



## Original Article

## Sinusitis and its association with deviated nasal septum at a tertiary hospital: A retrospective study



Zahraa H. Alsaggaf<sup>a,\*</sup>, Ahmed O. Almadfaa<sup>a</sup>, Amjad A. Marouf<sup>a</sup>, Khaled S. Alfawaz<sup>a</sup>,  
Rose A. Niyazi<sup>a</sup>, Nahla K. Ibrahim, DrPH<sup>b,c</sup> and Amr M. Ajlan, MD-PhD<sup>d</sup>

<sup>a</sup> Radiology Department, Faculty of Medicine, King Abdulaziz University, Jeddah, KSA

<sup>b</sup> Community Medicine Department, Faculty of Medicine, King Abdulaziz University, Jeddah, KSA

<sup>c</sup> Epidemiology Department, High Institute of Public Health, Alexandria University, Alexandria, Egypt

<sup>d</sup> Radiology Department, King Abdulaziz University Hospital, King Abdulaziz University, Jeddah, KSA

Received 28 March 2022; revised 18 May 2022; accepted 4 June 2022; Available online 18 June 2022

### المخلص

**أهداف البحث:** التهاب الجيوب الأنفية مرض شائع، وانحراف الحاجز الأنفي يعتبر من المتغيرات التشريحية السائدة في الجيوب الأنفية. هناك جدل حول تأثير انحراف الحاجز الأنفي على احتمالية حدوث التهاب الجيوب الأنفية. لذلك، هدفت هذه الدراسة إلى تحديد معدل التهاب الجيوب الأنفية وارتباطه بانحراف الحاجز الأنفي وعوامل أخرى بين المرضى الذين أتوا إلى مستشفى جامعة الملك عبد العزيز.

**طرق البحث:** تم إجراء دراسة استيعابية في مستشفى جامعة الملك عبد العزيز، حيث تم جمع البيانات من الأرشيف الإلكتروني للمستشفى. تضمنت الدراسة جميع المرضى الذين تبلغ أعمارهم 18 عامًا فما فوق والذين تمت إحالتهم إلى قسم الأشعة التشخيصية لإجراء أشعة تصوير مقطعية للجيوب الأنفية خلال يناير 2018 إلى ديسمبر 2020. تم حساب الإحصاء الوصفي والاستنتاجي.

**النتائج:** تضمنت هذه الدراسة 676 مريضًا، وكان متوسط أعمارهم 38.9 بانحراف معياري قدره 13 عامًا. التهاب الجيوب الأنفية كان موجودًا في 47.5% من العينة، وبلغت نسبة الذكور 54.8% من المرضى المصابين بالتهاب الجيوب الأنفية. أولئك الذين تتراوح أعمارهم بين 31-40 سنة عانوا من التهاب الجيوب الأنفية أكثر من الفئات العمرية الأخرى. من إجمالي العينة، تم تشخيص حوالي ثلاثة أرباع (75.1%) بانحراف الحاجز الأنفي، حوالي نصفهم (51.3%) كانوا أيضًا مصابين بالتهاب الجيوب الأنفية. أولئك الذين ليس لديهم انحراف الحاجز الأنفي ولكن لديهم التهاب الجيوب الأنفية كانوا 27.8%. كان هناك ارتباط كبير بين التهاب الجيوب الأنفية وكلاً من الجنس ( $P < 0.001$ ) والفئات العمرية ( $P < 0.05$ ). الذين لديهم انحراف الحاجز الأنفي كانوا أكثر عرضة للإصابة

بالتهاب الجيوب الأنفية بحوالي 3 مرات مقارنة بالآخرين ( $OR = 2.74$ ؛  $95\%$  CI: 1.86-4.04؛  $P < 0.001$ ).

**الاستنتاجات:** حوالي نصف العينة مصابون بالتهاب الجيوب الأنفية، وثلاثة أرباع العينة لديهم انحراف الحاجز الأنفي. يعتبر الجنس والعمر ووجود انحراف الحاجز الأنفي من العوامل المحتمل ارتباطها بالتهاب الجيوب الأنفية. توصي هذه الدراسة بتصحيح انحراف الحاجز الأنفي، إن أمكن، من أجل منع حدوث التهاب الجيوب الأنفية.

**الكلمات المفتاحية:** التصوير المقطعي؛ انحراف الحاجز الأنفي؛ الجيوب الأنفية؛ المتنبئات؛ التهاب الجيوب الأنفية

### Abstract

**Objectives:** Sinusitis is common and deviated nasal septum (DNS) is a frequent anatomical variant in the paranasal sinuses (PNS). Whether DNS can cause sinusitis has been a subject of debate. This study determined the rate of sinusitis and its possible association with DNS and other factors in patients attending King Abdulaziz University Hospital (KAUH).

**Methods:** We conducted a hospital-based cross-sectional study and reviewed the electronic health records of KAUH retrospectively. We recruited all patients aged  $\geq 18$  years who were referred to the Diagnostic Radiology Department for a PNS computed tomography scan from January 2018 to December 2020. Descriptive and inferential statistics were calculated.

**Results:** A total of 676 participants met the eligibility criteria, with a mean (SD) age of 38.9 (13) years. Sinusitis was present in 47.5% of patients, 54.8% of which were

\* Corresponding address: Faculty of Medicine, King Abdulaziz University, Jeddah, KSA.

E-mail: [zahraa.alsaggaf23@gmail.com](mailto:zahraa.alsaggaf23@gmail.com) (Z.H. Alsaggaf)

Peer review under responsibility of Taibah University.



males. Patients aged 31–40 years suffered sinusitis more than the other age groups. Approximately three-fourths (75.1%) of the total sample had DNS, and 51.3% of them had sinusitis. Those who did not have DNS but had sinusitis were 27.8%. There were significant associations between sinusitis and both sex ( $P < 0.001$ ) and age ( $P < 0.05$ ). Patients with DNS were approximately three times more likely to have sinusitis than those without DNS (OR = 2.74, 95% CI: 1.86–4.04;  $P < 0.001$ ).

**Conclusion:** Almost half of the patients had sinusitis, and three-fourths had DNS. Sex, age, and DNS are possible factors associated with sinusitis. Assessing the presence of DNS and correcting it, if possible, is recommended to prevent the occurrence of sinusitis.

**Keywords:** Computed tomography; Deviated nasal septum; Paranasal sinuses; Predictors; Sinusitis

© 2022 The Authors.

Production and hosting by Elsevier Ltd on behalf of Taibah University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Paranasal sinuses (PNS) are air-filled spaces located within certain bones of the skull. In total, there are four pairs of sinuses: frontal, maxillary, ethmoidal, and sphenoidal sinuses.<sup>1</sup> Sinusitis occurs when one or more of these spaces gets inflamed and swollen. It is considered a significant health issue, as it is one of the most common health problems encountered in clinical practice.<sup>2,3</sup> PNS are a complex region that are subject to notable anatomical variations.<sup>4,5</sup> Thus, it is crucial to obtain a preoperative computed tomography (CT) scan, not only for diagnostic purposes but also to understand the sinonasal anatomy and anticipate possible anatomical variations that could play an important role in the management of sinusitis.<sup>6</sup> However, the significance of detecting such variations resides not only in the planning of surgical or endoscopic PNS intervention but also in the link between their presence and the patient's susceptibility to sinus inflammatory disorders.<sup>7</sup>

While studies have examined the association between some anatomical variations of the nasal cavities and risk of sinusitis, the results have been conflicting.<sup>2,5,7–10</sup> For example, Espinosa et al.<sup>2</sup> and Shoib et al.<sup>10</sup> showed that there is a link between nasal septum deviation and sinusitis, but other publications such as studies by Shpilberg et al.<sup>9</sup> and Kaygusuz et al.<sup>8</sup> did not agree that this association exists.<sup>2,8–10</sup>

Multiple studies have explored the anatomical variations in different regions of KSA.<sup>4,11,12</sup> However, there is an evident lack of research assessing the prevalence of pathological lesions of the PNS among the Saudi population, particularly sinusitis. Moreover, there is a lack of Saudi literature evaluating the prevalence and possible association of DNS with sinusitis.

Therefore, the aim of this study was to assess the prevalence of sinusitis, and to evaluate its relationship with DNS and other factors among the Saudi population who attended KAUH.

## Materials and Methods

We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

### *Study type and setting*

A cross-sectional study with retrospective data collection was conducted in KAUH, Jeddah, KSA. We reviewed the electronic archives of KAUH to assess the demographic data and CT scan findings of the participants who attended KAUH during a 2-year period from January 1, 2018 to December 31, 2020.

### *Participants*

We recruited all adult patients aged  $\geq 18$  years, who were referred to the Diagnostic Radiology Department for a PNS CT scan for either clinical symptoms within the sinonasal region or for being noted to have DNS on examination in the allocated 2-year study period.

Those who were diagnosed with a PNS lesion other than sinusitis (including fungal sinusitis) or had previous changes in the structure of the PNS as a result of either facial trauma or sinus surgery were excluded from this study.

### *Data interpretation*

The CT scans were evaluated by radiologists to look for anatomical variations of the PNS and assess for evidence of sinusitis. We used a practical subjective assessment based on the findings of mucosal changes, i.e. thickening and opacification of each sinus, to categorize patients into those with sinusitis and those who were disease-free. Additionally, deviation of the nasal septum was classified as either present or absent, and if present, the direction of DNS was attributed to the convex side.

### *Statistical analyses*

Data entry and analysis were done using Microsoft Excel and IBM SPSS (version 24), respectively. Demographic data are expressed as the mean, standard deviation, and percentages. The prevalence of sinusitis, its location, and its distribution across sex and age were calculated. Additionally, the percentage of DNS and its direction were determined. Furthermore, the chi-square test was used to assess the association between sinusitis and sex, age, and DNS. Odds ratios (ORs) with 95% confidence intervals (CIs) were also calculated using MedCalc.  $P < 0.05$  was considered statistically significant.

## Results

### *Patients' characteristics*

A total of 807 patients were assessed, of whom 676 fulfilled the inclusion criteria. The mean age of the patients was  $38.9 \pm 13$  years, with an age range of 18–83 years. Overall, females accounted for 53.6% of the cases.

### Prevalence of sinusitis

Sinusitis was present in 321 patients (47.5%), whereas 355 (52.5%) did not have sinusitis. Maxillary sinusitis had the highest prevalence (36%), followed by ethmoidal sinusitis (24.7%), sphenoidal sinusitis (19.7%), and finally frontal sinusitis (19.6%).

### Risk factors of sinusitis

Table 1 shows that males accounted for 54.8% of the sinusitis cases compared to 45.2% of females. There was a significant association between sex and sinusitis. Males were about twice more likely to have sinusitis compared to females (OR = 1.91, 95% CI: 1.41–2.59). Patients aged 31–40 years suffered more sinusitis (30.5%) than the other age groups. We found evidence of a statistically significant association between age and the odds of sinusitis, with older individuals having a higher risk of sinusitis (OR = 4.11, 95% CI: 1.63–10.35;  $P < 0.05$ ).

### DNS

The results showed that 489 cases (75.1% of the total enrolled patients) were diagnosed with DNS by CT scans. Of the patients diagnosed with sinusitis, 84.4% additionally had DNS. The direction of DNS among those who had sinusitis was deviation to the left (43.2%) followed by the right (35.5%), and then bilateral (6.1%). Moreover, when evaluating the prevalence of DNS among the regions of sinusitis, 36.1% of patients had maxillary sinusitis, followed by ethmoidal sinusitis (25%), and then sphenoidal and frontal sinusitis, with a prevalence of 19.6% and 19.3%, respectively.

In Table 2, the presence of a statistically significant association between sinusitis and DNS can be seen. Among the DNS cases, 51.3% (251) also had sinusitis. However, the rate of sinusitis among cases with no DNS was 27.8%, and 72.2% had neither DNS nor sinusitis. Those who had

DNS were about three times more likely to have sinusitis (OR = 2.74, 95% CI: 1.86–4.04).

Regarding frontal sinusitis and DNS, those with bilateral frontal sinusitis and right-sided DNS had the highest prevalence (32.8%), followed by bilateral frontal sinusitis with left-sided DNS (32%). Regarding the ethmoidal type, bilateral sinusitis had the highest prevalence, and it was most commonly seen with right-sided (38.6%) and left-sided DNS (38.0%). Patients with left-sided DNS and bilateral maxillary sinusitis had the highest incidence compared to the other directions of maxillary sinusitis (40.1%). Regarding sphenoidal sinusitis, left-sided DNS and bilateral sphenoidal sinusitis had the highest frequency (29.9%).

### Discussion

In this large, hospital-based cross-sectional study, we found that approximately one in two patients had an image-based diagnosis of sinusitis. Similarly, Prasad et al.<sup>13</sup> noted that sinusitis was present among 52.5% of their adult Indian patients who underwent a CT scan due to nasal symptoms. In addition, a study from Iran found that sinus diseases were prevalent among 53% of their patients.<sup>14</sup> To the best of our knowledge, this is the largest cross-sectional study on the prevalence of sinusitis performed in a hospital-based population in KSA.

We also found statistically significant associations between age and sex in patients with sinusitis. In our study, males were more significantly afflicted with sinusitis compared to females. Likewise, Ravantara et al.<sup>15</sup> found that 65.7% of their patients with chronic sinusitis were men, with a male to female ratio of 1.9:1. Albeit, the National Health Interview Survey age-adjusted data found that sinusitis was more common in women (63%) than in men.<sup>16</sup> However, studies from Europe, Korea, and Taiwan found no sex variation in sinusitis occurrence.<sup>17–20</sup>

The highest prevalence of sinusitis in the current study was found among those aged 31–40 years. These findings are in accordance with those of Espinosa et al.,<sup>2</sup> who conducted

**Table 1: Relationship between the presence of sinusitis and the personal factors of participants who had a PNS CT scan at KAUH.**

Demographics	Sinusitis, No. (%)	No sinusitis, No. (%)	Total, No. (%)	Chi-square (P-value)	Odds ratio, (95% CI)
Sex					
Male	176 (54.8)	138 (38.9)	314 (46.4)	17.25 (<0.001)	1.91 (1.41–2.59)
Female	145 (45.2)	217 (61.1)	362 (53.6)		
Age				12.10 (0.017)	1
≤20 <sup>RC</sup>	7 (2.2)	22 (6.2)	29 (4.3)		
21–30	80 (24.9)	106 (29.9)	186 (27.5)		
31–40	98 (30.5)	102 (28.7)	200 (29.6)		
41–50	68 (21.2)	52 (14.6)	120 (17.8)		
≥51	68 (21.2)	73 (20.6)	141 (20.9)		

**Table 2: Relationship between the presence of sinusitis and the presence of deviated nasal septum among the participants who had a PNS CT scan at KAUH.**

Deviated nasal septum	Sinusitis, No. (%)	No sinusitis, No. (%)	Total, No. (%)	Chi-square (P-value)	Odds ratio (95% CI)
Present	251 (51.3)	238 (48.7)	489 (75.1)	27.22 (<0.001)	2.74 (1.86–4.04)
Absent	45 (27.8)	117 (72.2)	162 (24.9)		

Note: There are 25 missing cases.

a study in patients from the Philippines. A research conducted in KSA showed that, in general, those less than 40 years old were more likely to have sinusitis.<sup>21</sup> However, another study conducted in India found that those aged 21–30 years were most commonly affected.<sup>10</sup>

Due to the reliance on patient-reported symptoms for the diagnosis of sinusitis, the observed prevalence differences of sinusitis by sex and age group could be due to variation in the rates of patients seeking medical help and reporting symptoms.<sup>22</sup> Additionally, the presence of other possible risk factors for sinusitis may vary according to sex, for example, smoking could also play a role in causing the disease.<sup>23</sup>

Among the patients diagnosed with sinusitis, 84.4% also had DNS. Interestingly, another study done in Saudi reported an incidence of DNS in 91.3% of sinusitis cases, which is higher than that found in this study.<sup>3</sup> A study conducted in the United States had a similar percentage, with 98.4% of their patients having DNS.<sup>9</sup> In India, 88.2% of sinusitis cases also had DNS.<sup>24</sup> However, a study done in Pakistan reported an incidence of DNS in 56% of patients with sinusitis.<sup>5</sup> These findings raise the question of why the incidence of DNS among sinusitis patients seems to be higher in certain populations.

Our results revealed the presence of a statistically significant association between sinusitis and DNS ( $P < 0.001$ ). Patients with DNS were about three times more likely to have sinusitis compared to others (OR = 2.74, 95% CI: 1.86–4.04). The results of our study were in accordance with other studies conducted in different countries, which showed that DNS is associated with significant sinonasal disease.<sup>2,7,10</sup> In fact, Shoib, et al.<sup>10</sup> reported a similar statistically significant association between DNS and sinusitis.

There are two possibilities that can potentially explain the relationship of DNS with sinusitis. The first possibility is that a mechanical issue occurs in the form of a narrow osteomeatal complex as a result of nasal septum deviation.<sup>25</sup> The other possibility could be that DNS changes the airflow dynamics within the sinuses causing impairment of the mucociliary function. Both of these can cause retained secretions, and thus infections within the sinuses.<sup>26–28</sup>

By contrast, other publications found no link between the presence of DNS and the imaging evidence of rhinosinusitis.<sup>5,8,9</sup> This discrepancy regarding the relationship between DNS and sinusitis could possibly be attributed to the cumulative effect of different anatomical variations occurring at the same time and their role in sinus pathology in different patient groups worldwide, which could explain why this association is significant in certain populations. Therefore, further research should be done to assess whether certain types of DNS are more prone to developing sinusitis, and to evaluate the effect of other anatomical variations on sinusitis and their interplay with each other in regard to sinusitis.

Although our sample size was much larger than any published work in this field, this study was a retrospective record review. Therefore, some limitations should be noted. In some cases, there was not adequately reported clinical information to determine whether a case was diagnosed with sinusitis; thus, in those cases, we depended upon the radiological report findings only. As the study was conducted in a hospital setting (i.e. more severe cases), selection bias may

have inflated the prevalence. Additionally, due to the nature of this study, some cofounders, such as history of smoking and allergies, could not be assessed. Therefore, we recommend that studies be done to understand why sinusitis is more prevalent in men and in those within a certain age group, and to determine whether external factors such as smoking could be implicated behind such associations.

## Conclusion

Approximately half of the patients in this study suffered from sinusitis, and it was more prevalent in males, with a statistically significant difference between both sexes. There also appeared to be a significant association between age and sinusitis. Additionally, approximately three-quarters of the patients had DNS, and there was a significant association between DNS and sinusitis. Assessing for the presence of DNS and correcting it, if possible, is recommended to prevent the occurrence of sinusitis.

## Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Conflict of interest

The authors have no conflict of interest to declare.

## Ethical approval

The Institutional Review Board of King Abdulaziz University, Reference Number: 180-21, Date: March 21, 2021.

## Authors contributions

ZHA: Research design, data collection, data organization and analysis, and contributing significantly by fully writing the methodology. AOA: Data collection and contributing significantly by fully writing the abstract and conclusion. KSA: Data collection and contributing significantly by fully writing the introduction. AAM: Data collection and contributing significantly by fully writing the results. RAN: Data collection and contributing significantly by fully writing the discussion. NKI: Supervision of research, advanced statistical analysis, reviewing and editing the paper, and helping in submission to a journal with a good impact factor. AMA: Supervision of research, reviewing and editing the paper, and helping in submission to a journal with a good impact factor. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

## Acknowledgments

The authors would like to thank the Research Summer School 2021 project conducted by the Research Principles Club of King Abdulaziz University for their help in this research.



## References

- Ogle OE, Weinstock RJ, Friedman E. Surgical anatomy of the nasal cavity and paranasal sinuses. *Oral Maxillofac Surg Clin North Am* 2012; 24(2): 155–166.
- Espinosa W, Genito R, Ramos RZ. Anatomic variations of the nasal cavity and paranasal sinus and their correlation with chronic rhinosinusitis using Harvard staging system. *J Otolaryngol ENT Res* 2018; 10(4): 190–193.
- Mohammed OA, Yousef M, Abukonna A, Alghamdi SS, Abdelaziz I, Alkhidir NAM. Computed tomographic evaluation of anatomical variations of paranasal sinuses region in rhinosinusitis. *Merit Res J Med Med Sci* 2019; 7: 489–497. <https://doi.org/10.5281/zenodo.3592275>.
- Alrumaih RA, Ashoor MM, Obidan AA, Al-Khater KM, Al-Jubran SA. Radiological sinonasal anatomy. Exploring the Saudi population. *Saudi Med J* 2016; 37(5): 521–526.
- Qureshi MF, Usmani A. A CT-Scan review of anatomical variants of sinonasal region and its correlation with symptoms of sinusitis (nasal obstruction, facial pain and rhinorrhea). *Pak J Med Sci* 2021; 37(1): 195.
- Dwivedi AN, Singh KK. CT of the paranasal sinuses: normal anatomy, variants and pathology. *J Optoelectron Biomed Mater* 2010; 2(4): 281–289.
- Elsayed NM, Abdalaal LF. The relation between anatomical variations of osteomeatal complex & nasal structures and chronic sinusitis by computed tomography. *Int J Med Imaging* 2015; 3(2): 16–20. <https://doi.org/10.11648/j.ijmi.20150302.12>.
- Kaygusuz A, Haksever M, Akduman D, Aslan S, Sayar Z. Sinonasal anatomical variations: their relationship with chronic rhinosinusitis and effect on the severity of disease—a computerized tomography assisted anatomical and clinical study. *Indian J Otolaryngol Head Neck Surg* 2014; 66(3): 260–266.
- Shpilberg KA, Daniel SC, Doshi AH, Lawson W, Som PM. CT of anatomic variants of the paranasal sinuses and nasal cavity: poor correlation with radiologically significant rhinosinusitis but importance in surgical planning. *AJR Am J Roentgenol* 2015; 204(6): 1255–1260.
- Shoib SM, Viswanatha B. Association between symptomatic deviated nasal septum and sinusitis: a prospective study. *Res Otolaryngol* 2016; 5(1): 1–8. <https://doi.org/10.5923/j.otolaryn.20160501.01>.
- Sumaily I. Anatomical variations of paranasal sinuses gender and age impact. *Glob J Otolaryngol* 2018; 14(1). GJO.MS.ID.555877.
- Alshaikh N, Aldhurais A. Anatomic variations of the nose and paranasal sinuses in Saudi population: computed tomography scan analysis. *Egypt J Otolaryngol* 2018; 34(4): 234–241.
- Prasad S, Varshney S, Bist S, Mishra S, Kabdwal N. Correlation study between nasal septal deviation and rhinosinusitis. *Indian J Otolaryngol Head Neck Surg* 2013; 65(4): 363–366.
- Andy S, Sarookhani D, Tavirany MR. Prevalence of Sinusitis in Iran: a systematic review and meta-analysis study. *Der Pharm Lett* 2016; 8(5): 31.
- Ravantara CM, Magdi YL, Kasim BI. Prevalence of chronic rhinosinusitis in ENT Department RSUP Dr. Mohammad Hoesin Palembang Period 2016-2018. *Sriwij J Med* 2020; 3(2): 183–193.
- Schiller JS, Lucas JW, Ward BW, Peregoy JA. Summary health statistics for U.S. adults: National Health Interview Survey, 2010. *Vital Health Stat* 2012; (252): 1–207.
- Min Y-G, Jung H-W, Kim H, Park S, Yoo K. Prevalence and risk factors of chronic sinusitis in Korea: results of a nationwide survey. *Eur Arch Otorhinolaryngol* 1996; 253(7): 435–439.
- Kim YS, Kim NH, Seong SY, Kim KR, Lee G-B, Kim K-S. Prevalence and risk factors of chronic rhinosinusitis in Korea. *Am J Rhinol Allergy* 2011; 25(3): e117–e121.
- Hastan D, Fokkens W, Bachert C, Newson R, Bislimovska J, Bockelbrink A, et al. Chronic rhinosinusitis in Europe—an underestimated disease. A GA2LEN study. *Allergy* 2011; 66(9): 1216–1223.
- Chung SD, Hung SH, Lin HC, Lin CC. Health care service utilization among patients with chronic rhinosinusitis: a population-based study. *Laryngoscope* 2014; 124(6): 1285–1289.
- Homood MA, Alkhayrat SM, Kulaybi KM. Prevalence and risk factors of chronic sinusitis among people in Jazan region' KSA. *Egypt J Hosp Med* 2017; 69(5): 2463–2468.
- Ference EH, Tan BK, Hulse KE, Chandra RK, Smith SB, Kern RC, Conley DB, Smith SS. Commentary on gender differences in prevalence, treatment, and quality of life of patients with chronic rhinosinusitis. *Allergy Rhinol (Providence)*. 2015; 6(2): 82–88. <https://doi.org/10.2500/ar.2015.6.0120>.
- Dar AK, Lone AH. Demographic study of sinusitis in patients visiting Govt. Unani Hospital Srinagar and Ayush Centres in Kashmir. *Med J Islam World Acad Sci* 2013; 21(3): 115–118.
- Tiwari R, Goyal R. Study of anatomical variations on CT in chronic sinusitis. *Indian J Otolaryngol Head Neck Surg* 2015; 67(1): 18–20.
- Poorey V, Gupta N. Endoscopic and computed tomographic evaluation of influence of nasal septal deviation on lateral wall of nose and its relation to sinus diseases. *Indian J Otolaryngol Head Neck Surg* 2014; 66(3): 330–335.
- Yigit O, Akgul G, Alkan S, Uslu B, Dadas B. Changes occurring in the nasal mucociliary transport in patients with one-sided septum deviation. *Rhinology* 2005; 43(4): 257.
- Jang YJ, Myong N-H, Park KH, Koo TW, Kim H-G. Mucociliary transport and histologic characteristics of the mucosa of deviated nasal septum. *Arch Otolaryngol Head Neck Surg* 2002; 128(4): 421–424.
- Mariappan R, Dhanalakshmi M, Mathaikutty DM, Shanmugam R, Shanmugam U, Swaminathan B, et al. Clinico-pathological correlation and the effects of septal surgery on nasal mucociliary clearance. *Sch J Appl Med Sci* 2014; 2(5C): 1691–1695.

**How to cite this article:** Alsaggaf ZH, Almadfaa AO, Marouf AA, Alfawaz KS, Niyazi RA, Ibrahim NK, Ajlan AM. Sinusitis and its association with deviated nasal septum at a tertiary hospital: A retrospective study. *J Taibah Univ Med Sc* 2022;17(6):1065–1069.