Prevalence of chronic rhinosinusitis in São Paulo*

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Summary

Introduction: Studies designed to investigate chronic rhinosinusitis (CRS) epidemiology play an important role to assess population's distribution and risk factors to result in the development and promotion of public health policies.

Method: This study design is a survey carried out with a complex two-stage cluster sampling plan. Personal interviews were carried out with 2,003 individuals. The questionnaire included the epidemiological criteria for CRS. Demographic data, history of physician-diagnosed respiratory diseases (asthma, sinusitis, rhinitis), smoking, family income, educational attainment, and household characteristics were also evaluated.

Results: The overall response rate was 93.9% of the households. Mean age was 39.8 ± 21 years; 45.33% were male. The overall prevalence of CRS in the city of São Paulo was 5.51%. We found a significant association between diagnosis of CRS and diagnosis of asthma and CRS and diagnosis of rhinitis and a significant association between presence of CRS and belonging to the low-income subgroup.

Conclusion: The municipality of São Paulo has an urban population of 11 million. According to the present study, the prevalence of CRS is 5.51%, which represents more than 500,000 individuals affected by this condition in the city.

Key words: epidemiology, prevalence, chronic rhinosinusitis, sinusitis, survey

Introduction

Chronic rhinosinusitis is defined as inflammation of the mucosa of the nose and the paranasal sinuses lasting more than 12 weeks without complete resolution of symptoms. The underlying pathogenesis of this disease remains unclear. CRS carries a high burden of direct costs to public health, which includes physician visits, laboratory tests and medical imaging, hospital admissions, surgical intervention, and medical treatment. It is also associated with indirect cost, such as that of presenteeism (decreased productivity in the workplace due to work attendance while sick) and absenteeism [1-4]. In the United States, the estimated healthcare expenditure associated with a diagnosis of CRS amounts to US$8.6 billion per year [5], with US$150 million spent on antibiotics [6]. CRS has a proven impact on patient quality of life, as assessed by global and disease-specific questionnaires [7-8]. Quality of life evaluated by the SF-36 questionnaire has revealed that patients with chronic rhinosinusitis have more bodily pain and worse social functioning than patients with chronic obstructive pulmonary disease, congestive heart failure, diabetes, or back pain [9].

Studies designed to investigate CRS epidemiology play an important role in assessing its distribution, analyzing risk factors, and promoting public health policies. Epidemiological data on rhinosinusitis are scarce, and study methods and response rates vary widely. In a recent multicenter study performed as part of the Global Allergy and Asthma European Network project (GA^{2}LEN), the prevalence rate of CRS was found to reach 10.9%

in the European population [10]. This study used the epidemiological criteria described in the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) [11] and was based on a postal questionnaire with a mean response rate of 48% (23.2 - 80.3%). In an extension of this study, there was a strong association between asthma and CRS (adjusted OR: 3.47; 95% CI: 3.20 - 3.76) at all ages. The association with asthma was stronger in those reporting both CRS and allergic rhinitis (adjusted OR: 11.85; 95% CI: 10.57 - 13.17). CRS in the absence of nasal allergies was positively associated with late-onset asthma [12]. In the United States, population-based household surveys carried out by the National Center for Health Statistics found a prevalence of self-reported, physician-diagnosed rhinosinusitis of 13%, although there was no distinction between acute or chronic disease [13]. Chen et al., [14] reported a prevalence rate of 5% in Canada, with a response rate of 82%. However, this estimate was based on telephone interviews, and participants were evaluated for symptoms of over 6 months' duration. Shashy et al., calculated that approximately 2% of the population in Olmsted, Minnesota, had a diagnosis of rhinosinusitis, based on a review of medical records containing ICD-9 codes for this condition [15].

In the current literature, there are no data on the prevalence of CRS as obtained through 'face-to-face' interviews and defined according to EPOS criteria. Furthermore, there are no epidemiological data on the prevalence of CRS in Brazil.

The primary objective of this study was to evaluate the prevalence of chronic rhinosinusitis in the city of São Paulo, Brazil, through 'face-to-face' home interviews. Secondary objectives were to determine the potential associations between CRS and rhinitis, asthma, smoking, family income, educational attainment, and various household characteristics.

Materials and methods

This study was approved by the local ethics committee (judgment no. 0399/09).

Sampling plan

The study population comprised all individuals living in the urban areas of the city of São Paulo, according to Brazilian Institute of Geography and Statistics (IBGE) data, including slum areas. The household survey was carried out in accordance with a complex two-stage cluster sampling plan, with census sectors defined as the primary sampling unit and individual households as the secondary units. Fifty census sectors were randomly selected and each household in each sector was identified (canvassing). Thirty-two households were selected by systematic random sampling in each sector.

The study sample consisted of all permanent residents of the selected households. Domestic staff that did not live on-site was excluded from the sample, as were commercial properties with no on-site residents and uninhabited residential buildings. Under-20 and over-60 residents were interviewed in all households, whereas those between the ages of 20 and 59 were interviewed in only half of the selected households. This statistical sampling technique was chosen to assure that sample obtained from the population would be representative of a normal age distribution.

To reduce the possibility of sampling bias and the nonresponse and refusal rate, each household was visited up to 20 times for three consecutive months in the same season. Written guidance on the objectives of the study was distributed to building residents, superintendents, and condominium management companies. Telephone contact with the investigators was established as a means of clarifying any doubts and to assist in gaining permission for household visits. The total number of visited households was divided among the four seasons of the year so as to reduce any possibility of seasonality bias (increased positive response rates near winter). All interviewees provided written informed consent.

Personal (face-to-face) interviews were carried out by trained investigators. The study took place between 21 March 2010 and 20 March 2011. Collected data were compiled in spreadsheets using a double data entry method. A random subgroup comprising 3% of respondents was interviewed again by telephone, using a subset of the original interview items, for assessment of inter-rater agreement.

Definition outcomes

As suggested by EPOS [11], from an epidemiological standpoint, we defined rhinosinusitis as the presence of two or more symptoms, one of which should be either (1) nasal blockage / obstruction / congestion or (2) nasal discharge (anterior/post-nasal drip). The other symptoms to be evaluated are facial pain / pressure and partial or complete anosmia. For chronic rhinosinusitis to be diagnosed, symptoms must be present for more than 3 months [11].

Asthma was defined as reporting a physician diagnosis of asthma or a physician-detected episode of wheezing in the last 12 months. Rhinitis was defined as a positive response to the question 'During the past 12 months, have you been told by a doctor that you have rhinitis?' We did not ask specifically for allergic rhinitis. History of smoking (current, former or never) and smoking exposure (defined by a positive response to the question 'Does anyone smoke in your home?'), family income, educational attainment, and household characteristics were also evaluated.

Pilot study

Tomassen et al., showed that a symptom-based definition of CRS, according to the epidemiological part of the EPOS criteria

[11], has moderate reliability over time [16]. To assess the adequacy of questionnaire items in our population and calculate average interview duration, a pilot study was conducted on a sample of 80 patients treated by the ENT service of a tertiary referral hospital, divided into two groups according to diagnosis: 40 with rhinosinusitis and 40 controls (presenting with symptoms of allergic or non-allergic rhinitis or symptoms not associated with nasal or sinus conditions). All patients were evaluated by nasal endoscopy and/or CT-scan.

Statistical analysis

Statistical analyses were conducted in the STATA 10.0 software environment, using the SVY module, which is suitable for obtaining unbiased estimates from data originating from complex sampling strategies. Post-stratification weights were added to adjust for age, gender, and educational attainment, according to data from the 2010 Census [17] and the 2008-2009 Household Budget Survey [18]. We calculated the prevalence of chronic rhinosinusitis and corresponding 95% confidence intervals according to individual characteristics.

The logistic regression model was used to determine the significance of comparisons between qualitative study variables and the outcome of interest (presence or absence of CRS). The significance level was set at $\alpha \leq 0.05$.

Results

Pilot study

The pilot study revealed good agreement between epidemiological diagnosis (as established according to the case definition used in the questionnaire) and clinical diagnosis by trained otorhinolaryngologists. Clinical diagnosis was based on the EPOS criteria [11], and included not only reported symptoms, but also nasal endoscopy and/or sinus CT changes (*kappa* = 0.63).

Response rate

The overall response rate was 93.9% of households, which was believed to cover the entire eligible population. In these households, we were able to contact, at least once, someone who could explain the study to the other residents and identify which residents were eligible for participation. Only 6.1% of households remained unresponsive to all attempts at contact, refused to let the interviewer in, or refused to provide information on household residents. The final response rate was 87.8%, as 93.5% of the eligible population responded (Figure 1).

Sample data

The study sample comprised 2,003 subjects aged 12 years or older. Mean age was 39.8 years (SD = 21; range, 12 - 92); 45.33% (n = 908) were male and 54.67% (n = 1,095) were female (Figure 1).

The overall prevalence of CRS in the city of São Paulo was 5.51% (95% CI = 3.99-7.58). There were no statistically significant gender differences (male vs. female, 5.04% [95%CI = 3.32-7.56] vs. 5.92% [95%CI = 4.17 - 8.34], p = 0.41) (Table 1). The prevalence of physician-diagnosed sinusitis (no distinction between acute and chronic disease) was 16.55% (CI = 14.18 - 19.23) (Table 2).

There were no statistically significant differences in CRS prevalence according to number of household residents (p = 0.50), number of bedrooms in the household (p = 0.43), or educational achievement of the head of household in years of formal schooling (p = 0.64) (Table 1). Subgroup analysis by head-of-household income revealed a trend toward significance (p = 0.0677), with a significant association between presence of CRS and belonging to the low-income subgroup (OR = 2.24, 95%CI 1.06 - 4.72, p = 0.036) (Table 3).

No. of households	Nonresponse/ refusals	Household response rate	Response rate of eligible subjects	Overall response rate
1,480	6.1%	93.9%	93.5%	87.8%

Study population (age > 12 years)			
n	Age (range)	% male	% female
2,003	39.8 ± 21 (12-92)	45.4	54.6

Figure 1. Overview of response rates and study population.

Table 1. Sample profile and prevalence of chronic rhinosinusitis.

Variable	n	CRS	% CRS	95%CI	p-value
Gender					
Male	908	47	5.04	[3.32–7.56]	0.4125
Female	1,095	57	5.92	[4.17–8.34]	
Total	2,003	104	5.51	[3.99–7.58]	
No. of persons living in household					
1–2	435	28	6.55	[3.85–10.92]	0.5046
3	492	23	4.22	[2.49–7.08]	
4	516	24	5.05	[3.29–7.68]	
5–20	560	29	6.47	[3.63–11.28]	
No. of bedrooms in household					
1	519	28	5.77	[3.60–9.12]	0.4282
2	976	57	6.17	[4.05–9.32]	
3 a 6	508	19	4.07	[2.18–7.50]	
Educational attainment, head of household (years of formal education)					
0–8	1,030	51	4.74	[3.28–6.79]	0.6416
9–11	626	35	6.13	[3.79–9.76]	
≥12	347	18	6.05	[3.16–11.26]	
Monthly income, head of household (x minimum wages)					
0–1 (low income)	376	30	8.11	[5.82–11.2]	0.0677
>1–3 (medium income)	907	38	5.00	[3.33–7.45]	
>3 (high income)	576	33	5.71	[3.42–9.39]	
Unknown / unwilling to respond	144	3	1.86	[5.79–5.80]	
Smoking status					
Nonsmoker	1,378	64	4.95	[3.39–7.17]	0.4344
Current smoker	289	18	6.53	[3.36–12.30]	
Former smoker	336	22	6.76	[4.30–10.47]	
Pack years (smokers only)					
≤10	152	7	5.21	[2.33–11.24]	0.3686
≥11	133	11	8.45	[4.08–16.66]	
Exposure to passive smoking in household					
Yes	738	44	6.62	[4.30–10.06]	0.1819
No	1,265	60	4.92	[3.43–7.01]	
Physician-diagnosed asthma (self-reported)					
Yes	131	19	16.47	[8.92–28.44]	0.0001
No	1,868	84	4.82	[3.47–6.67]	
Unknown / unwilling to respond	3	1	-	-	
Physician-diagnosed rhinitis (self-reported)					
Yes	351	53	15.14	[10.81–20.80]	0.0000
No	1,649	51	3.44	[2.31–5.09]	
Unknown / unwilling to respond	3	-	-	-	

Table 2. Prevalence of self-reported CRS.

Prevalence of Self-Reported CRS by Questionnaire Criteria		Prevalence of Self-Reported Sinusitis (Diagnosed by a Physician – acute or chronic not specified)	
%	95%CI	%	95% CI
5.512	(3.99–7.58)	16.55	(14.18–19.23)

Statistically significant differences in CRS prevalence were found in the presence or absence of asthma (16.47% [95%CI 8.92 - 28.44] vs. 4.82% [95%CI 3.47 - 6.67], p = 0.0001) and in the presence or absence of rhinitis (15.14% [95%CI 10.81 - 20.80] vs. 3.44% [95%CI 2.31 - 5.09], p = 0.000) (Table 1). We also found a significant association between diagnosis of CRS and diagnosis of asthma (OR = 3.88, 95%CI = 1.94 - 7.77, p = 0.0001) or rhinitis (OR = 5.02, 95%CI = 3.35 - 7.53, p = 0.0000) (Table 3).

There were no significant differences in CRS prevalence according to smoking status (p = 0.43), pack years (p = 0.26), or exposure to passive smoking in the household (p = 0.18) (Table 1). Likewise, we did not find any significant associations between diagnosis of CRS and these variables (Table 4).

Discussion

This study reported the prevalence of chronic rhinosinusitis in a representative sample of the population of São Paulo, a Brazilian city with over 11 million inhabitants. The overall prevalence of CRS in the city of São Paulo was 5.51% (95%CI = 3.99 - 7.58), with a final response rate of 87.8% and a statistically significant association between low monthly income (head-of-household income in the lowest bracket) and diagnosis of CRS (OR = 2.24, 95%CI 1.06 - 4.72, p = 0.036). Significant differences in CRS prevalence were found according to the presence or absence of asthma (16.47%, 95%CI = 8.92 - 28.44, p = 0.0001) and rhinitis (15.14%, 95%CI = 10.81 - 20.80, p = 0.0000), and a strong association was found between diagnosis of CRS and past diagnosis of asthma (OR = 3.88, 95%CI = 1.94 - 7.77, p = 0.0001) or rhinitis (OR = 5.02, 95%CI = 3.35 - 7.53, p = 0.0000). Active smoking or exposure to passive smoking in the home was not associated with a diagnosis of CRS (p = 0.43 and 0.18, respectively).

The current literature shows that a broad range of methods have been used to assess the prevalence of CRS. This study estimates CRS prevalence on the basis of validated EPOS criteria [11] through a personal (face-to-face) interview strategy. These criteria have proved to be reliable for epidemiological research use, due to their reproducibility and correlation with endoscopic findings [16]. Collection of data through household interviews also provides superior reliability in responses and more detailed information. If we had chosen to inquire only as to the duration of symptoms required for a diagnosis of rhinosinusitis, for instance, we would have been unable to state whether symptoms had occurred concomitantly. The questionnaire used during interviews enabled assessment of the synchronicity of symptoms, which probably would have been less effective if a self-report questionnaire had been used instead.

Population-based surveys can provide reliable estimates, depending on the methodological and operational robustness of the sampling strategy. In surveys, obtaining a representative sample of the population and reducing the nonresponse rate are constant concerns. Active search by household visits, despite its relatively high cost, is far less liable to bias as a sampling strategy for prevalence studies. The use of postal questionnaires is susceptible to sampling bias, as symptomatic patients are more likely to complete and return the questionnaire. Remarkably, our response rate exceeded expectations for a city as large as São Paulo, where a response rate in the region of 80% would already have been satisfactory.

Estimation of disease prevalence based on review of medical records (ICD codes) only covers patients who sought and received medical attention, and may thus reflect only a certain geographic area of the city in which the study was conducted (the catchment area of the facility from which records were obtained) or even a population of patients living in other municipalities, when records are obtained from tertiary referral centers. The use of household visits sought to eliminate sampling bias by including patients who may not have had access to medical care, thus encompassing a truly representative population.

The correlation between questionnaire-based and clinical diagnosis was demonstrated, validating the suitability of this instrument for epidemiological research. Use of this instrument enabled more precise distinction to diagnosis of CRS, and the pilot study revealed satisfactory agreement (*kappa* 0.63) between epidemiological and clinical diagnosis using EPOS criteria [11], as in the GA^{2}LEN study [10].

However, we are well aware of the limitations of epidemiological diagnosis, as endoscopic or CT findings play an essential role in the clinical diagnosis of CRS. The high cost and complex logistics of confirming a symptomatic diagnosis of CRS make this an unfeasible consideration in epidemiological studies.

Table 3. Odds ratios of CRS.

	CRS			
Gender	OR	95%CI		p-value
Male	1			
Female	1.19	0.78	1.80	0.413
No. of persons living in household				
1–2	1			
3	0.63	0.29	1.35	0.229
4	0.76	0.38	1.52	0.429
5–20	0.99	0.53	1.82	0.967
No. of bedrooms in household				
1	1			
2	1.07	0.58	1.98	0.813
3–6	0.69	0.34	1.41	0.304
Educational attainment, head of household (years of formal education)				
0–8	0.77	0.36	1.64	0.495
9–11	1.01	0.44	2.32	0.973
≥12	1.00			
Monthly income, head of household (× minimum wages)				
0–1	2.24	1.06	4.72	0.036
>1–3	1.46	0.88	2.42	0.135
>3	1			
Physician-diagnosed asthma				
Yes	3.88	1.94	7.77	0.001
No	1			
Physician-diagnosed rhinitis				
Yes	5.02	3.35	7.53	0.00
No	1			

Furthermore, adequate epidemiological analysis is perfectly capable of drawing inferences on disease prevalence. Tomassen et al., assessed the reliability and validity of a symptom-based definition of CRS using data from the GA^{2}LEN European survey and suggested that a symptom-based definition of CRS, according to the epidemiological part of the EPOS criteria [11], has moderate reliability over time and is suitable for the assessment of geographic variation in CRS prevalence [16]. Although our questionnaire exhibited some differences in item wording due to our decision to distinguish acute symptoms from chronic ones, we followed the EPOS-recommended epidemiological definition [11].

The European CRS prevalence study found a strong association between symptomatic diagnosis of CRS and self-reported physician diagnosis of CRS [10]. It should be noted that, in a Brazilian population, a negative reply to the question "During the past 12 months, have you been told by a doctor that you have sinusitis?" may mean that the respondent was not diagnosed because he or she did not seek medical attention or did not have the chance to be seen by a physician.

We found that a substantial number of subjects with a formal medical diagnosis of sinusitis (45.6%) were unable to report whether they had acute or chronic disease, which may reflect a low level of patient awareness of their own health conditions or, perhaps, a lack of detail on the part of physicians while conveying the diagnosis to the patient.

Prevalence of CRS in the São Paulo population

The prevalence of CRS found in the present study (5.51%, 95%CI = 3.99-7.58) was lower than that reported in the recently

Table 4. Smoking status.

Variable	CRS			
	OR	95%CI		p-value
Smoking status				
Nonsmoker	1			
Current smoker	1.34	0.70	2.59	0.373
Former smoker	1.39	0.80	2.43	0.238
Pack years (smokers only)				
1–10	0.98	0.43	2.25	0.967
>11	1.28	0.89	1.86	0.179
Passive smoking in household				
Yes	1.37	0.86	2.19	0.183
No	1			

Table 5. Associations and comparisons between GA2LEN survey in Europe and São Paulo survey.

	Europe – GA²LEN Survey [12,16]	São Paulo – present study
Method	Postal questionnaire	Face-to-face interview
n	57,128	2,003
Age	15–75 years	12 years or older
Setting	19 centres / 12 countries	1 city
Prevalence (EP3OS criteria)	10.9% (range, 6.9–27.1)	5.51% (95%CI = 3.99–7.58)
Association between CRS and asthma	OR = 3.47; 95%CI = 3.20–3.76	OR = 3.88; 95%CI = 1.94–7.77
Association between CRS and rhinitis	56% of individuals that fulfilled EPOS criteria for CRS also reported nasal allergies or hay fever	OR = 5.02; 95%CI = 3.35–7.53
Association between CRS and current smoking	OR = 1.91; 95%CI = 1.77–2.05	OR = 1.34; 95%CI = 0.70–2.59
Association between CRS and low income	Not investigated	OR = 2.24; 95%CI = 1.06–4.72

published GA²LEN study (10.9%, 95%CI = 6.9-27.1) (Table 5) [10]. Although GA²LEN used analysis of the same symptoms for assessment of CRS prevalence, data were acquired by postal questionnaires. This difference in prevalence may be attributed to variation in geographic and demographic characteristics and to the lower response rate. There was wide variation in response rates across centers in the GA²LEN study (23.2 - 80.3%), and the profile of non-respondents was not reported. There is always the possibility that subjects will be more willing to respond to a survey when they are actually quizzed on their condition or symptoms.

Our results were similar to those reported in a study of CRS prevalence in Canadians (5%). Using a complex survey design, Chen et al., compiled data from telephone interviews of 73,364 subjects who, after being instructed that the survey questions referred solely to chronic illnesses with symptoms of over 6 months' duration, were asked: "Do you have sinusitis diagnosed by a health professional?"[14]. However, the symptom duration criterion used in the Chen study was longer than that recommended in EPOS [11], which may have led to underestimation of CRS prevalence.

The prevalence of self-reported, physician-diagnosed rhinosi-

nusitis was higher in our population (16.55%) than in the U.S. population according to 2009 National Center of Health Statistics data (13%); however, the latter do not report separate data for acute and chronic rhinosinusitis. CRS prevalence estimated by home visits in our sample was considerably lower than the rate of self-reported physician-diagnosed rhinosinusitis, so it is very important to improve accuracy of the diagnosis of rhinosinusitis [13].

Regarding gender, we found no statistically significant difference in CRS prevalence between men and women (5.04% vs. 5.92%), which runs counter to the findings of Chen et al., who reported a higher prevalence in females (5.7% vs. 3.4%). In the European study, prevalence was also slightly higher in females [10].

Differences between head-of-household income subgroups exhibited a trend toward significance (p = 0.0677). This borderline-significant p-value may represent a trend towards actual increased prevalence of CRS in certain income groups. This is confirmed by the statistically significant association between presence of CRS and belonging to the low-income subgroup (OR = 2.24, 95%CI 1.06 - 4.72, p = 0.036). One of the factors associated with this higher prevalence in this subgroup might be smoking status related to years of formal education and open-fire cooking [19].

In a recent study of 127 CRS patients published by Kilty et al., individuals with lower family income were likely to have higher self-reported sinus disease symptom severity, as measured by a validated quality of life questionnaire (SNAQ11) (OLS coefficient = 6.89; 95%CI = 0.08 - 13.7; p = 0.05) [21].

Smoking

Smoking was no more prevalent in the CRS group (17.30%) than in the overall population, and we found no association between smoking and chronic sinusitis (OR = 1.34, 95%CI = 0.70 - 2.59) in the study sample, even after subgroup analysis by gender. The European study, performed in greater sample size of 57,000 people, found a strong association between CRS and smoking (OR = 1.91, 95%CI 1.77 - 1.05) [10]. Chen et al., also found a significant association between CRS and smoking in women (OR = 1.57, 95%CI = 1.24 - 1.99) [14].

The prevalence of smoking among adults (age ≥ 18 years) in São Paulo was estimated at 20%, according to data from the Vigitel population-based telephone survey with 54,000 people. In this study, they demonstrated that less years of formal education was associated with higher prevalence of smoking [19]. In our study, the prevalence of smoking among respondents aged 12 or older was 16.23% (95%CI = 13.2 - 19.2%).
Smoking has a wide variety of potential effects on the respiratory epithelium, including reduction of mucociliary transport in vivo, changes in mucus production mechanisms, structural epithelial changes, increased propensity to bacterial infection and increased adhesion of these bacteria to epithelial cells, poorer postoperative outcomes leading to disease recurrence [21]. However, contrary to expectations, we were unable to establish any association between CRS and smoking in our sample. Chen et al., studying a sample of 73,364, also failed to show such an association in men (adjusted OR = 1.24; 95%CI = 0.9-1.7%) [14], and in a recent epidemiological study consisting of house calls to a sample of 4,098 individuals by Kim et al., smoking was not found to be a significant risk factor [22].

One hypothesis that may explain this finding is the lower prevalence of smokers in our sample (16%) as compared to the overall population (20%). We believe this difference may have compromised analysis of this risk factor, and further studies are needed to evaluate the real interaction between smoking and CRS.

Rhinitis

The prevalence of CRS in patients with a physician diagnosis of rhinitis was significantly higher than among respondents without a diagnosis of rhinitis (OR = 5.02, 95% CI = 3.35 - 7.53). However, our analysis did not consider whether rhinitis was of an allergic or non-allergic nature.

In the GA²LEN European survey, 56% of individuals that fulfilled the EPOS criteria [11] for CRS also reported nasal allergies or hay fever [12]. In Korea, persistent / moderate-to-severe allergic rhinitis was proven to be the most significant risk factor for CRS at the population level (OR 8.23, 95%CI = 4.70, 14.43) [22].

Bachert et al., found no statistically significant differences in the prevalence of CRS among patients with allergic rhinitis [23]. Although literature reviews suggest that allergy is a predisposing factor for rhinosinusitis and several published studies have reported a high prevalence of allergy in this patient population, there is no robust epidemiological evidence of a clear causal relationship [24,25].

Asthma

The current evidence suggests that inflammation of the upper and lower airway coexists and should be regarded as a continuous spectrum [26]. However, evidence for improvement of asthma symptoms after treatment of rhinosinusitis is derived solely from pediatric studies.

Jarvis et al., in the GA²LEN European survey, found a strong association of between asthma and CRS (adjusted OR = 3.47; 95%CI = 3.20 - 3.76) at all ages. The association with asthma was stronger in those reporting both CRS and allergic rhinitis (adjusted OR = 11.85; 95%CI = 10.57 - 13.17). CRS in the absence of nasal

allergies was positively associated with late-onset asthma [12].

In our sample, the prevalence of CRS was significantly higher among subjects with physician-diagnosed asthma, which suggests a major association (OR = 3.88, 95%CI = 1.94 - 7.77%).

Conclusion

The municipality of São Paulo has an urban population of 11 million; according to the present study, the prevalence of CRS is 5.51%, which represents more than 500,000 individuals affected by this condition in the city.

Conflict of interest statement

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Author contributions

RP: Conception and design, acquisition of data, analysis, and interpretation of data; drafting the article or revising it critically for intellectual content and final approval of the version to be published. FP: Analysis and interpretation of data; drafting the article or revising it critically for intellectual content and final approval of the version to be published. TB: Analysis and interpretation of data; drafting the article or revising it critically for important intellectual content and final approval of the version to be published. RL: Conception and acquisition of data. FP: Conception. RB: Conception. CP-N: Drafting the article or revising it critically for important intellectual content and final approval of the version to be published. CB: Drafting the article or revising it critically for important intellectual content and final approval of the version to be published. RV: Conception and design, analysis, and interpretation of data; drafting the article or revising it critically for important intellectual content and final approval of the version to be published.

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Appendix

Face to face interview.

1. During the past 12 months, have you had nasal obstruction / congestion? For how long? (If more than one episode, the interviewer must choose the longest one)
    1. I didn't have this symptom
    2. Less than 10 days
    3. Between 10 days and 3 months
    4. More than 3 months

2. During the past 12 months, have you had discolored nasal discharge? For how long? (If more than one episode, the interviewer must choose the longest one)
    1. I didn't have this symptom
    2. Less than 10 days
    3. Between 10 days and 3 months
    4. More than 3 months

3. During the past 12 months, was your sense of smell reduced or absent throughout all the period in which you had _____(nasal obstruction or discoloured nasal discharge – the interviewer asks about the longest episode mentioned in questions 1 or 2)?

4. During the past 12 months, have you had pain or pressure around the face throughout all the period in which you had_____(nasal obstruction or discoloured nasal discharge – the interviewer asks about the longest episode mentioned in questions 1 or 2)?

5. During the past 12 months, have you been told by a doctor that you had sinusitis?

6. Do you know if the diagnosis was acute or chronic sinusitis?

7. During the past 12 months, have you been told by a doctor that you had asthma (or had a wheezing chest noticed by a doctor)?

8. During the past 12 months, have you been told by a doctor that you had rhinitis?