

## TEETH ABRASION AMONG ARSENIC EXPOSED AND NON-EXPOSED POPULATION

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**Abstract:** This was a cross-sectional comparative study to explore teeth abrasion among the arsenic exposed and non exposed population in selected arsenic contaminated and non-contaminated areas of Bangladesh. A total of 600 respondents were selected of which 200 arsenicosis patients, 200 arsenic exposed but not arsenicosis patient, and another 200 were arsenic non-exposed individuals. The study revealed that 19% of arsenicosis patients had teeth abrasion while amongst non-arsenicosis arsenic exposed and non-arsenic exposed respondents, 9% and 2.5% had teeth abrasion respectively, and the differences were statistically significant ( $p < 0.001$ ). This study revealed that there was a tendency of occurring higher proportion teeth abrasion amongst the arsenicosis population. Further the study revealed that older people having arsenic exposure were more vulnerable for developing teeth abrasion.

**Keywords:** Arsenic, arsenicosis, oral health, teeth abrasion

### Introduction

Arsenic contamination is a major public health problem in Bangladesh. Tube well water of 62 districts is reported to be<sup>1</sup> arsenic contaminated. Till 2012, 65910 arsenicosis patients have been identified by DGHS through its house to house searching programme<sup>1</sup>. Prolonged exposure to arsenic contaminated drinking water may cause multi-organ pathologies that lead to various health effects<sup>2-4</sup>. Arsenicosis is diagnosed mainly on the basis of pigmentary changes such as melanosis and leucomelanosis, and keratinisation such as keratosis of palm and sole<sup>5-7</sup>. In Bangladesh, along with the dermatological manifestations of arsenicosis many other non-dermatological manifestations and complications are evident in several studies<sup>6-12</sup>. Pigmentary changes are also found in buccal mucous membrane, tongue and gingiva<sup>4, 13, 14</sup>. In addition to pigmentary changes in oral cavity, attrition of teeth associated with chronic arsenic toxicity has been reported from Bangladesh<sup>15-17</sup>. Arsenic was also reported to be toxic to vital pulp of the tooth

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causing damage to periodontal tissues and necrosis of gingiva and bone, which lead to osteomyelitis while arsenic trioxide was used as devitalization of pulp during root canal treatment<sup>18, 19</sup>.

Tooth abrasion is one of the tooth wear process which produced by interaction between teeth and materials like arsenic. In this process a chemical agent may weaken the superficial region of the tooth material and enhances its susceptibility to mechanical forces and lead to tooth abrasion<sup>20</sup>. Arsenic exposure through drinking water may influence this process of tooth abrasion, but no such report related to teeth abrasion due to arsenic toxicity has been located elsewhere. In this study an attempt has been undertaken to explore such clinical changes of tooth abrasion amongst the arsenic exposed and non-exposed population.

### Materials and methods

This was a cross-sectional comparative study. A total of 600 respondents were included in this study. Of which 400 respondents were arsenic exposed and selected from arsenic contaminated areas of Jessore, Kishoregonj, Chapai Nawabgonj and Narayangonj. Another 200 respondents were non-arsenic exposed and selected from arsenic non-contaminated villages of Kishoregonj and Chapai Nawabgonj districts. Among 400 arsenic exposed respondents 200 were arsenicosis patients with characteristic skin lesions like melanosis, leucomelanosis, and or keratosis and other 200 had history of arsenic exposure through drinking water but did not show any characteristic skin manifestations. Amongst the people who were aged 15-70 years and came to the camp organized for data collection, were selected as the respondents of this study. Criteria for selecting arsenic exposed respondents was based on

- a. drinking tube well water contains arsenic concentration above >0.05 mg/L or water from red tube well
  - b. history of drinking arsenic contaminated water for more than one year
- In calculating the sample size following formula was used.

$$n = \frac{z^2 a / 2 [P_1(1-P_1) + P_2(1-P_2)]}{d^2} \quad (1)$$

Where  $z = 1.96$ ;  $d =$  acceptable level of error = 10;  $P_1$  and  $P_2 =$  anticipated population of adverse effect of oral health status in arsenic exposed and non-exposed population were set at 50% i.e. 0.5 because available literature does not provide any estimation of the anticipated prevalence rate. Thus, the estimated sample size was 193 for each group of respondents which was inflated to 200. Therefore, the total sample size was 600 of which 200 arsenicosis patient, 200 arsenic exposed but not arsenicosis patient and 200 was non-exposed respondents.

The selected respondents were interviewed face to face through a pre-tested semi-structured questionnaire. A checklist was used to collect data on physical examination of oral cavity of the respondents. The respondents were interviewed and examined one by one in the medical camp. The principal investigator and selected dental surgeons

examined oral cavity of the respondents on sitting position. The oral examination was performed with the help of disposable dental mirror, probe, tongue depressor and a pencil torch.

Ethical clearance was collected from NIPSOM internal ethical committee. At the beginning of interview, the purpose of the study was explained to each respondent, and verbal consent to participate in the study was obtained. The respondents had the liberty to discontinue at any time if they desired.

Abrasion was defined as it is used by dental surgeons. Cases of teeth erosion was excluded from the study subjects.

### Results

The age of the respondents varied from 15 to 70 years and the mean was 34.42 ( $\pm 13.30$ ) years. Amongst the total respondents, the mean age of the arsenicosis respondents was found to be high but not statistically significant (Table-1).

**Table 1: Age and gender distribution of the Respondent**

Categories of Respondents	Age (Years) Mean $\pm$ Sd	Test of Significance t-test
Arsenicosis patient	35.57 $\pm$ 13.08	t=1.011; p=0.156
Arsenic exposed Non patient	34.25 $\pm$ 13.04	t=1.571; p=0.058
Arsenic Non-exposed	33.46 $\pm$ 13.77	t=0.589; p=0.278
Total	34.42 $\pm$ 13.30	Not Significant

Table 2 shows that among the total 600 respondents 10.2% developed teeth abrasion. Out of them 14.0% of arsenic exposed and 2.5% of the non-exposed respondents had the teeth abrasion and the difference was statistically significant ( $\chi^2 = 19.307$ ;  $p < 0.001$ ). Moreover, a higher proportion of teeth abrasion was found amongst arsenicosis patient (19.9%) compared to those of non-arsenicosis (9.0%) exposed respondents, which was statistical significant ( $\chi^2 = 8.30$ ;  $p < 0.01$ ).

**Table 2: Distribution of teeth abrasion among the arsenic exposed and non-exposed population**

Categories according to arsenic exposure	Teeth abrasion	Test of Significance
Arsenic exposed (n=400)	56 (14.0%)	$\chi^2 = 19.307$ ; $p < 0.001$
Arsenic non-exposed (n=200)	5 (2.5%)	
Total (n=600)	61 (10.2%)	$\chi^2 = 8.306$ ; $p < 0.01$
Arsenicosis patients (n=200)	38 (19.0%)	
Arsenic exposed non-patients (n=200)	18 (9.0%)	

Table 3 shows that respondents who were aged up to 20 years none of them found to be suffer from teeth abrasion. However, it was found that 8.6%, 33.3% and 45.5% of the

respondents of arsenicosis patients aged between 21-40 years, 41-60 years and above 60 years respectively had teeth abrasion. While among the respondents of arsenic exposed but not arsenicosis patients 2.6%, 24.5% and 50% of similar age group respectively had teeth abrasion. Amongst the non-exposed respondents the teeth abrasion was found in the age group of 21-40 years (2-7%) and 41-60 years (4.2%), and the respondents aged above 60 years none of them found to have teeth abrasion. Further, the proportion of teeth abrasion was found to be significantly higher ( $\chi^2=46.37$ ;  $p<0.001$ ) with the increased age of the respondents.

**Table 3: Distribution of teeth abrasion by age groups of the respondents**

Age Range of Respondents (Years)	Number of Teeth Abrasion			Total
	Arsenicosis Patients	Arsenic exposed but not patient	Non-Exposed	
21 to 40 (n)	9 (8.6%) (105)	3 (2.6%) (115)	3 (2.7%) 110	15 (4.6%) 330
41 to 60 (n)	24 (33.33%) (72)	12 (24.5%) (49)	2 (4.16%) (48)	38 (22.5%) (169)
Above 60 (n)	5 (45.5%) (11)	3 (50%) (6)	0 (7)	8 (33.33%) 24
Total	38 (19%) (200)	18 (9%) (200)	5 (2.5%) (200)	61 (10.16) (600)
Test of Significance	$\chi^2=20.858$ $p<0.001$	$\chi^2=27.581$ $p<0.001$		$\chi^2=46.37$ $p<0.001$

Parenthesis shows the total number of respondents in respective age group

Table 4 shows that the occurrence of teeth abrasion among arsenic exposed respondents with the duration of consuming arsenic contaminated water. It was found that the respondents who were exposed to arsenic contaminated water for more than 10 years had a higher proportion of teeth abrasion compared to those of consuming arsenic contaminated water less than 10 years and the difference was statistically significant ( $\chi^2=4.746$ ;  $p<0.05$ ).

**Table 4: Distribution of teeth abrasion amongst arsenic exposed respondents by duration of arsenic exposure**

Duration of arsenic exposure	Teeth abrasion		Test of significance
	Yes	No	
Upto 10 years (n=225)	24 (10.7%)	201 (89.3%)	$\chi^2=4.746$ ; $p<0.05$
Above 10 years (n=175)	32 (18.3%)	143 (81.7%)	
Total (400)	56 (14.0%)	344 (86.0%)	

## Discussion

Manifestations of chronic arsenic toxicity in oral cavity have been reported in several studies. Oral health problems particularly pigmentation, swelling of vallate papillae and teeth attrition amongst the arsenic exposed population are already evident in Bangladesh<sup>15-17</sup>. Tooth wear indicates the gradual loss of dental hard tissues through the processes of attrition, abrasion and abreaction<sup>20</sup>. So far, no such study could be located elsewhere in which arsenic toxicity is a causative or associated factor in these processes. Study conducted in Bangladesh found that the prevalence of teeth attrition was significantly high ( $\chi^2 = 108.51$ ;  $p < 0.001$ ) amongst the arsenic exposed population (71.4%) compared to those of arsenic non-exposed population (6.3%) and amongst the arsenic exposed population the prevalence was more among the arsenicosis patients. The current study revealed a significantly increased ( $\chi^2 = 19.307$ ;  $p < 0.001$ ) prevalence of teeth abrasion among the arsenic exposed respondents (14.0%) compared to those of arsenic non-exposed respondents (2.5%). The occurrence of teeth abrasion could not be found amongst the respondent aged up to 20 years and a tendency of occurrence of teeth abrasion was found with the increased age of the respondents. While comparing the occurrence of teeth abrasion between the arsenicosis (19.0%) and non-arsenicosis (9.0%) respondents a significantly ( $\chi^2 = 8.30$ ;  $p < 0.01$ ) higher proportion of teeth abrasion was found amongst the arsenicosis patients. The findings of this study revealed that the arsenic exposure through drinking water could increase the occurrence of teeth abrasion amongst the exposed population. Moreover, older people and those who are consuming arsenic contaminated water for longer duration are more likely to develop teeth abrasion.

A case control conducted in Ron Phibun districts of Thailand showed that the student who had lived in the arsenic endemic area had higher prevalence of enamel hypoplasia (destruction of enamel). On the other hand the study revealed that the periodontal diseases were less amongst the children of arsenic endemic area compared to those of the control group<sup>21</sup>. The cause of developing of teeth abrasion more amongst the arsenic exposed population is unknown. Whether the teeth abrasion amongst arsenic exposed population is developing in same mechanism as found to cause of enamel hypoplasia in Ron Phibun<sup>21</sup>, needs to be studied.

## Conclusion

The findings of the current study provide important information regarding the teeth abrasion. On the basis of which it could be concluded that there was an increased tendency of occurrence of teeth abrasion amongst the arsenic exposed population and the teeth abrasion could be regarded as a non dermatological manifestation of arsenicosis.

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