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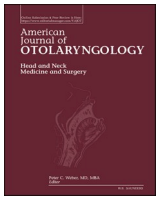

Iranian females report more severe symptoms on the SNOT-22: A cross-sectional population-based study

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ABSTRACT

Purpose: Rhinosinusitis encompasses a group of conditions characterized by inflammation of the nasal mucosa and paranasal sinuses, impacting the quality of life for those affected. This study was designed to assess the quality of life in the general population using the SNOT-22 questionnaire.
This study was designed to assess quality of life among the general population using the SNOT-22 questionnaire, which is a tool for measuring quality of life related to rhinological issues.
Material and methods: This population-based cross-sectional study was conducted as part of the baseline assessment for the Hoveyzeh cohort study, focusing on adults aged 35–70 in southwest Iran. Data related to socioeconomic factors, demographic characteristics, and anthropometric measurements were gathered. Subsequently, a random sample of 1324 individuals participated in the study, completing the Self-reported SNOT-22 questionnaire.
Result: The mean age of 1324 participants was 49.92 ± 8.97 years, and about 60 % were women. The average SNOT-22 score was 7.84 ± 10.78. Approximately 34 % of the participants had an abnormal score on the SNOT-22 questionnaire. These participants were assessed for domains related to nasal, otologic, sleep and emotional symptoms. The most common issues reported were sneezing, dizziness or vertigo, waking up tired, and feelings of sadness, respectively. We observed that the odds of having an abnormal SNOT-22 scores were 62 % higher in women compared to men.
Conclusion: Our results revealed a relatively higher prevalence of abnormal SNOT-22 scores, especially among women. Therefore, designing and implementing therapeutic and educational interventions for these people seems necessary.

1. Introduction

Rhinosinusitis is a group of diseases associated with inflammation of the nasal mucosa and paranasal sinuses [1]. According to The European Position Paper on rhinosinusitis and nasal polyps (EPOS) 2020, chronic rhinosinusitis is defined as the presence of two or more symptoms, one of which should be either nasal blockage /obstruction /congestion or nasal discharge (anterior/ posterior nasal drip) or/ and facial pain/pressure or/ and reduction or loss of smell; for ≥12 weeks [2]. Chronic rhinosinusitis is a common disease in the world. It is estimated that 31 million people in the United States are diagnosed with this disease yearly [3]. A study in the Netherlands reported that this disease affects 5–12 % of the general population [4]. The prevalence of rhinosinusitis is relatively high (up to 20 % in some places) in Iran, and chronic rhinosinusitis is considered a major public health problem [5]. Additionally, healthcare costs for rhinosinusitis are much higher than other diseases, such as peptic ulcer disease or acute asthma [6]. In the United States of America, direct costs for managing the treatment of chronic rhinosinusitis are estimated between 10 and 30 billion dollars per year [7].

Some studies showed chronic rhinosinusitis often causes absenteeism from work and school, sleep disturbances, and olfactory disturbances [8] and greatly impacts patients' daily activities. It has been shown that

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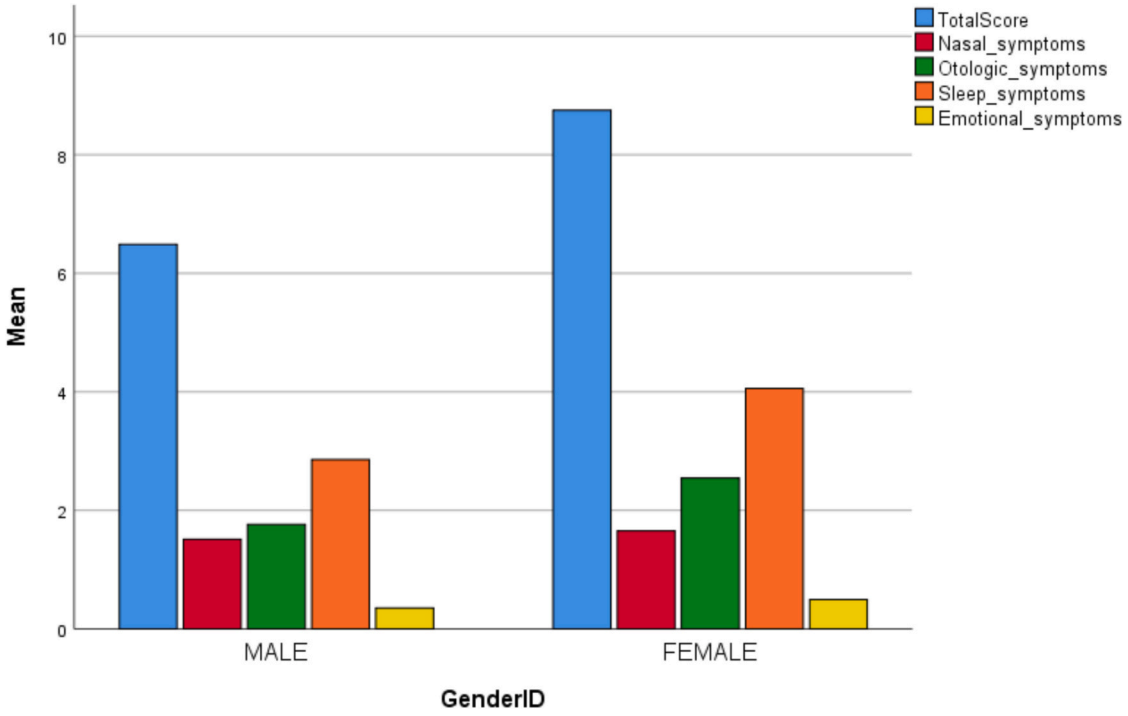

Fig. 1. Mean SNOT-22 score and domains of the SNOT-22 questionnaire by gender.

chronic rhinosinusitis has a higher negative impact on people's quality of life than people without the disease and even compared to people with other chronic diseases, such as congestive heart failure and obstructive pulmonary disease [9]. Special questionnaires are widely used to evaluate the severity of symptoms of chronic rhinosinusitis and can adapt more details of the symptoms of the disease than general instruments. They are more sensitive in detecting their differences after therapeutic interventions. The severity of symptoms of chronic rhinosinusitis, measured by specific questionnaires for measuring the quality of life, is usually shown as a symptom score [10]. Among the specific tools, the 22-item Sino-Nasal Outcome Test (SNOT-22) questionnaire has been introduced as the best tool for determining the quality of life of people with chronic rhinosinusitis [10]. SNOT-22 is a specific questionnaire with high validity that evaluates the severity of rhinosinusitis and its impact on quality of life [10] and is easy to use [11]. While the questionnaire was originally developed to measure the physical, functional, and emotional consequences of rhinosinusitis, it has been validated and adapted for use in various patient populations, including those with allergic rhinitis, and even in a non-rhinosinusitis UK-wide population [11–14]. This questionnaire has been translated into different languages, including Persian, and its validity has been proven [2,15–18] and is considered an internationally recognized valid questionnaire in the management of chronic rhinosinusitis [19].

The SNOT-22 questionnaire can provide valuable information about the impact of sinonasal symptoms on quality of life, which can be used to guide treatment decisions and improve patient outcomes. Additionally, evaluating the quality of life in the general population can help identify areas where public health interventions may be needed to improve overall health and well-being. Despite the clinical importance of assessing the quality of life of these patients, studies focused on this issue in our area are limited. Additionally, there is a lack of research examining the impact of risk factors on SNOT-22 scores. Therefore, we designed the present study to evaluate the prevalence of CRS base on SNOT in our participants.

2. Material and methods

2.1. Design and participants study

This population-based cross-sectional study was conducted on 10,009 people who entered the enrollment phase of the Hoveyzeh cohort study [20]. The Hoveyzeh cohort study is part of the PERSIAN cohort as a population-based prospective epidemiological study investigating the prevalence, incidence, and risk factors of non-communicable diseases in the Iranian adult population aged 35 to 70 [21,22]. In this study, the included criteria were ages of 35–70 years old, living in Hoveyzeh, and having the ability to answer the Self-report questionnaire without the help of others.

2.2. Sample size and sampling method

To determine the minimum sample size, we used the formula for estimating a population proportion. For this purpose, $\alpha = 0.1$, $p = 0.2(5)$, $d = 0.02$, and allow for loss of 15 % of subjects. A minimum sample size of 1274 was estimated. Finally, among the 10,009 participants in the Hoveyzeh cohort study, 1324 were randomly selected for our study and completed the SNOT-22 questionnaire.

2.3. SNOT-22 questionnaire

The SNOT-22 questionnaire contains 22 questions about possible symptoms related to chronic rhinosinusitis. Each question receives a score between 0 and 5, where a score of zero confirms the absence of that symptom, and the number 5 indicates the worst situation related to that symptom [19]. The final score (range 0–110) is obtained from the total scores of each item, and the higher score means the worse quality of life. Gillet et al. [23] performed a pilot study examining the SNOT-22 score in adults without sinonasal disease to establish what a normal SNOT-22 score is. They concluded that in a clinical setting, a SNOT-22 score of 7 should be considered a benchmark for “normal”. According to the score obtained in the SNOT-22 questionnaire, we divided the people into two groups: a normal score of 7 and below and an abnormal score of >7.

Table 1
Prevalence of symptoms in different domain and items of SNOT-22 by gender.

Domain	Item number	Item wording	Sex									
			Male					Female				
			Scores					Scores				
			0	1	2	3	4	0	1	2	3	4
Nasal symptoms	1	Need to blow your nose	469 (90.9)	23 (4.5)	11 (2.1)	12 (2.3)	1 (0.2)	727 (93.8)	18 (2.3)	9 (1.2)	19 (2.5)	2 (0.3)
	2	Sneezing	430 (83.3)	39 (7.6)	17 (3.3)	17 (3.3)	13 (2.5)	657 (84.8)	41 (5.3)	21 (2.7)	42 (5.4)	14 (1.8)
	3	Running nose	457 (88.6)	15 (2.9)	9 (1.7)	21 (4.1)	14 (2.7)	667 (86.1)	25 (3.2)	16 (2.1)	51 (6.6)	16 (2.1)
	4	Cough	458 (88.8)	21 (4.1)	17 (3.3)	13 (2.5)	7 (1.4)	669 (86.3)	28 (3.6)	14 (1.8)	35 (4.5)	29 (3.7)
	5	Post-nasal discharge	501 (97.1)	4 (0.8)	3 (0.6)	8 (1.6)	0 (0.00)	744 (96.0)	8 (1.0)	2 (0.3)	18 (2.3)	3 (0.4)
	6	Thick nasal discharge	501 (97.1)	4 (0.8)	3 (0.6)	8 (1.6)	0 (0.00)	743 (95.0)	7 (0.9)	6 (0.8)	15 (1.9)	4 (0.5)
	21	Difficulty feeling 'smells' or 'tastes'	496 (96.1)	5 (1.0)	3 (0.6)	9 (1.7)	3 (0.6)	733 (94.6)	18 (2.3)	5 (0.6)	17 (2.2)	2 (0.3)
	22	Stuffed nose	459 (89.0)	19 (3.7)	12 (2.3)	20 (3.9)	5 (1.2)	724 (93.4)	8 (1.0)	18 (2.3)	23 (3.0)	2 (0.3)
Otologic symptoms	7	A feeling of a full or stuffed ear	370 (71.7)	29 (5.6)	49 (9.5)	61 (11.8)	7 (1.4)	548 (70.7)	47 (6.1)	58 (7.5)	118 (15.2)	4 (0.5)
	8	Dizziness or vertigo	346 (67.1)	38 (7.4)	44 (8.5)	80 (15.5)	8 (1.6)	398 (51.4)	60 (7.7)	66 (8.5)	227 (29.3)	24 (3.1)
	9	Earache	456 (88.4)	13 (2.5)	14 (2.7)	30 (5.8)	3 (0.6)	628 (81.0)	19 (2.5)	35 (4.5)	89 (11.5)	4 (0.5)
	10	Facial pain or pressure	503 (97.5)	4 (0.8)	1 (0.2)	7 (1.4)	1 (0.2)	735 (94.8)	7 (0.9)	8 (1.0)	25 (3.2)	0 (0)
Sleep symptoms	11	Difficulty sleeping	443 (85.9)	12 (2.3)	14 (2.7)	39 (7.6)	8 (1.6)	588 (75.9)	38 (4.9)	29 (3.7)	113 (14.6)	7 (0.9)
	12	Wake up in the middle of the night	424 (82.2)	22 (4.3)	17 (3.3)	47 (9.1)	6 (1.2)	566 (73.0)	51 (6.6)	29 (3.7)	119 (15.4)	10 (1.3)
	13	Lack of a good night's sleep	430 (83.3)	16 (3.1)	18 (3.5)	44 (8.5)	8 (1.6)	586 (75.6)	28 (3.6)	25 (3.2)	124 (16.0)	12 (1.5)
	14	Wake up tired	392 (76.0)	23 (4.5)	19 (3.7)	67 (13.0)	15 (2.9)	504 (65.0)	61 (7.9)	28 (3.6)	158 (20.4)	24 (3.1)
	15	Fatigued or tired during the day	409 (79.3)	21 (4.1)	17 (3.3)	54 (10.5)	15 (2.9)	603 (77.8)	41 (5.3)	24 (3.1)	90 (1.6)	17 (2.2)
	16	Reduced productivity	478 (92.6)	8 (1.6)	6 (1.2)	18 (3.5)	6 (1.2)	688 (88.8)	22 (2.8)	9 (1.2)	44 (5.7)	12 (1.2)
	17	Reduced concentration	490 (95.0)	7 (1.4)	0 (0.00)	15 (2.9)	4 (0.8)	703 (90.7)	24 (3.1)	0 (0.00)	38 (4.9)	10 (1.3)
	18	Frustrated, restless or irritated	487 (94.4)	3 (0.6)	5 (1.0)	16 (3.1)	5 (1.0)	709 (91.5)	17 (2.2)	7 (0.9)	34 (4.4)	8 (1.0)
Emotional symptoms	19	Sadness	477 (92.4)	7 (1.4)	7 (1.4)	17 (3.3)	8 (1.6)	684 (88.3)	26 (3.4)	11 (1.4)	41 (5.3)	13 (1.7)
	20	A feeling of shame	489 (94.8)	2 (0.4)	4 (0.8)	16 (3.1)	5 (1.0)	714 (92.1)	13 (1.7)	5 (0.6)	35 (4.5)	8 (1.0)

2.4. Covariants

Variables in this analysis included age groups (35–39, 40–44, 45–49, 50–54, 55–59, 60–64 and ≥65 years), sex (male, female), residence type (urban and rural), educational level (Illiteracy, Primary school, Secondary school, High school Diploma, University). The physical activity score based on the Metabolic Equivalent Task (MET) was categorized into quartiles in our analysis. Body Mass Index categorized to <18.5 = underweight, 18.5–24.9 = normal, 25.0–29.9 = overweight, and ≥30 = obese. The Wealth Index is a composite measure of the cumulative living standard of a household. It is calculated using data on a household's ownership of a selected set of assets, such as televisions, bicycles, cars [24] computers, etc. The Wealth Index score converts Quintiles from the poorest to the richest. A smoker is defined as an individual who has smoked at least 100 cigarettes in his lifetime.

2.5. Statistical analysis

Descriptive statistics were performed for quantitative variables by mean, standard deviation, and categorical variables by frequency and percentage. The Chi-square test evaluated the association between the SNOT-22 score category and demographic variables, socioeconomic status, anthropometric measurements, and physical activity. We used multi-level logistic regression, controlling for confounding factors. In the univariate analysis, the criterion for entering variables into multiple regression models was $P < 0.25$. All reported p-values were based on two-tailed tests and considered to have a significance level of 0.05. Stata software version 14.0 was utilized for the statistical analysis.

3. Results

In this population-based cross-sectional study, a total of 1324 participants were assessed. The participants had a mean age of 49.92 ± 8.97 years, and approximately 60 % of them were women. The Mean ± Standard Deviation (SD) of the total score SNOT-22 questionnaire was 7.84 ± 10.78. The Mean ± SD scores for the Nasal symptoms, Otologic symptoms, Sleep symptoms, and Emotional symptoms domains of the SNOT-22 questionnaire were 1.6 ± 3.6, 2.23 ± 2.74, 3.57 ± 6.14 and 0.44 ± 1.49, respectively. A comparison of the mean SNOT-22 score and domains of the SNOT-22 questionnaire by gender is depicted in Fig. 1. In the study population, 1.7 % ($n = 22$) had undergone nasal surgery, 12.5 % ($n = 165$) used nasal sprays, and 2.3 % ($n = 30$) had nasal polyps.

Table 2
Association between SNOT-22 with demographic, life style and socioeconomic characteristics of the study participants.

Variables		SNOT-22		P-value
		Normal	Abnormal	
Age group	35–39	124 (68.1)	58 (31.9)	0.637
	40–44	163 (70.6)	68 (29.4)	
	45–49	154 (65.5)	81 (34.5)	
	50–54	149 (64.2)	83 (35.8)	
	55–59	127 (62.9)	75 (37.1)	
	60–64	76 (65.5)	40 (34.5)	
	≥65	58 (62.4)	35 (37.6)	
Sex	Male	376 (72.9)	140 (27.1)	**<0.001***
	Female	475 (61.3)	300 (38.7)	
Educational levels	Illiterate	537 (62.2)	326 (37.8)	**0.002***
	Primary school	138 (73.0)	51 (27.0)	
	Secondary school	51 (68.9)	23 (31.1)	
	High school diploma	63 (74.1)	22 (25.9)	
	University	62 (77.5)	18 (22.5)	
Residence type	Urban	527 (67.1)	258 (32.9)	0.251
	Rural	324 (64.0)	182 (36.0)	
Wealth index	Poorest	141 (60.3)	93 (39.7)	0.153
	Poor	161 (64.9)	87 (35.1)	
	Moderate	168 (64.6)	92 (35.4)	
	Rich	183 (68.8)	83 (31.2)	
	Richest	198 (70.0)	85 (30.0)	
BMI	Underweight	9 (81.8)	2 (18.2)	0.263
	Normal	170 (63.0)	100 (37.0)	
	Overweight	332 (68.5)	153 (31.5)	
	Obese	340 (64.8)	185 (35.2)	
Physical activity (MET)	Q1	218 (62.8)	129 (37.2)	0.552
	Q2	209 (67.4)	101 (32.6)	
	Q3	214 (67.3)	104 (32.7)	
	Q4	210 (66.5)	106 (33.5)	
Smoking	Yes	178 (68.2)	83 (31.8)	0.384
	No	673 (65.3)	357 (34.7)	

* $P < 0.05$ was considered a statistically significant level in the chi-square test.

Nasal surgery was performed because of a broken nose ($n = 8$) and deviated nasal septumE ($n = 14$). Our study revealed that the average SNOT-22 score was significantly higher in individuals with a history of nasal polyps (7.68 ± 10.56 vs. 15.03 ± 16.44; $p < 0.001$). Among individuals who had undergone nose surgery the SNOT score was higher than that of those without a history of nose surgery, but this difference was not statistically significant (8.09 ± 10.12 vs.7.84 ± 10.79; $p = 0.914$).

In the domain of nasal symptoms, sneezing was the most prevalent issue in both men and women. In the domains of otologic symptoms, Sleep symptoms, and Emotional symptoms, the prevalent disorders were dizziness or vertigo, waking up feeling tired, and Sadness, respectively (Table 1).

In our study, over 30 % (33.9 %) of the participants exhibited an abnormal score on the SNOT-22 questionnaire. The results of the Chi-square test are shown in Table 2. We observed a significant association between the SNOT-22 score and sex ($p < 0.001$), while the level of education demonstrated an inverse relationship with an abnormal SNOT-22 score ($p = 0.002$). Conversely, we found no statistically significant association between age, residence type, wealth index, BMI, physical activity, and smoking with SNOT-22 score ($P > 0.05$).

The Logistic Regression Model was utilized to calculate both crude and adjusted odds ratios in order to evaluate the strength of associations and control the potential confounders. The crude odds ratios were statistically significant for sex, educational level, and wealth status ($p < 0.05$). All variables with a p-value<0.25 were included in the multiple logistic regression model. In the final step of the model, only adjusted odds ratio for sex remained statistically significant ($p < 0.05$). Therefore, the odds of having an abnormal SNOT-22 score in women were 62 % higher than in men. The odds ratios and their confidence intervals of 95 % are reported in Table 3.

4. Discussion

We conducted an assessment of the SNOT-22 questionnaire and its associated risk factors among individuals aged 35 to 70 years in the southwest region of Iran. Our study revealed that >30 % of the participants exhibited abnormal scores on the SNOT-22 questionnaire. Notably, in the domain of nasal symptoms, sneezing was the most prevalent issue among both men and women. Additionally, the common disorders observed in the domains of Otologic symptoms, Sleep symptoms, and Emotional symptoms were Dizziness or vertigo, Waking up tired, and Sadness, respectively. Our findings indicated that the odds of having an abnormal SNOT-22 score were 62 % higher in women compared to men.

Previous studies have demonstrated sex-based differences in SNOT-22 scores for chronic rhinosinusitis, with females generally scoring higher overall and in specific areas [25,26]. Patient factors such as age, sex, and comorbidities can influence changes in SNOT-22 scores following treatment [27]. This discrepancy is likely due to a systematic variation in response style. It is possible that women perceive a greater burden or are more comfortable reporting the full extent of their symptoms, especially those individuals who are more inclined towards the “emotional” aspects of their condition [11].

Our results study showed that sneezing was the most common nasal symptom among both men and women. Previous studies have shown sex-based differences in the nasal symptom domain of the SNOT22 questionnaire for patients with chronic rhinosinusitis, but findings have been inconsistent. Some studies have reported higher scores for females in other domains or overall but not in the nasal symptom domain. Others have found no significant differences in this area at all [25,28–30]. Therefore, the gender disparities related to nasal symptom domains in the SNOT-22 questionnaire among patients with chronic rhinosinusitis are unclear and require further investigation. Sneezing is a common symptom associated with different conditions such as allergies, colds, and viral infections [31–33].

In this study, the most common Otologic symptoms in both men and women were dizziness [34,35]. Medications can also be a contributing factor, as certain drugs may induce dizziness as a side effect [36].

According to this study, a common complaint among patients in the sleep symptom domain of the SNOT-22 questionnaire is sleep disruption or dysfunction. Consistent with the research, patients with chronic rhinosinusitis (CRS) are susceptible to sleep disruption. This can be attributed to factors such as allergic rhinitis, smoking, and high SNOT-22 total scores [37].

A study by Khan et al. found that sleep problems are included in the SNOT-22 questionnaire for patients with chronic rhinosinusitis with nasal polyps, which aligns with our findings of higher SNOT scores in these individuals [38]. Erskine et al. noted that symptoms such as trouble sleeping and fatigue may be linked to obstructive sleep apnea [39,40]. Therefore, sleep issues are frequently reported in the SNOT-22 questionnaire, particularly among patients with nasal and sinus conditions.

In this study, the prevalence of smoking showed no statistically significant relationship with the SNOT-22 score. This finding may be attributed to reverse causality bias, which often occurs in cross-sectional studies. Individuals with sinusitis smoke less because of respiratory symptoms compared to those without sinusitis symptoms. Nonetheless, further research is essential to establish the nature and extent of this relationship.

We did not show a statistically significant relationship between age and SNOT-22 score. Furthermore, earlier studies did not establish a connection between age and quality of life in chronic rhinosinusitis [12–14].

Our study had several strengths. First, it was designed as a cohort study with randomly selected samples, which enhances the validity and generalizability of its results. The questionnaire was administered by trained personnel, and quality control of the study was overseen by two

Table 3
Crude and adjusted odds ratios for SNOT-22 using the logistic regression model.

SNOT22	Crude OR	CI 95 %	P-value	Adjusted OR	CI 95 %	P-value
Age						
35–39 y	1			–	–	–
40–44 y	0.89	0.59–1.36	0.594	–	–	–
45–49 y	1.12	0.74–1.70	0.577	–	–	–
50–54 y	1.19	0.79–1.80	0.405	–	–	–
55–59 y	1.26	0.83–1.93	0.280	–	–	–
60–64 y	1.13	0.69–1.84	0.640	–	–	–
≥60 y	1.29	0.76–2.18	0.339	–	–	–
Sex						
Female	1.70	1.33–2.16	**<0.001***	1.62	1.22-2.16	**0.001***
Male	1			1		
Education level						
Illiterate	1					
Primary school	0.61	0.43–0.86	**0.005***	1.54	0.86–2.79	0.149
Secondary school	0.74	0.45–1.23	0.254	1.12	0.59–2.11	0.735
High school	0.58	0.35–0.95	**0.032***	1.49	0.72–3.10	0.287
University	0.48	0.28–0.82	**0.008***	1.14	0.55–2.36	0.722
BMI						
Underweight	1					
Normal	0.41	0.09–1.91	0.255	0.525	1.09–2.53	0.422
Overweight	1.08	0.80–1.47	0.616	1.26	0.91–1.74	0.170
Obese	0.85	0.65–1.10	0.214	0.97	0.74–1.28	0.833
Residence type						
Urban	1.15	0.91–1.45	0.251	–	–	–
Rural	1			–	–	–
Physical activity						
Q1	1					
Q2	0.81	0.59–1.13	0.218	1.19	0.86–1.66	0.290
Q3	0.82	0.60–1.13	0.228	0.88	0.62–1.25	0.475
Q4	0.85	0.62–1.17	0.329	0.87	0.62–1.23	0.440
Smoking						
Yes	1.14	0.85–1.52	0.384	–	–	–
No	1			–	–	–
Wealth index						
Poorest	1					
Poor	0.82	0.57–1.19	0.290	1.23	0.83–1.82	0.299
Moderate	0.83	0.58–1.20	0.318	1.04	0.70–1.52	0.862
Rich	0.69	0.48–0.99	**0.046***	1.13	0.78–1.63	0.531
Richest	0.65	0.45–0.94	**0.021***	0.96	0.66–1.40	0.850

* $P < 0.05$ was considered a statistically significant level in the Logistic Regression Model.

otolaryngology specialists and an epidemiologist. However, our study had several limitations. Firstly, the variability in results may be attributed to variations in the populations studied and the examination of different confounding factors. Secondly, the absence of normative data for interpreting SNOT-22 scores might make it challenging to compare scores across diverse patient populations.

5. Conclusion

Abnormal SNOT-22 scores were notably prevalent in our population, particularly among women. This may have resulted in some individuals going undiagnosed for rhinosinusitis. Hence, it appears imperative to develop and implement therapeutic and educational interventions for this group. Additionally, it is crucial to refer individuals with abnormal scores to specialist doctors for a clinical evaluation.

CRediT authorship contribution statement

Soheila Nikakhlagh: Writing – review & editing, Project administration, Conceptualization. **Nader Saki:** Writing – review & editing. **Bahman Cheraghian:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis. **Zahra Rahimi:** Writing – original draft, Methodology, Formal analysis. **Sara Saki:** Writing – original draft, Data curation. **Seyed Mohammad Tabibzadeh:** Writing – review & editing, Supervision.

Ethics approval and consent to participate

The ethics committee of Ahvaz Jundishapur University of Medical Sciences (Ethical code: IR.AJUMS.REC.1402.665) has approved this study. The methods were performed by the Helsinki Declaration. Informed consent was obtained from all participants.

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Declaration of competing interest

The authors declare that they have no competing interests.

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