

# Prevalence of snoring and facial profile type, malocclusion class and dental arch morphology among snorer and nonsnorer university population

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## ABSTRACT

**Objectives:** The objectives of this study were to determine the prevalence of snoring in an adult male university population, and to test the null hypothesis that there is no difference in facial profile shape, malocclusion type, or palatal morphology among snorer and nonsnorer.

**Materials and Methods:** Berlin questionnaire was given to 840 students and employees aged 18–45 years ( $24 \pm 40$ ). Both snorers and nonsnorers were assessed for the facial profile type, malocclusion type, and palatal morphology. Chi-square and Student's *t*-test were used to compare the difference between the two groups.

**Results:** The prevalence of snoring was 16.28%. The most frequent findings among snorer were straight profiles (52.0%), Class I malocclusion (74.7%), and V palatal shape (16.0%), respectively. The Chi-square test revealed a significant difference in terms of V-shaped palatal morphology ( $P < 0.05$ ); higher neck circumference (NC) ( $P < 0.007$ ); upper arch length was significantly shorter ( $P < 0.038$ ); and the inter-first upper premolar distance was significantly narrower ( $P < 0.013$ ).

**Conclusion:** The null hypothesis is rejected. Snoring in our university population is associated with V-shape palatal morphology, increased NC and decrease in the upper arch length, and inter-first upper premolar distance.

**Key words:** Adult, dental arch, facial profile, malocclusion, orthodontic, snoring

## INTRODUCTION

Snoring is not a benign symptom. It is associated with an increased risk of hypertension, cardiac arrhythmias, and mortality.<sup>[1]</sup> Snoring is defined as a sound produced when an individual breaths during sleep due to the turbulence of air

passing through the partially obstructed airway. It is considered as one of the most common clinical symptoms of obstructive sleep apnea (OSA).<sup>[2]</sup> Snoring may result in excessive daytime sleepiness, loss of concentration, and psychological disturbances that may eventually cause deterioration of the patient life quality unless treated.<sup>[1]</sup> The estimations of snoring prevalence ranged between 16% and 89% of the general population. This wide range is due to the differences in the populations studied, study design, investigations performed, ethnic group, age, and sex of the subjects.<sup>[1-6]</sup> Snoring is potentially related to the increase in the body mass index (BMI), cigarette consumption, ethnic differences, infections, and hypertension.<sup>[7-9]</sup> Nocturnal polysomnography is considered the best tool to investigate whether snoring is a health risk.

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However, it is not widely available and expensive to be used as a screening tool, as it is mostly available only in specialized sleep clinics. Therefore, the use of questionnaires like Berlin questionnaire become a simple and effective method of screening for snoring and risk of OSA.<sup>[3]</sup> In addition, many craniofacial features and malocclusions were reported to be associated with snoring. For example; narrow airway at the level of the soft palate and oropharynx, more inferiorly positioned hyoid bone, more protruding maxilla, anterior-posterior discrepancy of maxilla and mandible, Class II malocclusion, increase in over-jet, reduced overbite, narrower upper, and shorter lower dental arch and crowding in the mandibular arch.<sup>[10-13]</sup> According to literature, snoring was associated with OSA, and the characteristics were complicated with other dentofacial risk features such as facial profile, malocclusion classification, and dental arch morphology. For instance, Stellzig-Eisenhauer and Meyer-Marcotty (2010) reported a significant difference between patients with retrognathism and pragmatism in respect to the transverse dimension of the nasopharynx.<sup>[14]</sup>

However, de Freitas *et al.*, found no correlation between obstructions of the upper airway and the frequency of malocclusions.<sup>[15]</sup> This reflects the discrepancy between the influence of the facial profile, malocclusion classification, and dental arch morphology on airway measurements. Therefore, the aim of this study was to test the null hypothesis that there is no morphological difference in facial profile, malocclusion class, and dental arch morphology in adult Yemenis male with and without snoring. Rejection of the null hypothesis might improve our understanding of the influence of snoring on the surrounding dentofacial structures.

## MATERIALS AND METHODS

After the study was approved at the institutional level and informed consent was obtained, a cross-sectional study was carried out among male students and employees at the University of Science and Technology. For the prevalence study, the sample size was calculated using Power and Sample Size Software (5.2 MB version 2.1.31.) which indicated 840 subjects is required for this study. When the participants agreed to participate in the study, a consent form was given along with a set of the sleep behavior questionnaire (Berlin questionnaire). The inclusion criteria were: Age 18 and above, healthy individuals without any diseases or congenital abnormalities and the presence of at least six teeth in each maxillary and mandibular arch. The exclusion criteria were any psychological diseases, alcohol drinking, and craniofacial deformity. Each selected subject undergone clinical examination, upper and lower arch impression, and BMI calculation. Totally, 150 participants (75 snorers: 9 employees, 66 students) and (75 nonsnorers: 8 employees, 67 students) were able to complete their required records. For assessment of snoring, the Berlin questionnaire was used to assess snoring status.<sup>[16]</sup> The Arabic version of the questionnaires was adapted from a previous study.<sup>[17]</sup>

Each individual age, sex, height, and weight were recorded. BMI was calculated from the patient's height and weight in standard units ( $\text{kg}/\text{m}^2$ ), and neck circumference (NC) was measured at the level of the thyroid cartilage. The facial profile was assessed by classifying the facial profile into convex, concave, and straight. Malocclusion was assessed according to Angle classification.<sup>[10]</sup> Assessment of arch morphology and palatal morphology were carried out as following: Arches were classified as constricted and nonconstricted. The dental arch constriction was defined as the presence of two or more maxillary posterior teeth in edge to edge cuspal relationship with their antagonists, or in a frank cross bite.<sup>[18]</sup> The palatal morphology divided into U-shaped (normal) and V-shaped (constricted).<sup>[10]</sup> Maxillary constriction was defined by the presence of all the following features: A narrow and high palatal vault; corresponding narrow arch form and unilateral or bilateral buccal tilting of the maxillary alveolar arches with posterior teeth in crossbite or edge to edge relationship with the lower teeth.<sup>[18]</sup> Assessment of dental cast parameters were completed by taken dental impression and fabricating a set of upper and lower models. Alginate impression material (Zhermack, Germany) mixed according to the manufacturer's instructions. The following measurements were recorded using digital calipers: Inter-canine distance; inter-premolar distance; intermolar distance; arch length; palatal cast depth.<sup>[18]</sup>

## RESULTS

Out of 840 questionnaires distributed, 700 were returned (77 employees and 623 students); the response rate was 80%. A total of 114 snorers were identified (16.28%). Nine were employees (11.7%), and 105 were students (16.9%). Totally, 150 participants (75 snorers) and 75 nonsnorers were able to complete their required records and, therefore, were included in the comparison study. Table 1 shows the demographic profile of 150 subjects who were males with mean age of  $24 \pm 4$  years, mean height of  $167 \pm 6$  cm, mean weight of  $63 \pm 10$  kg, mean BMI of  $22.5 \pm 3$   $\text{kg}/\text{m}^2$ , and mean NC  $36 \pm 2.6$  cm.

Accordingly, the mean neck size was found to be significantly greater for the snorer group ( $36.6 \pm 2.5$ ) than nonsnorer group [ $35.4 \pm 2.6$ ;  $P < 0.007$ ; Table 1]. Clinical examination shows that the most frequent finding among snorer groups when compared with the nonsnorer group were straight profiles (52.0%), Class I malocclusion (74.7%), and V palatal shape (16.0%), respectively [Table 2]. The Chi-square test revealed a significant difference among the V-shape palatal

**Table 1: Clinical observation of snorers and non-snorers extra-oral variables**

| Variable                       | n=75        |             | P value |
|--------------------------------|-------------|-------------|---------|
|                                | Snorers     | Non-snorers |         |
| Height (cm)                    | 167.32±7.15 | 166.5±6.67  | 0.484   |
| Weight (kg)                    | 64.57±11.05 | 61.43±9.57  | 0.065   |
| BMI ( $\text{kg}/\text{m}^2$ ) | 23.00±3.24  | 22.14±3.23  | 0.107   |
| NC (cm)                        | 36.59±2.55  | 35.42±2.65  | 0.007*  |

\*Significant  $P < 0.05$ . BMI – Body mass index; NC – Neck circumference

morphology ( $P < 0.034$ ), but no significance was found in terms of the facial profiles; malocclusion class or arch morphology. These results are summarized in Table 2. In addition, the upper arch length was significantly shorter ( $35.6 \pm 2.5$ ) in the snorer subjects than the nonsnorer group ( $36.4 \pm 2.5$ ;  $P < 0.038$ ), and the inter-first upper premolar distance was significantly narrower ( $39.6 \pm 2.6$ ) in the snorer subjects than in the nonsnoring group [ $40.8 \pm 2.9$ ;  $P < 0.013$ ; Table 3].

## DISCUSSION

The present study was carried out to determine the prevalence of snoring among male adult at university population setting

**Table 2: Orthodontic observation of facial profile, malocclusion class, arch morphology and palatal shape**

| Variables            | n=75 (n (%)) |            | P value <sup>a</sup> |
|----------------------|--------------|------------|----------------------|
|                      | Snorer       | Non-snorer |                      |
| Facial profile shape |              |            |                      |
| Straight             | 39 (52.0)    | 38 (50.7)  | 0.343                |
| Convex               | 34 (45.3)    | 37 (49.3)  |                      |
| Concave              | 02 (02.7)    | 0.0        |                      |
| Malocclusion         |              |            |                      |
| Class I              | 56 (74.7)    | 57 (76.0)  | 0.691                |
| Class II             | 10 (13.3)    | 7 (9.3)    |                      |
| Class III            | 9 (12.0)     | 11 (14.7)  |                      |
| Arch morphology      |              |            |                      |
| Constricted          | 15 (20.0)    | 12 (16.0)  | 0.524                |
| Normal               | 60 (80.0)    | 63 (84.0)  |                      |
| Palatal morphology   |              |            |                      |
| U (shape)            | 63 (84.0)    | 71 (94.7)  | 0.034*               |
| V (shape)            | 12 (16.0)    | 4 (5.3)    |                      |

<sup>a</sup>Pearson Chi square was used. \*Significant at  $P < 0.05$

**Table 3: Orthodontic observation of dental cast measurements (mean±SD) in snorers and non-snorers**

| Cast measurements | n=75       |             | P value |
|-------------------|------------|-------------|---------|
|                   | Snorers    | Non-snorers |         |
| ICDU              | 29.34±2.16 | 29.57±2.02  | 0.501   |
| IP1DU             | 35.56±2.50 | 36.41±2.48  | 0.038*  |
| IP2DU             | 40.86±2.98 | 41.44±2.75  | 0.216   |
| IMDU              | 46.61±3.12 | 47.46±2.83  | 0.084   |
| ICDL              | 23.82±2.06 | 23.62±1.74  | 0.542   |
| IP1DL             | 30.21±2.20 | 29.87±2.20  | 0.345   |
| IP2DL             | 35.11±3.52 | 35.11±2.26  | 0.999   |
| IMDL              | 41.45±3.22 | 41.82±2.63  | 0.434   |
| UAL               | 39.63±2.63 | 40.77±2.90  | 0.013*  |
| LAL               | 34.23±2.59 | 35.13±3.18  | 0.060   |
| PD1M              | 21.51±2.40 | 21.05±2.44  | 0.251   |
| PD2P              | 19.84±2.30 | 19.48±2.64  | 0.381   |
| PD1P              | 15.07±2.23 | 15.23±2.74  | 0.699   |
| PDC               | 9.94±2.04  | 10.03±2.15  | 0.794   |

All measurements are in millimeters. ICDU – Inter upper canine distance; IP1DU – Inter upper first premolar distance; IP2DU – Inter upper second premolar distance; IMDU – Inter upper molar distance; IC DL – Inter lower canine distance; IP1DL – Inter lower first premolar distance; IP2DL – Inter lower second premolar distance; IMDL – Inter lower molar distance; UAL – Upper arch length; LAL – Lower arch length; PD1M – Palatal depth at first molar area; PD2P – Palatal depth at second premolar area; PD1P – Palatal depth at first premolar area; PDC – Palatal depth at canine area. \*Significant at  $P < 0.05$

and to compare the craniofacial features of an adult with and without snoring using clinical examination. Our result indicate that the prevalence of snoring in our university population was 16.28%. In addition, the clinical examination showed that the snoring in our adult university population manifested a significantly different craniofacial feature, such as a V-shaped palate; higher NC; lower upper arch length; and a decrease in the inter-first upper premolar distance. Based on our prevalence of snoring result, it seems that the prevalence of snoring in our sample is slightly higher from the average of snoring prevalence quoted earlier<sup>[1,6,19]</sup> but lesser compared with the other studies in student population.<sup>[20-22]</sup> Table 4 summarized previous studies of snoring among the student population. Comparing our result to Malaysian medical students,<sup>[21]</sup> our result showed a higher percentage of snoring, which might be due to a mixture of students and employees in our sample; different age; and BMI and diverse definition of snoring. Hui *et al.* concluded that snoring was prevalent in student population, and male gender showed a trend as an independent predictor for snoring, which is similar to our result.<sup>[6]</sup>

When we compared our result with the general adult population findings, our result is slightly lower than the prevalence of snoring reported by middle-Eastern studies (52.3% Saudi and 28.7% Jordanian BaHammam *et al.* and Khassawneh *et al.*, respectively).<sup>[17,23]</sup> However, in Asian adults, it was found that the prevalence of snoring is higher than the western population study.<sup>[24,25]</sup> Nevertheless, it should be understood that the prevalence of snoring does not necessarily indicate the development of obstructive complications but these findings do highlight the need for awareness about possible complications.<sup>[19]</sup>

The results of this current study, indicate the NC is significantly greater for the snoring group than for the nonsnorer group. This finding supports the view that NC is one of the significant risk factors for Yemeni snorer, which is in good agreement with findings obtained in the Chinese<sup>[9,26]</sup> and Japanese populations.<sup>[13]</sup> Increased NC even in the absence of obesity in our subjects, may draw our attention on the importance of the fat tissue around the neck in nonobese individuals. Furthermore, snoring and greater NC were also considered as useful clinical predictors of OSA.<sup>[27]</sup> Clinical examination findings indicate that the most frequent finding among snorer groups were straight profiles (52.0%), Class I malocclusion (74.7%), and V palatal shape (16.0%), respectively. Even though, there is no relationship between upper airway obstruction and the type of malocclusion were found but it has been reported that the upper pharyngeal width in the subjects with Class I and Class II malocclusions with the vertical growth patterns were significantly narrower than in the normal growth pattern group.<sup>[15]</sup> Therefore, this makes the orthodontist more alert to enquire about snoring even in Class I malocclusion and straight profile patients especially with vertical growth patterns. On the other hand, it has been reported that convex profiles (71.7%), Class II malocclusion (51.7%), and V palatal shape (53.3%)

**Table 4: Summary of snoring among the student population (from most to least severe)**

| Author                                  | Location  | Year | Participant                      | Sex | Age   | Percentage |
|---|-----------|------|----------------------------------|-----|-------|------------|
| Patel <i>et al.</i> <sup>[1]</sup>      | USA       | 2008 | University students              | MF  | 18-25 | 30.0       |
| Hui <i>et al.</i> <sup>[6]</sup>        | Hong kong | 1999 | First year Medical students      | MF  | 19-21 | 25.7       |
| Singh <i>et al.</i> <sup>[19]</sup>     | India     | 2012 | Medical students                 | MF  | 17-25 | 17.7       |
| Al-madani <i>et al.</i> (current study) | Yemen     | 2013 | University students and employee | M   | 18-45 | 16.28      |
| Ficker <i>et al.</i> <sup>[20]</sup>    | Germany   | 1999 | Final year Medical students      | MF  | 24-27 | 11.9       |
| Tiong <i>et al.</i> <sup>[21]</sup>     | Malaysia  | 2007 | Medical students                 | MF  | 19-42 | 7.2        |
| Stoohs <i>et al.</i> <sup>[22]</sup>    | Germany   | 1998 | University students              | MF  | 19-22 | 3.4        |

MF – Male, Female

were frequent features in an Asian OSA sample.<sup>[10]</sup> This in contrast to our current study, and this could be related to the difference between the OSA as a general term while the snoring is one of the OSA symptoms and to the differences in the cranial base morphology between Asians and Caucasian.

Using dental examination, we found statistically significant difference between Yemeni snorers and nonsnorer in a V-shape palatal arch; the arch length and the inter-first premolar distance. In view of the fact that the roof of the mouth is also the floor of the nose, a narrow arch can infringe on the nasal cavity space. Therefore, maxillary constriction, in addition to his responsibility as one of the important factors for determining nasal airway properties, it can also contribute to lateral narrowing of the upper oral cavity and a low tongue posture which consequently narrow the retroglossal region.<sup>[18]</sup> This may provide a reasonable explanation for the narrowing of the posterior airway space seen in OSA patients.<sup>[10]</sup> The V palatal shape was also included as one predictive morphometric model for OSA, and the model illustrates the potential value of physical and dental examination.<sup>[27]</sup> Our cross-sectional study may have some potential limitations to consider. For instance, there is a possibility of under diagnosis of snoring when a standard full night polysomnography test is not administered. However, Berlin questionnaire can still be considered as an effective and inexpensive way for screening snoring. Another limitation of this study is the fact that females were not included. For cultural factors, females were not included in this study.

In summary, this study suggests that snoring among our university population is associated with increased NC; V-shape palatal morphology; the short upper arch length; and narrow inter-first upper premolar distance. Clinically, increased NC even in the absence of obesity may draw our attention to the importance of the fat tissue around the neck in nonobese individuals. In addition, the orthodontist and other health care should be more alert to enquire about snoring, take the complaint of snoring seriously, and perform a thorough clinical and orthodontic evaluation even in Class I malocclusion and straight profile patient especially college-aged male adult with vertical growth patterns.

Furthermore, on the basis of clinical and orthodontic observation that have been recognized in this study, we believe that those observation features could be used to improve our

understanding of the influence of snoring on the surrounding dentofacial structures of the adult university population and may provide valuable screening information in the identification of patients with undiagnosed OSA. Further studies are needed to find other clinical and orthodontic features in a diverse university population with different ethnic and sex trends in regards to snoring patterns.

## CONCLUSION

The null hypothesis is rejected. Snoring in our university population is associated with V-shape palatal morphology, increased NC, and decrease in the upper arch length and inter-first upper premolar distance.

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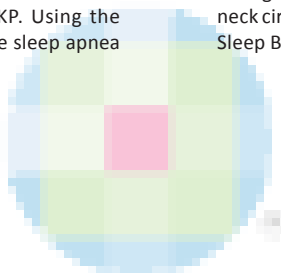
## Conflicts of Interest

There are no conflicts of interest.

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