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Oral Health Status Of Battery Factory Workers In Ghaziabad City: A Cross-Sectional Study

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ABSTRACT

Background: Some occupational exposures are linked to alterations in oral hard and soft tissues, making the mouth cavity susceptible to external substances.

Objectives: The purpose of this study was to evaluate the oral health of Ghaziabad city battery manufacturing employees as well as to describe the frequency and type of oral health issues that they experience.

Materials and Methods: On the basis of their exposure to acid, a total of 60 battery employees were enlisted and split into study and control groups. A modified World Health Organization proforma from 1997 was used to record the data. Version 15.0 of the Statistical Package for Social Sciences was used to analyze the data. The quantitative ordinal variables were compared using the Mann-Whitney U-test, whilst the categorical variables were compared using the Chi-square test for proportions. An independent samples t-test was used to compare quantitative continuous variables.

Results: All of the workers that were polled had an average age of 37.24 years. There were significantly significant ($P < 0.001$) differences in the gingival index, oral cleanliness, and erosion ratings between the two groups.

Conclusion: Dental erosion was highly correlated with poor oral health condition.

Key words: Acid fumes, dental erosion, oral health status

INTRODUCTION

The oral cavity serves as a point of entry for a variety of diseases and has some distinctive characteristics that make it particularly vulnerable to occupational disease. On the basis of the afflicted structure, the many features of oral occupational disease can be examined, including In cobblers, carpenters, and glass blowers, prehension tools can cause localized abrasions, while aviators may experience gingival bleeding owing to changes in atmospheric pressure. [1] The oral cavity is exposed to harmful substances more often than any other organ or bodily part. The only times it is protected are when masks are worn. An accumulation of irritants of a chemical, physical, or microbiological nature results from the ingestion and inhalation of foreign substances that have a tendency to stagnate and amass in the oral cavity.

It is well known that industrial employees who are exposed to inorganic acids have varied degrees of damage to their teeth. When exposed to an industrial acid mist, coughing, runny nose, and irritation of the upper respiratory tract are the only localized consequences. Additionally, the eyes and exposed skin surfaces get irritated. [2] Local variables have an impact on hard tissues

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like enamel and the underlying dentin since they are both avascular and cellular. Enamel is prone to decalcification due of its quick reaction to acids. With repeated exposures, the tooth crowns fall out. The gingiva, a soft dental structure, has been referred to as the entrance to good oral health. [1]

Today, many previously dangerous procedures have been eliminated as a result of advancements in plant design and manufacturing techniques. The majority of acid-related tooth erosion is mostly observed in the battery business, where large amounts of sulphuric acid are employed as a necessary component of the battery manufacturing process. [3]

Dental hard tissue loss caused by a chemical process, not a bacterial one, is known as erosion of the teeth. [4] The etiology of the illness is multifaceted and includes intrinsic (acid regurgitation) and extrinsic (acidic meals and medicines) as well as occupational dangers. [5-11] Industrial erosion can happen in a variety of settings, including battery manufacturing, zinc galvanizing plants, etc. The anterior teeth's exposed portions to the air are harmed and could entirely dissolve. [14] Protons from the acidic substance attack the hydroxyapatite's carbonate, phosphate, and hydroxyl ions during an erosive attack. The attack causes the hydroxyapatite crystals to dissolve, releasing calcium ions in the process. Additionally, the frequency and duration of acidic events have an impact on how erosion develops. [15] Acid droplets directly impinging on the tooth crown gradually destroy the tooth crown. [16] However, behavioral and biological variables including tooth location, the strength of the dental hard tissues, and salivary variables like composition, buffer capacity, and flow rate may have an impact on how erosions begin and advance. [15]

MATERIALS AND METHODS

The oral health of the workers at the battery industry in Ghaziabad city was evaluated by a cross-sectional, comparative study.

From the Uttar Pradesh Battery Udyog Association, all necessary and pertinent information regarding the battery factories in the city of Ghaziabad was gathered. At a 90% confidence level and a 10% error margin, the number of battery industry workers in the city of Ghaziabad is 3000. The 68 people that participated in the study make up the sample size. A sample size calculator was used to determine the sample size. [17] Even though the sample size estimated was 68, for the purposes of this study, 60 workers from six randomly chosen battery factories were enlisted.

There are two different sorts of workers at the battery units: those who are exposed to acid fumes or mists (working in the forming/charging departments), and those who are not (working in grid casting, pasting, pressing and packing departments). About 67.1% of workers in the battery plants were exposed to acid and acid vapors or mists, whereas the remaining third (32.9%) were engaged in tasks that did not expose them to acid. In the current study, the former made up the study group and the latter, the control group.

Santosh Medical College & Hospital Ghaziabad's Institutional Ethical Committee gave its approval before the survey could begin.

The study included all available battery manufacturing workers, regardless of age, at the time of the test. In order to avoid any inconvenience and to guarantee full cooperation, the study group was fully informed of the study's objectives and given their consent before participating. To avoid any diagnostic variability among the study subjects during the oral examinations, the examiner and recording assistant (who was pursuing internship training) were trained and

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calibrated in the Department of Preventive and Community Dentistry, Santosh Medical College & Hospital Ghaziabad, under the supervision of the staff members.

The survey was planned out in great detail far in advance. Throughout the study period, the investigator made scheduled visits to the study area until the necessary sample size was attained.

During the investigation, enough sterile instruments were made available for the examination. The following equipment and supplies were utilized for the study: disposable gloves, mouth masks, explorers, tweezers, kidney trays, BetadineTM, saline, gauze, and cotton with cotton holder, containers (one for used instruments and the other for sanitized tools), explorers, and tweezers.

Along with the name, age, sex, location, food habits, harmful habits, and oral hygiene practices, information was recorded about the department in the battery factory, the length of the job, exposure to various working circumstances, and oral symptoms. The World Health Organization (WHO), oral health survey, and fundamental techniques were used to evaluate the dentition status and treatment requirements index (1997). Dental erosion was measured using indices,[18,19] Gum index and simplified oral hygiene [20] (GI). [21] A modified WHO 1997 proforma was used to record the information. [22]

The study subjects were sitting in regular chairs during the clinical examination, which was conducted solely by the investigator in the presence of daylight. A recording assistant who had received particular training for the task captured all the information. The recording assistant was made to sit close during the examination so that instructions and codes could be clearly heard and repeated for verification. An individual subject's interview and examination lasted, on average, 15 to 20 minutes. Workers who need immediate assistance for pain or an infection were directed for further evaluation and treatment.

Using the spreadsheet program Microsoft Excel, the collected raw data was tallied (Microsoft). Version 15.0 of the Statistical Package for Social Sciences was used to analyze the data. The chi-square test is used to compare the proportional categorical variables. In order to compare the quantitative ordinal variables, the Mann-Whitney U-test is performed. The t test is used to compare quantitative continuous variables between independent samples.

RESULTS

The investigation was carried out in the city of Ghaziabad's battery factories. The data was split into two groups because there are two different worker kinds in battery units. In the battery factory, about one-third of the workers (the control group) performed tasks that did not expose them directly to acid, while the remaining workers (the study group) were required to perform tasks that exposed them directly to acid and its vapors.

The majority of workers (92.3%) in the control group were between the ages of 20 and 40, while only 1 (4.35%) of the participants in the control group were above the age of 40. In contrast, 21/47 (42.9%) of the workers in the study group were over the age of 40. (P = 0.014) The difference was statistically significant. Male workers only, with a mean age of 37.24 years, made up the entire sample.

The control group's exposure time was substantially shorter than that of the study group (P 0.001) In the study group, 85.3% of individuals had exposure lasting longer than 5 years, in contrast to the control group, where more than two thirds (65.5%) of respondents had up to 5 years of experience [Table 1].

Table 1: Distribution of subjects according to duration of job

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Duration of job (years)	**Study group (*n*=37)**	**Control group (*n*=23)**	**Total**
<1	0	6 (25.7)	6
2-5	4 (8.6)	10 (43.8)	14
6-10	12 (28.0)	4 (17.7)	16
>10	21 (45.3)	3 (12.7)	24

χ^2=28.732 (df=3); $P<0.001$

The type of exposure amongst study group subjects was draft and unpleasant smell in all except around (8.6%) subjects; however, in the control group it was chiefly the dust (87.3%). The difference was statistically significant about the type of exposure ($P < 0.001$) [Table 2].

Table 2: Distribution of subjects according to exposure to various working conditions

Condition	**Study group (n=37)**	**Control group (n=23)**	**Total**
Draft	12(28.0)	0	12
Unpleasant smell	21 (45.3)	0	21
Dust	4 (8.6)	20 (87.3)	24
Vibration	0 (0.0)	3 (12.7)	3

χ^2=51.694 (df=3); $P<0.001$

All of the study group's participants had some sort of oral symptom, as far as that was concerned. In comparison to the control group, there were considerably more sensitive teeth, sharp, thin teeth, taste disturbances, dry mouth, and bad breath in the study group. Regarding the presence of bleeding gums and toothaches, there was no discernible difference between the two groups [Table 3].

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Table 3: Distribution of subjects according to oral symptoms

Oral symptoms	Study group (n=47)	Control group (n=23)	χ2	p-value
Sharp and thin teeth	21 (44.6)	0	12.702	<0.001
Disturbed sense of taste	35 (74.3)	3 (13.0)	20.796	<0.001
Dry mouth	36 (76.5)	5 (22.1)	13.897	<0.001
Foul breath	26 (53.1)	4 (17.7)	5.323	0.015
Bleeding gums	34 (72.2)	17 (71.6)	0.003	0.756
Toothache	8 (16.9)	5 (21.7)	0.033	0.635
Sensitive teeth	38 (80.7)	9 (39.1)	11.645	0.002
None	0 (0.0)	4 (17.7)	6.705	0.013

The majority of participants in both groups—72.2% of the study group and 71.6% of the control group participants—used finger and toothpowder. Only 12.6% of research participants and 21.4% of control group participants used a toothbrush and toothpaste, whereas 21.1% of study participants and 17.0% of control group participants applied toothpaste using their fingers. According to statistics, there was no discernible difference in the two groups' oral hygiene practices (P = 0.643).

The average number of decaying, missing, and filled teeth is 2.33, 0.58, and 0.03 in the study group, compared to 2.16, 0.47, and 0.12 in the control group. The decayed missing filled (DMF) status between the two groups did not show any statistically significant differences [Table 4].

Table 4: Distribution of subjects according to caries experience

Caries experience	Study group (n=47)		Control group (n=23)		Statistical significance	
	Mean	**SD**	**Mean**	**SD**	***t***	***P- value***
Decayed	2.33	0.58	2.16	0.81	0.875	0.323
Missing	0.58	0.81	0.47	0.51	0.526	0.434
Filled	0.03	0.20	0.12	0.34	1.039	0.285
DMFT	3.05	0.74	2.86	0.69	1.021	0.206

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

In comparison to the control group, which had 14 (60.9%) respondents, none of the study group's participants had an erosion score of 0. Two (8.7%) of the remaining nine control participants had erosion scores of 1 while seven (30.4%) had scores of 2. On the other hand, over half (48.9%) of the study participants had an erosion score of 3, and about a fifth (19.1%) had an erosion score of 4. According to statistics, there was a substantial difference between the two groups (P 0.001).

No respondents in either group had an OHIS score between 0.1 and 1.2. 39 (83%) of the study group's individuals and 2 (8.7%) of the control group's participants had OHIS scores between 3.1 and 6.0. The OHIS score of study group participants was substantially higher (P 0.001) than that of the control group.

DISCUSSION

The purpose of this study was to describe the prevalence and nature of oral health issues among battery plant workers as well as to evaluate the current state of their oral health. the city of

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Ghaziabad's battery manufacturing. Workers from battery manufacturing participated in the poll, and 100% of them responded. On the day of the examination, there were only male employees surveyed. According to employers' psychology, the job is risky since it necessitates safe handling of sulfuric acid, which is typically preferred by men. Sulfuric acid has 20% or more of sulphur trioxide dissolved in the acid, which emits powerful fumes and has a pungent, piercing odor at room temperature. [23]

Since acid mist regularly leaks from unsealed containers, it is usually seen in the workplace. Humans can detect exposure at a level of 0.5–0.7 mg/m3, it irritates them at 1.0–2.0 mg/m3, and it makes them cough at 5.0–6.0 mg/m3. According to a prior study [16] from 1961, acid fume exposure levels among battery manufacturing employees ranged from 0.8 to 16.6 mg/m3. Battery workers in a research from Finland[11] were exposed to 0.06 to 2.0 mg/m3. The Tanzanian Fertilizer Company's workplace air has acid fume concentrations ranging from 1 to >5 mg/m3. [8] Comparing the results of these research, it appears that a correlation exists between higher levels of acid fumes in the workplace and a higher percentage of subjects who have lost tooth material. However, the large percentage of injured workers, as well as our observations of unprotected acid handling and weakened safety procedures, suggest that workers were exposed to excessive amounts of acid fumes. Unfortunately, statistics on acid fume levels in the facilities we visited were not available. [23] The majority of workers in the control group (91.3%) were between the ages of 21 and 40, while only 2 (8.7%) of the participants in the control group were above the age of 40. In contrast, 22/47 (46.9%) of the workers in the study group were over the age of 40. In the battery industry, where there is direct acid exposure in the forming and charging departments (study group), more skilled workers are needed due to job-related risks, whereas those who are not as skilled are placed in less risk-prone jobs like the pasting, drying, and packing departments (control group), where there is no direct acid exposure. The control workers in the acid-free departments of Ten Bruggen Cate's 1968 study, who were younger, unskilled apprentices, were similar to those in our study, which is consistent with their findings. [10]

The surfaces of the teeth that were exposed to the air the most initially suffered from industrial erosion. These were the labial surfaces of the front teeth's incisal third to half. The back teeth showed no signs of degradation. [13] Malcolm and Paul observed a comparable discovery in 1961. [16] Amin et alstudy .'s from 2001 also demonstrated that the labial surfaces of the upper anterior teeth were the only areas where acid vapors induced tooth surface loss; in contrast, the posterior teeth were shielded by the cheeks and lips. Only the portion of the teeth that are exposed by the lips and cheeks is harmed. The lips act as a direct barrier against acid spray and also offer a protective salivary bath for the teeth.

The location of the erosive lesions shows that acid vapors directly affected the teeth that were exposed while speaking or breathing via the mouth.

[10,11,16,23] Workers in the battery business were known to frequently breathe through their mouths[1], which is consistent with our study, which found that dry mouth was present in 76.5% of the study group and 22.1% of the control group [Table 3]. When the atmospheric acidity reached a point where breathing through the nose became uncomfortable, it is likely that acid workers breathed through their mouths. The lack of salivary lubrication in a dry mouth caused significant tooth damage, according to the evidence. [24]

The control group's exposure time was substantially shorter than that of the study group (P 0.001) It was observed that more than 71.5% of respondents in the control group had up to five

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years of experience, whereas 87.3% of participants in the study group had exposure lasting longer than five years. The employees in direct exposure departments may have the necessary experience, which could be the cause. In accordance with our study, which found that the proportion of subjects with erosion and the severity of erosion increased with prolonged duration of exposure, prior studies[10,11,16,23,25] have suggested a relationship between the incidence of dental erosion in acid workers and length of exposure.

All of the study group's participants had some sort of oral symptom, as far as that was concerned. Regarding the presence of bleeding gums and toothaches, no discernible difference between the two groups was found. The German survey[13] from 1991 and Amin et alstudy[23] .'s both found that acid workers frequently lost their sense of taste or developed an unpleasant taste sensation; this finding is also true of our study, where acid workers account for 72.3% of the sample [Table 3]. This might be connected to potential atrophic alterations in taste receptors brought on by exposure to acid vapors at work.

Our study found no statistically significant difference in DMF status between the two groups, and there was no evidence of a link between DMF status and degree of erosion, which is consistent with research by Malcolm and Paul[16], Ten Bruggen Cate[10], and Tuominen et al.[11] from the 1960s, 1968, and 1989, respectively.

In line with the research conducted by Amin et al., differences in GI and oral hygiene scores between the study group and control group were highly significant (P 0.001).

[23] According to Amin et alsurvey .'s of battery employees,[23] 79.2% of acid workers and 46.7% of controls had erosion, which was consistent with our study's finding that all study group participants and 39.1% of control participants had erosion.

Their study found that 62.5% of acid workers had erosion in grades 2 and 3, and 16.7% had erosion in grade 4, which was consistent with our study's finding that 70.2% of the study group had erosion in grades 2 and 3, and 19.1% had erosion in grade 4. Similar findings that are consistent with our work have been proposed by Malcolm and Paul,[16] Ten Bruggen Cate,[10], Tuominen et al.,[11], and Petersen and Gormsen[13].

The problem of preventing oral occupational risks must be addressed by both improving working circumstances and by establishing and maintaining oral health. Oral symptoms of occupational origin are easily predisposed and made worse by neglect of oral health. The authorities in industrial and public health are challenged by the oral occupational disorders found in this study to provide effective measures for their prevention, early detection, and treatment. [1]

CONCLUSION AND RECOMMENDATIONS

Poor oral health was prevalent among battery industry employees. The control groups' significantly improved overall and oral health compared to their acid-exposed counterparts supported the link between declining oral health and risky working conditions. Dental degradation and a decline in oral health are strongly linked to exposure to sulfuric acid emissions.

The "arising out of and in the course of employment" guideline should be an adequate basis for any evaluation for determining "occupational risk (s)" as the primary contributing factor (s) of tooth erosion, according to the Evidence-Based Practice Group of WorkSafeBC.[27]

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Industrial hygiene must include oral hygiene. The prevention, early detection, and treatment of oral occupational disorders should be part of adequate provisions for industrial health. Therefore, oral health is a regulating factor rather than only an additive or reducing component in the development of oral occupational disease.

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