

A cross-sectional study on oral health status of battery factory workers in Chennai city

J. Babu Susai Raj, Sabitha Gokulraj¹, Konthoujam Sulochana², Vivek Tripathi³, Susanthi Ronanki⁴, Preeti Sharma⁵

Department of Oral Medicine and Radiology, Vivekananda Dental College, Tiruchengode, ¹Department of Oral Medicine and Radiology, Vinayaka Missions Sankarachariyar Dental College, Salem, Tamil Nadu, ²Department of Oral Pathology, AJ Institute of Dental Sciences, Mangalore, Karnataka, ³Department of Periodontology, Dental College, Azamgarh, Uttar Pradesh, ⁴Department of Preventive and Community Dentistry, DY Dental College, DY Patil Knowledge City, Pune, Maharashtra, ⁵Department of Pedodontics, Mansarovar Dental College, Bhopal, Madhya Pradesh, India

Corresponding author (email: <ajayjesudoss@yahoo.com>)

Dr. J. Babu Susai Raj, Department of Oral Medicine and Radiology, Vivekananda Dental College, Tiruchengode, Tamil Nadu, India.

Abstract

Aim and Objective: Some occupational exposures are associated with oral changes in both hard and soft tissues. Presence of oral lesions can interfere with speech, swallowing, and general health of a patient. The present cross-sectional study was conducted to evaluate the oral health status of battery factory workers in Chennai city. **Materials and Methods:** A total of 600 subjects were selected in battery factory out of 3500 workers using statistical sample selection formula $4pq/l^2$ and divided into study and control groups based on acid exposure. The data were recorded on a modified World Health Organization 1997 pro forma. The data were evaluated using Chi-square test and Mann-Whitney U-test. **Results:** Oral symptoms such as disturbed taste, dry mouth, oral ulcers, and foul breath were statistically significant between the groups (<0.001). Dental erosion was statistically significant with the duration of working years. Dental erosion was significant among study group compared to control (0.001). **Conclusion:** The present study showed that selected samples had various oral conditions due to exposure to acids from battery. It was observed that oral health problems were directly related to the duration of acid exposure in the study group. Implementing exhaust ventilation and monitoring the devices help in reducing the acid exposure. Implementation of oral hygiene education and nutritional supplementation helps in improving their oral health.

Key words: Acid, battery, lesions, oral health status

INTRODUCTION

Healthy oral cavity signifies healthy well-being of an individual.^[1] Impaired oral health can affect mastication, speech, and general health of an individual. Oral mucosa is subjected to pathological changes upon local, environmental, and systemic influences.^[2] Oral lesions

can be secondary to nutritional deficiency, trauma, infection, local irritation, ill-fitting denture, sharp tooth, electro galvanism, adverse oral habits, and systemic infections.^[2-5]

Some occupational exposures are associated with changes in both hard and soft tissues of oral cavity. Oral

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cavity is more frequently exposed to injurious agents than any other body organs. Ingestion and inhalation of foreign substances that tend to stagnate and collect within the oral cavity lead to an accumulation of irritants of a chemical, physical, or bacterial nature.^[6]

Sulfuric acid is used commonly at a higher quantity in battery-making process as an essential part of battery manufacturing. It has been observed that frequent industrial acidic exposure can affect teeth and oral tissues. Breathing of industrial acidic mist irritant can be localized at nose, mouth, and throat. Acidic mist exposure can erode the enamel and dentin of teeth and makes teeth vulnerable to acidic de-calcification^[6] Dental erosion is defined as a loss of dental hard tissue by a chemical process in the absence of bacteria^[6,7] Acidic exposure results in the dissolution of hydroxyapatite crystals. It has been found that occupational exposure to certain acid content is known for oral cancers.^[8]

Several studies have shown the direct association of acid mist exposure and oral ulcerative lesions of mucosa. Severity was relevant in the study group with an increased duration of exposure for more than 5 years.^[6-8] Khurana *et al.* found that battery factory workers were exposed to various environmental conditions such as vibrations, unpleasant smell, dust, and draft. They found some poor oral hygiene in people working in battery factory.^[6] Petersen and Gormsen observed 31% with dental erosion and 92% with attrition in study population. They found that there was a continuous exposure of acid fumes during battery manufacturing.^[7]

Battery factory workers are often exposed to sulfuric acid, which can result in various oral problems.^[6,7] There is a lack of sufficient information on oral health status of battery factory workers of Chennai city; hence, the present study was planned to (i) evaluate the prevalence and nature of oral health problems among workers exposed to sulfuric acid fumes (ii) suggest remedial measures for improving the oral health status of the workers.

MATERIALS AND METHODS

A cross-sectional comparative study was conducted in Chennai city to assess the oral condition of battery factory workers from March 2012 to June 2012. All information regarding battery factory workers was obtained from Tamil Nadu Battery Udyog association. There are 3500 battery factory workers in Chennai city. The battery unit has 2 types of workers (i) subjects

working in forming/charging department and exposed to acid fumes and (ii) subjects working in casting, pasting, packing, and who are not exposed to acid fumes. A total of 600 subjects were selected in battery factory out of 3500 workers using statistical sample size selection formula $4pq/l^2$ with dental erosion prevalence of 40%. Ethical clearance for the study was obtained from Tamil Nadu battery Udyog association and written consent for the study was obtained from participating battery factory workers. Selected subjects were enrolled and divided into study (300 exposed to acid fumes) and control groups (300 not exposed to acid fumes), based on acid exposure.

Inclusion criteria

Subjects who were present at the time of study at all ages willing to participate were included in the study. Exclusion criteria: Subjects who were not willing to participate. The examiner was trained and calibrated to prevent any diagnostic variability among the study subjects.

Clinical examination and calibration were done in a dental clinic by a trained single examiner. Detailed information of all participants about name, age, type of work, duration of job, oral hygiene habit, caries status, and oral symptoms was recorded. Modified Smith and Knight erosion index (2003) was used to assess erosion experience.^[9] The data were recorded on a modified World Health Organization 1997 pro forma. The data were evaluated using Chi-square test and Mann-Whitney U-test using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 15.0.

RESULTS

In the study group, 182 (60.6%) and 77 (25.6%) subjects were at 6–10 years and >10 years, respectively, in job. In the control group, 187 (62.5%) and 68 (22.6%) subjects were in job for 6–10 years and >10 years, respectively. The study subjects were exposed to draft, etching substance compared to control group, which is statistically significant (<0.001) [Table 1]. Oral symptoms such as disturbed taste, dry mouth, oral ulcers, and foul breath were statistically significant between the groups (<0.001) [Table 2]. There was no statistically significant difference in DMFT between two groups [Table 3]. Dental erosion was statistically significant with the duration of working years [Graph 1]. Dental erosion was significant in the study subjects [Graph 2].

Table 1: Subject distribution according to age, duration of job and exposure to various working conditions

	N (%) (n=300)		Total 600
	Study group	Control group	
Age group			
21-30	30	28	58
31-40	72	68	140
41-50	192	196	388
51-60	6	8	14
Job duration			
<1 year	16 (5.3)	25 (8.3)	41
2-5 year	25 (8.3)	20 (6.6)	45
6-10 year	182 (60.6)	187 (62.3)	369
>10 year	77 (25.6)	68 (22.6)	145
Working condition			
Draft	60 (20)	0	60
Etching substance	44 (14.6)	0	44
Unpleasant taste	154 (51.3)	0	154
Dust	36 (12)	242 (80.6)	278
Vibration	6 (2)	58 (19.3)	64

$\chi^2=52.585, df=3, P<0.001$

Table 2: Subject distribution according to oral health status

Oral conditions	N (%) (n=300)		Statistical significance	
	Study group	Control group	χ^2	P
Sharp and thin teeth	128 (42.6)	0	13.702	<0.001
Disturbed taste	84 (28)	12 (4)	21.682	<0.001
Dry mouth	68 (22.6)	5 (1.6)	14.872	<0.001
Foul breath	72 (24)	20 (6.6)	15.721	<0.001
Bleeding gums	62 (20.6)	38 (12.6)	0.002	0.891
Tooth ache	58 (19.3)	42 (14)	0.042	0.921
Oral ulcers	85 (28.3)	8 (2.6)	10.682	<0.001
None	0	58 (19.3)	6.396	<0.001

Table 3: Caries experience of subjects

Caries experience	Study group (n=51)		Control group (n=24)		Statistical significance	
	Mean	SD	Mean	SD	t	P
Decayed	2.44	0.56	2.27	0.82	0.971	0.332
Missing	0.67	0.82	0.56	0.49	0.624	0.532
Filled	0.05	0.20	0.12	0.36	1.335	0.183
DMFT	3.16	0.75	2.98	0.68	1.028	0.303

SD=Standard deviation, DMFT=Decayed, missing, filled, teeth

DISCUSSION

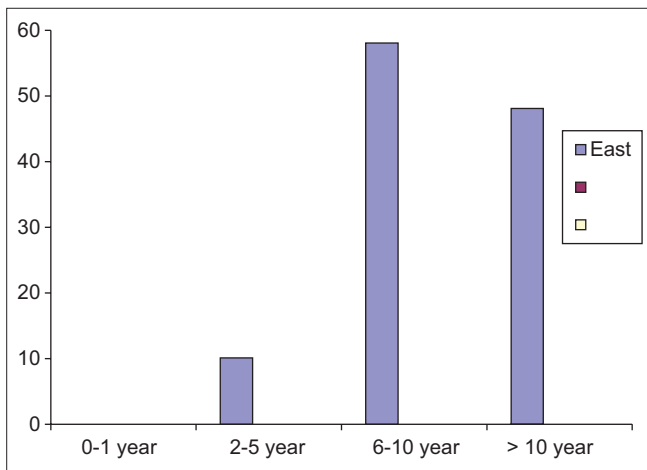
It has been observed that oral injuries are common with direct contact in occupational exposure.^[7] In battery industries, sulfuric acid has been used in large quantity. This sulfuric acid contains >20% of sulfur dioxide

dissolved in the acid, which has a sharp penetrating odor. Acid mist will be collected in work rooms due to continuous discharge of acid fumes from container. It has been reported that acid mist at a level of 1–2 mg/m³ causes irritation and coughing at 5–6 mg/m³.^[6]

In the present study, majority of participating subjects in study group (192) and control group (196) were in the age range of 41–50, and the mean age of all the workers surveyed was 43.2 years [Table 1]. In study group, 182 (60.6%) and 77 (25.6%) subjects were in job for 6–10 years and >10 years, respectively. In control group, 187 (62.3%) and 68 (22.6%) subjects were in job for 6–10 years and >10 years, respectively [Table 1]. Duration of exposure was less in control group compared with study group. In study group, subjects above 6 years in job had more exposures to acid mists. Khurana *et al.* in their study found 89.5% subjects in study group had a period of exposure more than 5 years.^[6]

Study subjects were exposed to draft, etching substance, and unpleasant taste compared with control group, which is statistically significant (<0.001) [Table 1]. Oral symptoms such as disturbed taste, dry mouth, and oral ulcers were statistically significant between the groups (<0.001) [Table 2]. Many studies showed a positive association between acid mists and ulcerative lesions of oral mucosa among workers without lip seal.^[8,10] We found sharp and thin teeth in study group compared to control one ($P < 0.001$) similarly, Petersen and Gomsen who observed sharp (56%) and thin teeth (29%), poor oral health ($D-T = 3.8$).^[7] Similarly, association of acid exposure with oral lesions was observed by many researchers.^[6,11-13] de Almeida *et al.* observed a positive association between acid mist and periodontal condition and attachment loss >4 mm in study subjects.^[14]

There was no statistically significant difference in DMFT between two groups [Table 3]. It was in agreement with Khurana *et al.*^[6] It has been observed that acid fumes exposures do not affect decayed, missing, filled teeth (DMFT) status of an individual. Dental erosion was statistically significant with the duration of working years. In our study, dental erosion was significant at 6–10 years and >10 years of working group in study subjects [Graph 1]. Suyama *et al.* observed that long-term (>10 years) workers in lead storage battery manufactures had dental erosion, and erosion was prevalent in mandibular anterior teeth with 20% prevalence rate.^[13] There was a significant association of acid exposure (sulfuric acid) with dental erosion in study group over control group. Dental erosion index score was more significant in study group over control one [Graph 2]. This is in agreement



Graph 1: Tooth erosion experience of subject with number of working years in study group

with a study by Petersen and Gormsen and they observed 31% prevalence of erosion, and by Khurana *et al.* and others.^[6,7,12] Sudhanshu *et al.* from their systematic review found positive correlation with occupational acid exposure and periodontal condition and dental erosions.^[15]

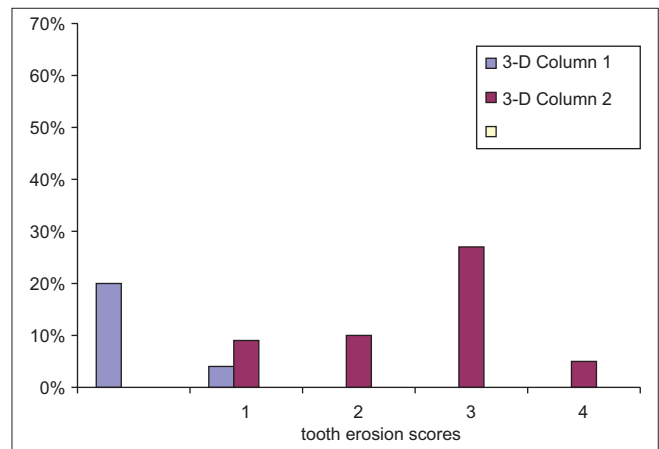
Mansour Ghanai *et al.* found highest oral lesions (55.8%) among young adults at age range of 30–40 years; similarly, >35 years by Cury *et al.*, between 65 and 70 years observed by Patil *et al.*, and Ali *et al.* observed common at >21 years.^[4,16-18] Mansour Ghanai *et al.* found oral lesion common among 30–40 years group compared with 40–50 years in our study.^[4]

Various studies have shown different prevalence rate of oral lesions worldwide such as 9.7% in Malaysia, 15.5% in Turkey, 25% in Italy, 61.1% in Slovenia, 19.4% in Iran, and 8.8% by Najm in Iraq.^[4,19] Torwane *et al.* found 19.9% prevalence of oral lesions among Eunuchs and 30.03% by Chandroth *et al.*, 64% by Ambika *et al.* on school children, 39.3% by Arjun *et al.* in psychiatric inmates, 8.4% by Mehrotra *et al.*, 8.4% by Patel and Patel, 46.1% by Thada and Pai, and 64% by Patil *et al.*^[1-3,5,17,20-22]

From the present study, it has been observed that acid fumes (sulfuric acid) produce dental erosion and oral lesions. Oral lesions and erosion are directly related to the duration of working period and exposure time. Acid fumes do not affect DMFT status. There is a need of sufficient ventilation, exhaust fans, mandatory wearing of masks, and mouth guard during work.

Limitation of the study

- Other oral health status of study subjects related to gingival and periodontal status were not included in the present study



Graph 2: Dental erosion experience among study and control groups

- Sample size was less and only purposive sampling for pilot sampling was done initially to evaluate the problem.

CONCLUSION

The present study showed that selected samples had various oral conditions due to exposure to acids fumes. It was observed that acid exposure was directly related to the duration of exposure in study group. These data can be used for preventing and protecting battery factory workers from exposing to acid fumes. Implementing exhaust ventilation, mandatory use of protective masks, face guard, and monitoring the devices and acid fumes helps in reducing the acid exposure. Implementation of oral hygiene education and nutritional supplementation helps in improving their oral health.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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