risk factors related to the disease are not thoroughly investigated. There is a lack of research regarding the concept of CRS and its associated risk factors in Saudi Arabia. This study aims to investigate the occupational and environmental risk factors associated with CRS in further detail in Saudi Arabia.

METHOD

A cross-sectional study was conducted among the Saudi Arabia population from November 2022 to March 2023 by using an online questionnaire that was translated into Arabic language and sent out through social media (Whatsapp, Twitter, and Telegram) using Google form, and the responses are automatically captured. This study received approval from the research ethical committee at King Faisal University, Ref. No. KFU-REC-2022-NOV-ETHICS346. An Arabic and English version of the Sino-Nasal Outcome Test-22 questionnaire (SNOT-22) have been used in this research. There were no incentives presented to the participants and the questionnaire was optional. Four sections made up the open questionnaire: the first section's contents are the study's title, its target group, and consent. 13 questions made up the second half, which was personal data. The third section, which contained 19 questions, asked about environmental and occupational risk factors, and the final section, which contained 22 questions, asked about the signs and symptoms of chronic rhino-sinusitis. Simple and straightforward questions were presented. We had 703 participants, which was a significant quantity. The IP check was utilized to prohibit users from accessing the survey more than once while using the same IP address.

The population that was targeted was Saudis or any individuals that lived in Saudi Arabia. Patients with chronic rhinosinusitis and healthy Saudi or foreign residents of Saudi Arabia met the inclusion criteria. Patients under the age of twelve, participants who did not complete the entire questionnaire, and Saudi nationals who did not reside in Saudi Arabia were disqualified from the study.

The Richard Geiger equation was used to establish the sample size, which was set at 385 with a 95% confidence level and a 5% margin of error. Data gathering: After the participants gave their informed consent, some demographic information—such as age, gender, and occupation—was collected. The portion of the patient's impression of environmental and occupational risk factors for chronic rhinosinusitis came next. The signs of chronic rhinosinusitis were the last. The information was then input into Microsoft Excel 2010. The data were collected, reviewed and then fed to Statistical Package for Social Sciences version 21

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(SPSS: An IBM Company). All statistical methods used were two-tailed with an alpha level of 0.05 considering significance if the P value is less than or equal to 0.05. As for CRS severity assessment, SNOT-22 scores for different discrete items were summed. The overall score was categorized as follows; non-significant symptoms for those who had an overall score less than 8, Mild being defined on the SNOT-22 score as 8-20 inclusive, Moderate as >20-50, and Severe as >50. Descriptive analysis was done by prescribing frequency distribution and percentage for study variables including participants' bio-demographic data, work-related data, occupational and environmental factors. SNOT-22 items for CRS symptoms severity were also tabulated. The overall CRS severity was graphed. Cross tabulation to assess factors associated with CRS, besides environmental and occupational risk factors was carried out with Pearson chi-square test for significance and exact probability test if there were small frequency distributions. One-Way ANOVA was used to show distribution of symptoms by chronic rhinosinusitis severity among study participants.

RESULT

A total of 703 eligible participants completed the study questionnaire. Participants' ages ranged from 12 to more than 60 years with mean age of 27.6 ± 13.9 years old. Exact of 467 (66.4%) participants were females. As for educational level, 508 (72.3%) were university graduates. Monthly income less than 5000 SR was reported among 304 (43.2%) participants while 250 (35.6%) had monthly income exceeding 10000 SR. A total of 288 (41%) were employed in the governmental sector while 337 (47.9%) were not employed. Exact 148 (21.1%) had chronic health problems and 89 (12.7%) had respiratory problems which were asthma among 44 (50%), ARS among 25 (28.4%), and RS among 19 (21.6%).

Regarding the prevalence and severity of Chronic Rhinosinusitis in (figure 1), exact of 601 (85.5%) showed significant symptoms of CRS based on the study SNOT-22 scale. It was mild among 140 (19.9%) participants, moderate among 261 (37.1%), and severe among 200 (28.4%).

Table 1. Distribution of symptoms by chronic rhinosinusitis severity among study participants. There was a significant difference for all related SNOT-22 symptoms according to CRS severity among study participants with higher scores among those with severe symptoms and lowest for those with no clinically significant symptoms.

Table 2. Bio-demographic factors and association with Chronic Rhinosinusitis in Saudi Arabia. Exact of all participants aged more than 560 years had significant symptoms for CRS in comparison to 75% of others aged 12-18 years (P=.049). Significant symptoms for CRS were detected among 94.6% of participants with chronic diseases versus 83.1% of others without with recorded statistical significance (P=.001). Also, 97.8% of those with respiratory disease had clinically significant symptoms for CRS in comparison to 83.7% of others without (P=.001).

Table 3. Occupational Risk Factors for Chronic Rhinosinusitis in Saudi Arabia. Among all included occupational factors, all of those who worked in the health field had significant symptoms for CRS versus 84.5% of others (P=.027). Also, CRS was detected among 92.6% of those who were frequently exposed to occupational triggers such as chemicals used in farming, hairdressing, or manufacturing in comparison to 82.8% of those who were never exposed (P=.048). Work and work nature were insignificantly associated with developing significant symptoms for CRS.

Table 4. Environmental Risk Factors for Chronic Rhinosinusitis in Saudi Arabia. CRS significant symptoms were detected among 86.5% of those who use gas to cook at home versus none of those who used Coal/firewood (P=.002). Also, 90.7% of those who were frequently exposed to moldy or dump environments had CRS versus 79.1% of those who were never exposed (P=.002). CRS was detected among 94% of those who were frequently exposed to exhaust fume or other types of pollution versus 78.9% of others who were never exposed (P=.001). A total of 96.2% of those who frequently experience symptoms with dust exposure in comparison to 69.1% of those who never (P=.001). Likewise, 94.6% of those who frequently experience symptoms with pesticides or cleaning products compared to 74.5% of those who never experienced (P=.001). Exact 92.6% of participants frequently experience symptoms with burning fossil fuels or other pollution in comparison to 78.4% of those who never did (P=.001). About 95.5% of participants frequently experience symptoms with chemical or toxic gases exposure versus

76.9% of others who never did (P=.001). CRS was detected among 94.1% of participants who frequently experience symptoms with cigarette smoke versus 77.7% of others who never experienced it (P=.001). A total of 95.2% of those who frequently experience symptoms with perfumes/Bukhoor versus 75.7% of others (P=.001). Additionally, 95.6% of those who frequently experience symptoms with cold or hot air versus 72.9% of those who never (P=.001). A total of 96.4% of participants frequently experience symptoms with season change compared to 65.7% of those who never (P=.001).

DISCUSSION

The current study included 703 participants, most of them were females 467 (66.4%) and 236 (33.6%) were males. The majority age group was made up of 322 (45.8%) people, who were between the ages of 20 and 39. Regarding the prevalence and severity of CRS, according to the SNOT-22 scale used in our study,601 people (85.5%) displayed significant signs of CRS and (28.4%) of them had severe symptoms. In line, a previous study conducted in Saudi Arabia in 2017 reported the prevalence as (79.7%) in the Saudi population. [11] However, it represented only (25.3%) in another Saudi study.[12] While it was (8.0%) in China, and (12.0%) in the USA. [1-13]

Our present study showed no significant difference between males and females, as the percentage of CRS among males was (84.7%) and (85.9%) among females. However, the previous Saudi study reported that the rate of CRS was higher among females than in males at (61.6%).[11] This finding contrasts with that of a Chinese study, which indicated that chronic rhinosinusitis was more common in men than in women in the general population. [1]

Regarding age, (45.3%) of people with chronic sinusitis were between the ages of 19 and 30. Our findings concurred with a prior Saudi investigation, according to which (55.6%) of chronic sinusitis patients were between the ages of 21 and 30. [11] Similarly, Shi JB et al. [1] demonstrated that, in people aged 15 to 34, the prevalence was noticeably greater. The exact reverse was reported by Kim et al. [14] where the lowest frequency was seen in people aged 19 to 29, and the highest incidence was seen in people over 70 in the Korean population, as they explained their findings by the decrease in mucociliary function according to Ho et al. [15]. This indicates the need for further evaluation in people aged 60 and above, as in our study this age group made up only 18 (2.7%) of the respondents in which (100%) of them displayed signs and symptoms of sinusitis.

In other sociodemographic factors such as educational level and income, no significant difference was observed in this present study. In addition to these factors, we found that having chronic illnesses and respiratory conditions greatly enhanced the incidence of CRS, which was in line with several researches' findings that demonstrated a positive relationship between chronic and respiratory diseases and CRS. [1,7,11,12,14]

In our study, there is a correlation between occupational exposure and CRS. However, the influence remains complicated. In the present study, governmental sector workers have higher CRS prevalence compared to other types of jobs. This result is probably because most of the subjects are working in the governmental sector. No previous research found to be working in this correlation. Therefore, more research should be done in the future in this area. Thilsing et al. [16] found elevated CRS prevalence among subjects working in a cleaning job specifically in trades involving industrial cleaning. However, in the present study regarding the nature of the job, no difference in CRS prevalence was observed.

Gao et al. [7] reported that the presence of carpets in the workplace was a significant risk factor for CRS. However, in our study, there is no significant influence of occupational exposure to carpets on CRS prevalence. Healthcare providers like nurses have increased the risk of CRS as a result of their exposure to cleaning products and disinfectants [17]. Therefore, these results resemble our results in this area. Health field workers have a higher CRS prevalence in the present study with a p-value less than 0.05 which is significant. Another study showed no significant correlation between healthcare-related jobs and CRS [7].

Thilsing et al. [16] reported a tendency toward increased risk of CRS among workers with occupational exposure to gases, fumes, dust, or smoke. Dietz de Loos et al. [17] found that 70% of CRS patients with occupational exposure were exposed to irritants, 37% to LMW sensitizers,

and 23% exposure to HMW sensitizers. Similarly, in the present study, we found 92.6% of subjects who are frequently exposed to chemicals used in farming, hairdressing, or manufacturing have CRS which showed a strong association between occupational exposure to chemicals used in farming, hairdressing or manufacturing and CRS prevalence.

We found that certain factors were significantly linked to a higher prevalence of the condition. These factors included air pollution, cigarette smoke, dampness, cleaning products, perfumes or bukhor exposure, and seasonal change. On the other hand, factors such as pet ownership, residency weather, residency in urban or rural areas, and method of keeping warm showed no significant correlation with CRS occurrence.

The literature has a debate regarding the link between cigarette smoking and CRS [10,16,19-21]. Our study found a significant correlation between cigarette smoking and CRS, of 187 (26.6%) participants exposed to cigarette smoke,178 (94.1%) were diagnosed with CRS. Therefore, findings were consistent with recent systematic reviews that have identified

smoking exposure is one of the most aggravating environmental factors for CRS patients [10]. The finding is further supported by the idea that tobacco smoke contains carcinogens and irritants that can damage the sinonasal mucosa, impairing mucociliary clearance and causing inflammation and infection [18]. However, some studies have found no significant association between cigarette smoking and CRS [19-21]. Nonetheless, smoking has been linked to poorer postoperative outcomes and impaired quality of life, emphasizing the need for increased awareness of tobacco smoke risks in CRS [21,22].

A cross-sectional study conducted in Sweden by Pind et al. [23] demonstrated an independent association between dampness at home and CRS in adults. Another study showed that dampness and molds at home increase the onset of asthma symptoms, and rhinitis and decrease the remission rate [24]. Those findings are consistent with this study's results. Nonetheless, it must be mentioned that only a small number of our sample were frequently exposed 75(10.7%).

The present study found that 116 (16.5%) of participants were frequently exposed to air pollution and exhaust fumes, with 109 (94%) having CRS, indicating the significant role of air pollution in CRS. However, caution is necessary while interpreting these results, and further studies, including dose exposure association, are required to establish a stronger correlation. Kim et al. [25] showed that traffic exposure to Diesel exhaust particles increases interleukin- 6 and interleukin-8 expression and disturbs epithelium integrity. People living near heavy traffic with higher exposure to air pollution reported nasal symptoms permanently or recurrently [26]. People exposed to occupational airborne pollutants were most likely to require FESS and corticosteroids [27]. In contrast, research conducted on residents of Taiwan revealed a there was only minimal correlation between chronic rhinosinusitis and air pollutants at moderate levels of exposure [28].

Indoor air pollution has emerged as an additional risk factor for CRS. As demonstrated by a study done in China, using firewood and charcoal as a method of keeping warm in winter was associated with an increased risk of developing CRS [7]. Contrarily, the current study found no significant relation between CRS and the method of heating. However, it should be noted that only 22 (3.1%) of our sample participants used charcoal; differences in culture and climate between countries may contribute to this discrepancy.

Our study found that exposure to perfumes and burning incense (bukhor); a widespread cultural and religious practice in Asian and Arabian Gulf countries, poses a potential risk for CRS. Dalibalta et al. [29] reported Inhaled bukhor smoke containing carcinogenic and toxic compounds that can irritate the eyes, skin, respiratory, and digestive tracts. Other studies have also shown that occupational exposure to incense smoke in temples and working bukhor shops can increase the risk of nose and throat irritation and impair lung function [30,31].

Studies in the western region of Saudi Arabia, China, and Telemark showed no static significance between pet ownership or animal exposure and CRS [7,19,32]. Similarly, in the present study, no statistically significant associations were detected. Our study showed comparable results regarding the cleaning product and dust exposure as Clarhed et al. [32] where they had a significant association with the prevalence of CRS.

While this study has provided valuable insights into the occupational and environmental risk factors of chronic rhinosinusitis (CRS), it is essential to acknowledge its limitations. Firstly, our study relied solely on self-reported symptoms to diagnose CRS without documenting objective evidence of inflammation through imaging or endoscopy. This may have led to the mislabeling of non-CRS patients as having CRS, which could have affected the accuracy of our findings. Additionally, our study did not include questions about exposure measurement, such as the dose, duration, and intensity of potential environmental factors that could contribute to CRS. This limited our ability to understand the relationship between environmental factors and CRS fully. Furthermore, it is essential to note that our study did not cover various age groups equally, and therefore our findings might not be generalizable to the broader population.

Despite these limitations, our study provides valuable insights into the risk factors of CRS, particularly in the context of the Saudi Arabian culture, where this topic is under-researched. As one of the few studies conducted on this topic in Saudi Arabia, our findings can help shape future regional research.

Looking forward, we recommend that future studies build on our findings by incorporating objective evidence of inflammation through imaging or endoscopy and documenting face-to-face interviews in clinics to increase the accuracy of diagnosis. Additionally, future studies should investigate exposure measurement and involve different age groups to provide a more comprehensive understanding of CRS risk factors. Conducting further experimental studies to elucidate the biological mechanisms underlying the associated factors would be valuable. We also recommend establishing and increasing awareness about protective measures to prevent and manage CRS in Saudi Arabia.

CONCLUSION

Occupational and environmental risk factors have effects on chronic rhinosinusitis patients. Our study discovered that having chronic illnesses and respiratory conditions increased the likelihood of CRS significantly. A link exists between occupational exposure and CRS. Employees in the healthcare sector have a high CRS incidence due to exposure to cleaning agents and disinfectants. CRS was found in subjects who were frequently exposed to chemicals used in farming, hairdressing, or manufacturing. There was a high association between occupational exposure to chemicals used in farming, hairdressing, or manufacturing and CRS occurrence. Particular factors were shown to be substantially associated with a greater prevalence of the condition. There is a significant correlation between CRS and cigarette smoking, exposure to air pollution and exhaust fumes, and exposure to perfumes and burning incense (bukhor). It would be beneficial to conduct more experimental research to clarify the biological mechanisms underlying the related factors. We also advocate promoting and raising awareness regarding CRS prevention and management techniques in Saudi Arabia.

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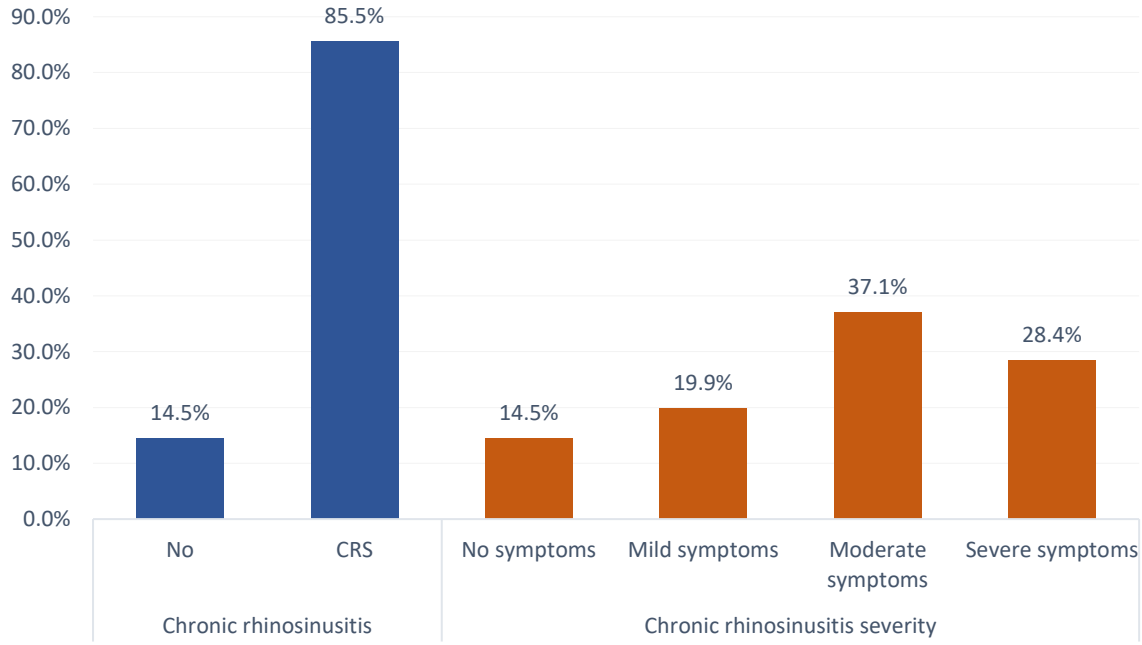

FIGURE 1: Prevalence and severity of Chronic Rhinosinusitis in Saudi Arabia

TABLE 1: Distribution of symptoms by chronic rhinosinusitis severity among study participants

Symptoms	Chronic rhinosinusitis severity								p-value
	No symptoms		Mild symptoms		Moderate symptoms		Severe symptoms		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Need to blow nose	.28	.65	.74	.89	1.58	1.30	2.60	1.61	.001*
Sneezing	.34	.62	.99	.97	1.67	1.23	2.79	1.56	.001*
Runny nose	.18	.38	.96	.91	1.75	1.24	3.08	1.41	.001*
Nasal blockage	.25	.56	1.11	1.11	2.11	1.27	3.67	1.29	.001*
Decrease the sense of smell\ taste	.03	.17	.33	.81	1.02	1.38	2.48	1.83	.001*
Cough	.17	.45	.81	1.07	1.56	1.30	2.77	1.58	.001*
Post-nasal discharge	.09	.29	.59	.88	1.26	1.18	2.95	1.46	.001*
Thick nasal discharge	.12	.32	.68	.81	1.49	1.20	3.17	1.42	.001*
Ear fulness	.11	.34	.72	.96	1.64	1.26	3.18	1.43	.001*

Dizziness	.01	.10	.41	.72	1.15	1.26	2.54	1.62	.001*
Ear pain	.04	.24	.50	.84	1.15	1.12	2.58	1.62	.001*
Facial pain \ pressure	.03	.17	.29	.63	1.02	1.13	2.69	1.77	.001*
Difficulty falling asleep	.06	.31	.46	.80	1.62	1.26	3.66	1.36	.001*
Wake up at night	.11	.37	.56	.90	1.65	1.28	3.57	1.42	.001*
Lack of a good night's sleep	.01	.10	.56	.81	1.62	1.34	3.54	1.52	.001*
Wake up tired	.12	.41	.79	.92	2.07	1.38	3.77	1.27	.001*
Fatigue	.08	.30	.75	.82	2.17	1.32	3.76	1.18	.001*
Reduced productivity	.04	.31	.75	.95	1.60	1.19	3.41	1.24	.001*
Reduced concentration	.07	.29	.71	.88	1.88	1.25	3.46	1.28	.001*
Frustrated \restless\irritable	.04	.20	.75	.90	1.91	1.32	3.69	1.21	.001*
Sad	.14	.56	.74	1.04	1.63	1.38	3.20	1.57	.001*
Embarrassed	.08	.54	.25	.55	.93	1.21	2.31	1.82	.001*

P: One Way ANOVA

* P < 0.05 (significant)

TABLE 2: Bio-demographic factors and association with Chronic Rhinosinusitis in Saudi Arabia

Bio-demographic factors	**Chronic rhinosinusitis**				**p-value**
	Non		**CRS**		
	No	**%**	**No**	**%**	
Age in years					.049*$
12-18	9	25.0%	27	75.0%	
19-30	50	15.5%	272	84.5%	
31-40	20	16.5%	101	83.5%	
41-50	13	9.2%	128	90.8%	
51-60	10	15.4%	55	84.6%	
> 60	0	0.0%	18	100.0%	
Gender					.690
Male	36	15.3%	200	84.7%	
Female	66	14.1%	401	85.9%	
Educational level					.144
Below secondary	5	31.3%	11	68.8%	
Secondary education	23	16.9%	113	83.1%	
University graduate	70	13.8%	438	86.2%	
Post-graduate degree	4	9.3%	39	90.7%	
Monthly income					.681
< 5000 SR	48	15.8%	256	84.2%	
5000-10000 SR	21	14.1%	128	85.9%	
> 10000 SR	33	13.2%	217	86.8%	
Chronic diseases					.001*
Yes	8	5.4%	140	94.6%	
No	94	16.9%	461	83.1%	

Do you have any respiratory disease					.001*
Yes	2	2.2%	87	97.8%	
No	100	16.3%	514	83.7%	

P: Pearson X^2 test $: Exact probability test

* P < 0.05 (significant)

TABLE 3: Occupational Risk Factors for Chronic Rhinosinusitis in Saudi Arabia

Occupational factors	**Total**		**Chronic rhinosinusitis**				**p-value**
			No		**CRS**		
	No	**%**	**No**	**%**	**No**	**%**	
Work							
Unemployed	337	47.9%	53	15.7%	284	84.3%	.430
Governmental sector	288	41.0%	36	12.5%	252	87.5%	
Private sector	62	8.8%	9	14.5%	53	85.5%	
Free business	16	2.3%	4	25.0%	12	75.0%	
If you work in the health field, did your job cause you a sinus attack							.027*$
Yes	27	9.7%	0	0.0%	27	100.0%	
No	251	90.3%	39	15.5%	212	84.5%	
Nature of your job							.558
Office work	324	46.1%	42	13.0%	282	87.0%	
Outdoor work	52	7.4%	8	15.4%	44	84.6%	
Industrial	327	46.5%	52	15.9%	275	84.1%	
Is there carpet at work							.982
Yes	213	30.3%	31	14.6%	182	85.4%	
No	490	69.7%	71	14.5%	419	85.5%	
Are you exposed to occupational trigger such as chemicals used in farming, hairdressing or manufacturing							.048*
Never	354	50.4%	61	17.2%	293	82.8%	
Rarely	295	42.0%	37	12.5%	258	87.5%	
Frequently	54	7.7%	4	7.4%	50	92.6%	

P: Pearson X^2 test $: Exact probability test

* P < 0.05 (significant)

TABLE 4: Environmental Risk Factors for Chronic Rhinosinusitis in Saudi Arabia

Environmental factors		**Total**		**Chronic rhinosinusitis**				**p-value**
				No		**CRS**		
		No	**%**	**No**	**%**	**No**	**%**	
How would you describe the weather in your residency place	Dusty weather	290	41.3%	33	11.4%	257	88.6%	.065
	Humid weather	164	23.3%	23	14.0%	141	86.0%	
	Clear weather	249	35.4%	46	18.5%	203	81.5%	
The neighbored you live in	Urban	562	79.9%	81	14.4%	481	85.6%	.885

	Rural	141	20.1%	21	14.9%	120	85.1%	
Method used to cook at home	Gas	490	69.7%	66	13.5%	424	86.5%	.002*$
	Electric	211	30.0%	34	16.1%	177	83.9%	
	Coal/firewood	2	.3%	2	100.0%	0	0.0%	
Method of keeping warm at winter	Oil heater	64	9.1%	11	17.2%	53	82.8%	.496$
	Electric heater	406	57.8%	54	13.3%	352	86.7%	
	Gas heater	15	2.1%	1	6.7%	14	93.3%	
	Coal/ fireplace	22	3.1%	2	9.1%	20	90.9%	
	None	196	27.9%	34	17.3%	162	82.7%	
Are you exposed to moldy or dump environment	Never	244	34.7%	51	20.9%	193	79.1%	.002*
	Rarely	384	54.6%	44	11.5%	340	88.5%	
	Frequently	75	10.7%	7	9.3%	68	90.7%	
Are you exposed to exhaust fume or other types of pollution	Never	223	31.7%	47	21.1%	176	78.9%	.001*
	Rarely	364	51.8%	48	13.2%	316	86.8%	
	Frequently	116	16.5%	7	6.0%	109	94.0%	
Do you experience symptoms with dust exposure	Never	181	25.7%	56	30.9%	125	69.1%	.001*
	Rarely	256	36.4%	36	14.1%	220	85.9%	
	Frequently	266	37.8%	10	3.8%	256	96.2%	
Do you experience symptoms with pesticide or cleaning products	Never	184	26.2%	47	25.5%	137	74.5%	.001*
	Rarely	260	37.0%	41	15.8%	219	84.2%	
	Frequently	259	36.8%	14	5.4%	245	94.6%	
Do you experience symptoms with the burning fossil fuels or other pollution	Never	264	37.6%	57	21.6%	207	78.4%	.001*
	Rarely	264	37.6%	32	12.1%	232	87.9%	
	Frequently	175	24.9%	13	7.4%	162	92.6%	
Do pets in the house cause a sinus attack	Yes	106	15.1%	17	16.0%	89	84.0%	.853
	No	76	10.8%	10	13.2%	66	86.8%	
	No animals	521	74.1%	75	14.4%	446	85.6%	
Do you experience symptoms with chemical or toxic gases exposure	Never	255	36.3%	59	23.1%	196	76.9%	.001*
	Rarely	250	35.6%	34	13.6%	216	86.4%	
	Frequently	198	28.2%	9	4.5%	189	95.5%	
Do you experience symptoms with cigarette smoke	Never	242	34.4%	54	22.3%	188	77.7%	.001*
	Rarely	274	39.0%	37	13.5%	237	86.5%	
	Frequently	187	26.6%	11	5.9%	176	94.1%	
Do you experience symptoms with perfumes/Bukhoor	Never	259	36.8%	63	24.3%	196	75.7%	.001*
	Rarely	257	36.6%	30	11.7%	227	88.3%	
	Frequently	187	26.6%	9	4.8%	178	95.2%	
Do you experience symptoms with cold or hot air	Never	221	31.4%	60	27.1%	161	72.9%	.001*
	Rarely	257	36.6%	32	12.5%	225	87.5%	
	Frequently	225	32.0%	10	4.4%	215	95.6%	
Do you experience symptoms with season change	Never	166	23.6%	57	34.3%	109	65.7%	.001*
	Rarely	257	36.6%	35	13.6%	222	86.4%	
	Frequently	280	39.8%	10	3.6%	270	96.4%	

P: Pearson X^2 test $: Exact probability test

* $P < 0.05$ (significant)