

## ORIGINAL RESEARCH

# Visually impaired population from low socioeconomic strata and their oral health status: an observational study

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**Abstract**

A significant portion of the world's population suffers from blindness. Despite being a vital part of systemic health, oral health is neglected in such a population. The present study aimed to determine the oral health status of blind individuals in north India and to identify the factors affecting it. Sixty-nine blind students from a local school for the visually impaired were included in the study. A questionnaire was used to record the basic demographic details and oral habits, followed by an oral examination by a single trained dentist to record dental caries, periodontal status and dental trauma. The prevalence of Dental caries was 63.8% (mean 1.43 ± 1.61). Gingival bleeding on probing (BOP) was found in 60.9% of individuals. Dental trauma prevalence was 23.2%, and harmful oral habits were found in 31.9% of individuals. Individuals experiencing a toothache in the last year had a 1.784 times higher risk of dental caries than those who didn't experience a toothache. Individuals having acquired blindness are 2.411 times more prone to dental trauma in comparison to those suffering from congenital blindness. Blind individuals have poor oral health. Toothache in the last one year is an important risk factor for dental caries in such individuals. Acquired blindness makes a person more susceptible to dental trauma than congenital blindness.

**Keywords**

Visual impairment; Blindness; Oral health; Dental caries; Low socioeconomic status

## 1. Introduction

Visual impairment is a globally prevalent condition which affects individuals in carrying out their day-to-day activities like reading, writing, brushing teeth, walking without support, *etc.* World Health Organization (WHO) reported a global prevalence of 2.2 billion people suffering from visual impairment as on October 2022. A person with visual acuity worse than 3/60 is considered blind [1]. There are numerous reasons for visual impairment which may lead to blindness; the majority of those, like cataracts, refractive error, *etc.*, are preventable, while the other few, like age-related macular degeneration, optic atrophy, *etc.*, are non-preventable. Visual impairment is more prevalent in underdeveloped or developing countries like those in sub-Saharan Africa and southern Asia [2]. Asia-pacific region has a greater prevalence of visual impairment compared to Europe or America because of the very large population, especially in China and India [2].

Oral health is affected in people with visual impairment mainly because of a lack of attention to their oral health, as these people are more concerned about their systemic health. Lack of hand-eye coordination is another major reason for neglected oral health in such people [3]. Majority of people suffering from visual impairment have little or no knowledge

about maintenance of oral hygiene and have limited access to oral health care services, as a result of which oral diseases are prevalent in such populations [4, 5]. As visual impairment is more common in populations with low per capita income, such people also have very poor health status and need oral health care [1].

Deleterious oral habits like nail biting, bruxism, mouth breathing, lip biting, *etc.*, affect the oral health status of the individual as such habits lead to changes in our facial musculature, malocclusion and other dental-facial abnormalities [6]. Most oral diseases like dental caries and periodontal disease are preventable if proper oral care measures are taken, and vulnerable sections of the population are made aware of them. Completely blind people with no sensation of sight face more difficulty maintaining their oral hygiene than mild or moderately visually impaired people. Despite having a very high prevalence of visual impairment in India, few studies exist evaluating the oral health status of visually impaired people; however, to the best of our knowledge, no study exists evaluating oral health status and the prevalence of harmful oral habits in completely blind people.

This study aimed to evaluate the oral health status of completely blind students in north India, determine the prevalence of deleterious oral habits in such students and analyse the

factors determining the oral health status of such individuals.

## 2. Materials and methods

A cross-sectional study was conducted from September 2022 to December 2022, in which blind participants were enrolled. All the students who were studying at a school for blind students in the area and fulfilled the eligibility criteria were included in the study. A purposive sampling technique was used to enrol participants in the study.

### 2.1 Eligibility criteria

Inclusion criteria for enrolling participants: (1) Blind individual, (2) Able to cooperate during the study, (3) Willing to participate. Exclusion criteria: (1) Person suffering from mental retardation; (2) Person suffering from any other kind of disability.

### 2.2 Data collection and clinical examination

The study was conducted by first asking the participants about their oral habits, followed by an oral examination. The oral examination of the participants was carried out by a single trained dentist who first recorded the general characteristics data like age, gender, residence, brushing frequency, deleterious oral habits, *etc.*, using a questionnaire form and then carried out an oral examination of the participants. The examination was conducted on a chair with a light source, mouth mirror and Community Periodontal Index Probe (CPI Probe). A decayed Missing Filled Tooth (DMFT) score was recorded to assess dental caries; gingival bleeding was recorded for the evaluation of periodontal disease. CPI Probe was used to check the periodontal condition and bleeding on probing. A force of approximately 20 grams was used while using the probe for periodontal evaluation by moving all around the tooth (buccal, lingual/palatal and interproximal area), and 30 seconds was allowed to pass to check for bleeding on probing before moving to the next tooth. A modified traumatic dental injury classification system by the WHO was used to record dental trauma [7], in which each tooth was classified into one of the eight different groups and assigned a score accordingly. Score 0: No sign of injury; 1: Treated injury; 2: Enamel fracture only; 3: Enamel and dentin fracture; 4: Pulp involvement; 5: Missing tooth due to trauma; 6: Other damage; 9: Excluded tooth. All the teeth' surfaces in the oral cavity were examined to record dental caries, bleeding on probing, and traumatic dental injuries. Sample size was calculated using the formula given below, where  $n$  is the sample size,  $z = 1.96$  (value of  $z$  at 95% confidence interval),  $p$  is the population proportion, which is 0.0008 in this case as the prevalence of blindness in children in India is 0.08% [8], and  $e$  is the margin of error, which is 0.05 in this case.

$$n_0 = \frac{Z^2 p (1 - p)}{e^2}$$

## 2.3 Statistical analysis

Statistical analysis of the data was done using SPSS software (Statistical Package for the Social Science; version 16.0, SPSS Inc., Chicago, USA). Univariate analysis (chi-square test) was done to identify the possible risk factors of dental caries, dental trauma and bleeding on probing. Relative risk was calculated for the identified risk factors. Fisher's exact test was used when it was found to be less than five during the analysis of the table value in any cell. Mann-Whitney U test was used when the data was not normally distributed to compare the significant difference between the mean number of teeth. Differences having  $p$ -value  $< 0.05$  were considered to be statistically significant.

## 3. Results

A total of 69 participants were enrolled in the study, of which 55 (79.7%) were male and 14 (20.3%) were female. All the participants were in the age range of 7–28 years, having a mean age of  $19.74 \pm 4.77$  years. Congenital blindness was found in 45 (65.2%) participants, while 24 (34.8%) participants acquired it later in life. The overall prevalence of dental caries was 63.8% with the mean DMFT score being  $1.43 \pm 1.61$  (Table 1). Participants in the age group of 7–12 years had a mean DMFT score of  $2.71 \pm 3.15$ , while those in the age group of 13–28 years had a mean DMFT score of  $1.29 \pm 1.31$ . Bleeding on probing was found in 60.9% of the participants with the mean number of teeth with bleeding on probing being  $4.97 \pm 6.25$ . The mean number of teeth with bleeding on probing in the age group of 7–12 years was  $0.57 \pm 1.51$ , while those in the age group of 13–28 years had a mean of  $5.47 \pm 6.40$ , having a statistically significant difference between them ( $p$ -value = 0.009). The prevalence of teeth with bleeding on probing in the age group of 7–12 years was 14.3%, while in the age group of 13–28 years, the prevalence was found to be 66.1%, having a statistically significant difference between them ( $p$ -value = 0.012) (Table 1). The overall prevalence of dental trauma was 23.2% with the mean number of teeth affected by dental trauma being  $0.39 \pm 0.88$ . The prevalence of dental trauma in participants suffering from congenital blindness was 15.6%, while among participants with acquired blindness, the prevalence was found to be 37.5%, having a statistically significant difference between them ( $p$ -value = 0.04) (Table 1).

The prevalence of deleterious oral habits was found to be 31.9%. Among deleterious oral habits, bruxism (11.6%) was found to be most common, followed by nail biting and mouth breathing habits (8.7% each), while thumb sucking (1.4%) was found to be least common (Table 2). The prevalence of thumb sucking in the age group of 7–12 years was 14.3%, while none of the participants in the age group 13–28 years reported the habit of thumb sucking. Tongue thrusting habit was found in 12.5% of the participants having acquired blindness, while none of the participants suffering from congenital blindness reported tongue thrusting habit, having a statistically significant difference between them ( $p$ -value = 0.04) (Table 2).

To identify factors affecting dental caries, dental trauma, and bleeding on probing, data collected using the questionnaire like

TABLE 1. Oral health status of blind students.

Variables	n (%)	Mean DMFT score <sup>a</sup>	Caries frequency <sup>b</sup>	Mean number of teeth with BOP <sup>a</sup>	BOP frequency <sup>b</sup>	Mean number of teeth with dental trauma <sup>a</sup>	Dental trauma frequency <sup>b</sup>
Gender							
Male	55	1.42 ± 1.69	34 (61.8%)	4.89 ± 5.89	31 (56.4%)	0.38 ± 0.87	13 (23.6%) <sup>c</sup>
Female	14	1.50 ± 1.35	10 (71.4%)	5.29 ± 7.77	11 (78.6%)	0.43 ± 0.94	3 (21.4%)
Age (yr)							
7–12	7	2.71 ± 3.15	4 (57.1%) <sup>c</sup>	0.57 ± 1.51*	1 (14.3%) <sup>c**</sup>	0.43 ± 0.79	2 (28.6%) <sup>c</sup>
13–28	62	1.29 ± 1.31	40 (64.5%)	5.47 ± 6.40	41 (66.1%)	0.39 ± 0.89	14 (22.6%)
Blindness							
Congenital	45	1.60 ± 1.76	29 (64.4%)	5.82 ± 7.29	27 (60.0%)	0.29 ± 0.79	7 (15.6%) <sup>***</sup>
Acquired	24	1.12 ± 1.26	15 (62.5%)	3.38 ± 3.13	15 (62.5%)	0.58 ± 1.02	9 (37.5%)
Total (%)	69	1.43 ± 1.61	44 (63.8%)	4.97 ± 6.25	42 (60.9%)	0.39 ± 0.88	16 (23.2%)

<sup>a</sup>: Mann-Whitney U test was used, <sup>b</sup>: Chi square test was used, <sup>c</sup>: Fisher's exact test was used.

\* $p = 0.009$ , \*\* $p = 0.012$ , \*\*\* $p = 0.04$ .

DMFT: decayed missing filled tooth; BOP: bleeding on probing.

TABLE 2. Deleterious oral habits in blind students.

Variables	n (%)	Thumb sucking prevalence <sup>a</sup>	Tongue thrusting prevalence <sup>a</sup>	Nail biting prevalence <sup>a</sup>	Bruxism prevalence <sup>a</sup>	Mouth breathing prevalence <sup>a</sup>	Lip sucking prevalence <sup>a</sup>
Gender							
Male	55	1 (1.8%)	2 (3.6%)	4 (7.3%)	6 (10.9%)	5 (9.1%)	1 (1.8%)
Female	14	0 (0%)	1 (7.1%)	2 (14.3%)	2 (14.3%)	1 (7.1%)	1 (7.1%)
Age (yr)							
7–12	7	1 (14.3%)	1 (14.3%)	0 (0%)	1 (14.3%)	0 (0%)	0 (0%)
13–28	62	0 (0%)	2 (3.2%)	6 (9.7%)	7 (11.3%)	6 (9.7%)	2 (3.2%)
Blindness							
Congenital	45	1 (2.2%)	0 (0%)*	3 (6.7%)	6 (13.3%)	2 (4.4%)	1 (2.2%)
Acquired	24	0 (0%)	3 (12.5%)	3 (12.5%)	2 (8.3%)	4 (16.7%)	1 (4.2%)
Total (%)	69	1 (1.4%)	3 (4.3%)	6 (8.7%)	8 (11.6%)	6 (8.7%)	2 (2.9%)

<sup>a</sup>: Fisher's exact test was used; \* $p = 0.04$ .

age, gender, toothache in the last 1 year, and status of blindness as congenital or acquired were analyzed by univariate chi-square test. It was found that toothache in the last 1 year ( $p$ -value = 0.001), acquired blindness ( $\chi^2 = 4.232$ ,  $p$ -value = 0.040), and age group 13–28 years ( $p$ -value = 0.012) was significantly associated with dental caries, dental trauma, and bleeding on probing respectively (Tables 3,4,5). Relative risk (RR) and 95% confidence interval (CI) of these factors were calculated and it was found that toothache in the last 1 year had a relative risk of 1.784 (95% CI = 1.307–1.929) for dental caries (Table 3). Acquired blindness had a relative risk of 2.411 (95% CI = 1.042–5.550) for dental trauma (Table 4), and age group 13–28 years had a relative risk of 4.629 (95% CI = 1.262–26.027) for bleeding on probing (Table 5).

## 4. Discussion

Visually impaired individuals have less access to oral health care services [9], and this condition is even worse in those belonging to low socioeconomic strata, so it is important to determine their oral health status and analyse the factors associated with it. In our study, the prevalence of dental caries (63.8%) and the mean DMFT score (1.43 ± 1.61) were found to be higher than those reported in previous studies [10, 11]. This may be due to the reason that in our study, we included only completely blind individuals, while in other studies, individuals with varying degrees of visual impairment were included. Completely visually impaired individuals are less independent as compared to partially visually impaired individuals, thereby having a greater prevalence of dental caries [12]. The mean DMFT score in the 7–12 years' age group (2.71 ± 3.15) was found to be higher than that in the 13–28 years' age group (1.29 ± 1.31). This finding is consistent with

**TABLE 3. Univariate analysis of potentially significant factor of dental caries.**

Factor	n	Number of students with dental caries (%)	Number of students without dental caries (%)	<i>p</i> value <sup>a</sup>	Relative Risk (RR)	95% CI
Toothache in last 1 year						
Yes	18	17 (94.4%)	1 (5.6%)	0.001	1.784	1.307–1.929
No	51	27 (52.9%)	24 (47.1%)			

<sup>a</sup>: Fisher's exact test was used; CI: confidence interval.

**TABLE 4. Univariate analysis of potentially significant factor of dental trauma.**

Factor	n	Number of students with dental trauma (%)	Number of students without dental trauma (%)	Chi square ( $\chi^2$ )	<i>p</i> value	Relative Risk (RR)	95% CI
Acquired blindness							
Yes	24	9 (37.5%)	15 (62.5%)	4.232	0.040	2.411	1.042–5.550
No	45	7 (15.6%)	38 (84.4%)				

CI: confidence interval.

**TABLE 5. Univariate analysis of potentially significant factor of gingival bleeding on probing.**

Factor	n	Number of students with bleeding on probing (%)	Number of students without bleeding on probing (%)	<i>p</i> value <sup>a</sup>	Relative Risk (RR)	95% CI
Age group 13–28 years						
Yes	62	41 (66.1%)	21 (33.9%)	0.012	4.629	1.262–26.027
No	7	1 (14.3%)	6 (85.7%)			

<sup>a</sup>: Fisher's exact test was used; CI: confidence interval.

a previous study which reported higher mean DMFT in the age group <12 years as compared to those in the age group >12 years [12]. Frequent consumption of sweets and in between meals snacking is reported to be more prevalent in 6–12 years old visually impaired children [13], which may be the reason for the higher mean number of dental caries in this group as compared to those in the age group of 13–28 years. In the present study, toothache in the past year was found to be a risk factor for dental caries in visually impaired individuals (RR 1.784, 95% CI 1.307–1.929), which is consistent with the findings of a previous study that reported a similar outcome [14].

In the present study, the prevalence of gingival bleeding on probing and the mean number of teeth with gingival bleeding on probing was found to be significantly higher in the age group 13–28 years old (prevalence 66.1%, mean 5.47  $\pm$  6.40) in comparison to that in the age group 7–12 years old (prevalence 14.3%, mean 0.57  $\pm$  1.51) (*p*-value = 0.012, 0.009 respectively). Our findings are consistent with previous studies reporting a greater prevalence of gingival bleeding on probing in visually impaired children in the age group 13 years or older as compared to those in the 6–12 years' age group [13]. Visually impaired individuals have a poor understanding of maintaining oral hygiene, thereby leading to ineffective cleaning of teeth, resulting in increased plaque and calculus deposition, causing gingival inflammation, and leading to gingival bleeding on probing [15]. Dental calculus accumulates with age [14], causing an increase in gingival inflammation, thereby leading to an increased prevalence of gingival bleeding

on probing and more number of teeth affected by bleeding on probing in the 13–28 years' age group as compared to those in the 7–12 years' age group.

Previous studies reported the prevalence of traumatic dental injuries in visually impaired individuals to be about 19%–39% [12, 16]. In the present study, the prevalence of traumatic dental injury was found to be 23.2%. A significantly higher prevalence of traumatic dental injury was found in participants in the acquired blindness group (37.5%) in comparison to those in the congenital blindness group (15.6%) (*p*-value = 0.04). Until now, no study has reported the prevalence or frequency of traumatic dental injuries while comparing them to congenital and acquired blindness. The greater prevalence of traumatic dental injuries in participants having acquired blindness may be because individuals with congenital blindness have been taught since birth how to walk or carry out day-to-day activities, while on the other hand, those with acquired blindness had a normal lifestyle before getting blind, so they have to adapt to the new situation during walking or carrying out daily activities which may make them more prone to traumatic injuries at least during the initial period when they are learning to carry out their activities without vision.

Deleterious oral habits affect the oral health of an individual as they can initiate, predispose, and aggravate dental malocclusion by altering their dentofacial growth [17]. The prevalence of deleterious oral habits in the present study was found to be 31.9%. A previous study reported that 53.3% of hearing-impaired individuals had deleterious oral habits [18]. Individuals with visual impairment reported a lower prevalence



of deleterious oral habits than those with hearing impairment. However, no study has reported the prevalence of deleterious oral habits in blind individuals. Thumb sucking habit was found to be more prevalent in the 7–12 age group (14.3%) compared to the 13–28 years age group (0%). The finding is consistent with a previous study, which reported a high prevalence of thumb sucking (12%) among younger children (ages 4–6 years) [18]. As the likelihood of thumb sucking decreases with age [19], it was found to be less common in the 13–28 age group.

One of the limitations of this study is the relatively small sample size, as only one school for the blind was present in the locality. The study did not include individuals who didn't attend school for the visually impaired and were taught at home. Although other clinical indexes are available for recording dental caries, the sake of simplicity, as we are just concerned with recording the number of carious teeth, the DMFT index was used. However, the present study showed the poor oral health status of blind individuals and the factors affecting their oral health. Further studies with a larger sample size are required to corroborate our findings.

Blind individuals have poor oral health status, high prevalence of dental caries, gingival bleeding on probing, and traumatic dental injuries. Individuals experiencing toothache in the last one year should be provided immediate dental treatment, as there are increased chances of them suffering from dental caries. Individuals with acquired blindness suffer from traumatic dental injuries more frequently than those with congenital blindness.

## 5. Conclusions

Poor oral health conditions are prevalent in blind individuals from low socioeconomic strata, so such individuals should be made aware of the maintenance of oral health and the importance of regular, periodic oral health checkups. A toothache in the past year is a risk factor for dental caries, so such individuals should immediately receive oral health care services. Individuals with acquired blindness are more likely to suffer from dental trauma than those with congenital blindness, so such individuals need to be properly trained in carrying out day-to-day activities.

## AVAILABILITY OF DATA AND MATERIALS

The data presented in this study is available from the corresponding author upon reasonable request.

## AUTHOR CONTRIBUTIONS

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical clearance was obtained from the ethical committee of Banaras Hindu University prior to the commencement of study (letter number: Dean/2022/EC/3451). Informed consent was obtained from all the participants and their legal guardian prior to enrolling them in the study.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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