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Oral Health Status of Workers in Lead Battery Manufacturing Units in Udaipur City: A Cross-Sectional Comparitive Study

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ABSTRACT

Background: Every person's oral health is an important aspect of their overall health and a valuable asset. In India, the majority of working people are often from lower socioeconomic groups.

Aim: To evaluate the oral health status of workers in lead battery manufacturing units in Udaipur city.

Methodology: Following their fulfilment of the study's requirements, 900 individuals were chosen. The study was cross-sectional, and the pre-validated proforma was used to gather the necessary data. This proforma contained information on demographics (age, sex, bad habits, consumption of acidic foods, etc.), as well as hard and soft tissue examinations. The latter included information on extraoral alterations, dental caries status, oral mucosal disorders, periodontal state, and fluorosis status. The data was gathered using the WHO Oral Health Assessment form from 1997. The degree and presence of tooth erosion in the sampled workers were evaluated during the oral examination between July 20, 2021, and September 25, 2021, using the Basic Erosive Wear Examination (BEWE) scoring method. The descriptive statistics were applied along with Chi-square test using the SPSS (version 20).

Results: The results indicated male prevalence of the age 25-35 years, with many consuming smoking and drinking, acidic food and drinks, reduced use of toothbrush based on the SES that they belonged. Treatment was required for trauma, prosthetics, restoration, and fluorosis among the study population. SES was directly correlated with dental usage, bad behaviours, dentition state, and treatment requirements.

Conclusion: The SES and the dental treatment needs are directly related to one another. Lower the socio-economic group, more neglected the unmet dental treatments and awareness.

Keywords: *dental treatments, socio-economic group, basic erosive wear examination, lead battery factory workers, WHO Oral Health Assessment form 1997..*

1. INTRODUCTION

Oral health is a vital but often overlooked aspect of general health. Environmental factors, including living and working conditions, significantly affect both general and oral health disorders.[1] In India, the factory industry employs a large population, utilizing various metallic and non-metallic minerals.[2] Globally, factory workers face hazardous conditions, exposing them to injuries and impairments.[3–5] Genetic makeup and environmental exposure contribute to disease susceptibility. While industrialization improves living standards, it increases occupational health risks.[6] Hazardous work environments deteriorate both general and oral health.[7] The nature of occupational illnesses is influenced by chemical, physical, and microbial agents, as well as their mode of entry into the body.[8]

The oral cavity, directly exposed to industrial contaminants, links the external environment to the body and is vulnerable to disorders. Oral conditions like caries, periodontitis, malocclusion, oral cancer, and traumatic injuries significantly affect general health. Workers in mining, metal, and chemical industries may suffer from periodontal and mucosal diseases.[8]

Mining is a highly destructive activity that generates large amounts of mineral waste such as tailings and waste rock, which often contain heavy metals like lead. Lead, naturally present in the earth's crust, is used in various products like batteries, ceramics, and pipes. Mining operations worldwide release lead into the environment, with South America, Africa, and India being heavily impacted. Over 12 million people face serious lead poisoning risks at 36 mining sites globally.[9,10]

Lead mining operates continuously, requiring laborious shift work that disrupts circadian rhythms, increasing the risk of obesity, diabetes, gastrointestinal, neurological, and cardiovascular disorders. Workers frequently resort to alcohol and tobacco, worsening oral health through mucosal diseases and periodontitis. Independent studies link mining to musculoskeletal, respiratory, and neurological health issues.[8]

Oral health is further influenced by socioeconomic factors, culture, and diet. Several studies have shown that workplace environments affect dental health. Occupation is often used as a proxy for socioeconomic class in epidemiological research. As people spend a large part of their lives at work, workplace-related stress and healthcare policies significantly impact oral health, especially among the elderly. Integrating dental services and education in workplace settings is crucial. Implementing public health strategies in the workplace can prevent and control oral diseases.[11–17]

Lead mining workers often suffer from poor nutrition and physical impairments due to frequent accidents. The Government of Rajasthan reports that the average life expectancy of lead mine workers is 49 years—10 years below the national average. Workers are exposed to biological, chemical, and physical agents, leading to occupational diseases such as lung fibrosis, deafness, neuropathy, and cancers.[18]

Limited workspace increases the risk of dental trauma. Addictive behaviors like drinking and smoking due to job stress also contribute to poor oral hygiene. Common issues include bleeding gums, calculus (17.6%), and dental caries (67.5%), with 49.7% having a DMFT index of 1–3. Access to dental care in rural areas remains limited.[19-22]

Given these factors, the present study was conducted to assess the oral health status of workers in lead battery manufacturing units in Udaipur, focusing on extraoral changes, dental caries, oral mucosal conditions, periodontal status, fluorosis, and work experience.

2. METHODOLOGY

Type of Study- A cross-sectional study was conducted to evaluate the oral health status of workers employed in lead battery manufacturing units in Udaipur city.

Study Location- The research was carried out among workers of a lead battery manufacturing factory and small-scale manufacturing units located within Udaipur city.

Source of Data- Data was obtained from the factory authorities, listing all eligible workers in the identified lead battery manufacturing facility and associated units.

Ethical Clearance- The study received approval from the Institutional Ethical Committee of Darshan Dental College and Hospital (Approval No: DDCH/ADM/2023-24/1080-PHD).

Sample Description and Size- Initially, it was found that only one lead battery factory existed in Udaipur city. According to the factory records, 1521 workers were employed; however, 621 were daily wage workers and excluded from the study. Among the remaining workers, only those who provided informed consent were included, resulting in a final sample size of **900** participants.

Study Duration- Data collection took place from **20th July 2021 to 25th September 2021**, and the study was completed within six months.

Selection CriteriaInclusion criteria:

- Workers from factories that granted permission and who voluntarily consented to participate.
- Individuals with a minimum of 20 teeth (excluding third molars).
- Participants not currently on any medication.

Exclusion Criteria

- Workers employed on a **daily wage basis** or temporary contractual basis.
- Individuals who did **not provide informed consent** to participate in the study.

- Workers with **fewer than 20 teeth** (excluding third molars).
- Participants currently **undergoing any systemic medication or treatment** that could affect oral health.
- Workers with a **history of systemic diseases** known to influence oral health (e.g., diabetes, autoimmune disorders).
- Individuals who had undergone **periodontal or dental treatment** in the past 6 months.
- Workers with **cognitive or physical impairments** that could hinder participation in the study or comprehension of the questionnaire

Methodology - Upon receiving ethical clearance, the cross-sectional survey commenced among workers of the lead battery factory and small-scale units. Oral examinations were performed during working hours using Type III clinical examination procedures as per **WHO guidelines** (1997), utilizing a **mouth mirror and CPI probe**. Examiners were calibrated prior to data collection to ensure consistency.

A **pre-validated questionnaire** was administered to collect data on dietary and oral health habits, socio-demographic information, and job-related factors such as duration of service and work environment.

Clinical assessments included:

- **Extraoral changes**
- **Dental caries status**
- **Oral mucosal conditions**
- **Periodontal status**
- **Dental fluorosis**

Dental erosion and its severity were recorded using the **Basic Erosive Wear Examination (BEWE)** scoring system.

Data Handling and Statistical Analysis- Out of the total eligible participants, **936 completed questionnaires** were used for final analysis. Data were compiled in **MS Excel (version 18)** and analyzed using **SPSS software (version 25)**. Descriptive statistics (mean and standard deviation) were used to summarize data, while the **Chi-square test** assessed associations between variables. A **p-value < 0.05** was considered statistically significant.

3. RESULTS

Here's an enhanced and concise version of your **Results** section, preserving all key findings while improving clarity and structure:

Table 1: Demographic Profile of Study Participants

Parameter	**Category**	**Frequency (%)**
Age	Mean ± SD	38.44 ± 8.4
	Range	24–55 years
Gender	Male	682 (75.8%)
	Female	218 (24.2%)
Socioeconomic Status	Lower	629 (69.9%)
	Lower Middle	198 (22%)
	Upper Lower	73 (8.1%)
Toothbrush Usage	Not answered	487 (54.1%)
	Every 3 months	324 (36%)
	Monthly	89 (9.9%)

Parameter	Category	Frequency (%)
Adverse Habits	Present	600 (66.7%)
	Absent	300 (33.3%)
Acidic Food Consumption	Yes	600 (66.7%)
	No	300 (33.3%)

Table 2: Clinical Oral Health Findings

Clinical Findings	Category	Frequency (%)
BEWE Score	Score 2	363 (40.3%)
	No erosion	300 (33.3%)
	Score 3	173 (19.2%)
	Score 1	64 (7.1%)
Dentition Status	Filled with caries	363 (40.3%)
	Sound teeth	301 (33.4%)
	Filled no caries	172 (19.1%)
	Caries	64 (7.1%)
Gingival Bleeding	Present	236 (26.2%)
	Absent	664 (73.8%)
Periodontal Pockets	Present	427 (47.4%)
	Absent	473 (52.6%)
Loss of Attachment (LOA)	0–3 mm	664 (73.8%)
	4–5 mm	236 (26.2%)
Enamel Fluorosis	Normal	663 (73.7%)
	Very Mild	173 (19.2%)
	Questionable	64 (7.1%)
Dental Erosion Severity	Enamel lesion	414 (46%)
	Dentinal lesion	186 (20.7%)
	No erosion	300 (33.3%)
Teeth Affected by Erosion	3 teeth	414 (46%)

Clinical Findings	Category	Frequency (%)
	4 teeth	186 (20.7%)
	None	300 (33.3%)

Table 3: Trauma and Oral Mucosal Lesions

Trauma and Mucosal Lesions	Condition/Location	Frequency (%)
Dental Trauma	No trauma	664 (73.8%)
	Treated injury	135 (15%)
	Pulp involvement	63 (7%)
Oral Mucosal Lesions (Conditions)	Malignant Tumor	96 (10.7%)
	Abscess	83 (9.2%)
	Leukoplakia	70 (7.8%)
Lesion Location	Buccal mucosa	148 (16.4%)
	Palate	83 (9.2%)
	Tongue	66 (7.3%)

Table 4: Prosthesis Use and Treatment Needs

Prosthesis and Treatment Need	Category	Frequency (%)
Upper Denture	Partial	159 (17.7%)
Lower Denture	Partial	65 (7.2%)
Treatment Need	Prompt treatment	363 (40.3%)
	Immediate intervention	172 (19.1%)
	Preventive care	64 (7.1%)
	No treatment	301 (33.4%)

Table 5: Associations with Socioeconomic Status (SES)

Associations with SES	Findings	Significance
Toothbrush use	Higher non-use in lower class	$p < 0.001$
Adverse habits	Highest in lower class	$p < 0.001$

Associations with SES	Findings	Significance
Acidic food consumption	Highest in lower class	$p < 0.001$
Oral mucosal lesions	More common in lower SES	$p < 0.001$
Lesion location	Buccal mucosa most affected	$p < 0.001$

The tables in this study collectively present a comprehensive overview of the oral health status and associated risk factors among lead battery factory workers in Udaipur. **Table 1** outlines the demographic profile, showing a predominance of male participants, most of whom belong to a lower socioeconomic status, with poor oral hygiene practices and high prevalence of adverse habits and acidic food consumption. **Table 2** details the clinical oral findings, highlighting significant rates of dental erosion (BEWE score 2 in 40.3%), periodontal issues (47.4% with pockets), and caries experience, along with notable enamel fluorosis and loss of attachment in a substantial portion of the workforce. **Table 3** focuses on oral trauma and mucosal lesions, where nearly a quarter of workers had signs of trauma and conditions like malignant tumors and leukoplakia were recorded. **Table 4** shows prosthetic status and treatment needs, with a considerable number requiring prompt or immediate dental intervention. Lastly, **Table 5** examines associations with socioeconomic status, demonstrating statistically significant links between lower SES and poorer oral health behaviors and outcomes, including toothbrush use, adverse habits, acidic food intake, and higher incidence and severity of oral mucosal lesions. These findings underline the critical influence of occupational and socioeconomic factors on the oral health of industrial workers.

4. DISCUSSION

This study assessed the oral health status of 900 lead battery factory workers in Udaipur, aged 24–55 years. The majority were male (75.8%), aligning with findings from Janapareddy K in steel factory workers and Sanadhya S among salt workers, where male dominance was also observed in industrial settings.[23] Most participants belonged to the lower socioeconomic group, similar to studies by Chandra Shekar and Rao B.[24]

Oral hygiene practices were poor; 54.1% did not answer the toothbrush replacement question, with only 9.9% changing it monthly. In contrast, Bommireddy VS reported higher usage but infrequent replacement.[25] Adverse habits such as tobacco or alcohol use were present in 66.7%, consistent with findings from Sanadhya S, Sandeep Kumar, and Bommireddy VS.[26]

Clinically, 40.3% had moderate erosive tooth wear (BEWE score 2), and 46% showed enamel lesions. These findings are consistent with chemical factory and steel industry studies.[27] Caries prevalence (40.3%) was comparable to Sanadhya S and Sandeep Kumar's findings, where high DMFT scores were recorded among industrial workers.[28] Gingival bleeding (26.2%) and periodontal pockets (47.4%) were also prevalent, aligning with reports by Sandeep Kumar and Rao BV, who found high rates of periodontal disease among mine workers.[29]

Loss of attachment (LOA) of 4–5 mm was seen in 26.2%, echoing studies by Sanadhya S and Sandeep Kumar, where similar levels of periodontal deterioration were reported.[30] Enamel fluorosis was present in 26.3% of workers, within the range seen among salt and steel workers.[31] Dental trauma was noted in 26.2% of participants, mainly treated injuries or pulp involvement, comparable with findings by Janapareddy K and Sandeep Kumar.[32]

Oral mucosal lesions, particularly leukoplakia, were prevalent, supporting the findings of Rao BV, Dagli et al., and others.[33] Most lesions occurred in the buccal mucosa (16.4%). Prosthetic need was moderate, with 17.7% requiring upper and 7.2% requiring lower dentures, similar to Rao BV's results. Regarding treatment needs, 40.3% required prompt care. This aligns with studies by Singh M and Sandhaya et al., where most workers needed urgent or routine treatment.[34]

The study highlights poor awareness, risky habits, and limited access to care among industrial workers. Targeted oral health education and integration of dental services into workplace health programs are crucial. Cross-sectional limitations and recall bias exist, but the findings reinforce the urgent need for preventive strategies among industrial laborers.

5. CONCLUSION

The results of this study have important implications for future research and public health interventions. Future studies could delve deeper into the specific environmental and occupational factors that contribute to poor oral health in industrial workers, including lead exposure, which may exacerbate dental erosion and other oral health issues. Longitudinal studies could also help track the effectiveness of oral health interventions over time and identify any changes in health outcomes due to improved access to care or lifestyle changes. Additionally, intervention strategies should be tailored to address the unique needs of different SES groups, with a focus on promoting preventive care, improving oral hygiene practices, and reducing harmful habits such as smoking and alcohol use.

While this study provides valuable data, it is not without limitations. The cross-sectional nature of the research means that causality cannot be established between the identified factors and the oral health outcomes. Moreover, the study relied on self-reported data for certain behavioral factors, such as smoking and alcohol consumption, which may be subject to reporting biases. The sample was also restricted to workers from one geographic area, limiting the generalizability of the findings to other populations. Furthermore, the study did not consider potential confounding factors, such as genetic predispositions or environmental exposures outside of the workplace, which may have influenced the participants' oral health.

In conclusion, this study underscores the urgent need for improved oral health policies and interventions that are specifically designed for high-risk, low-SES populations. By addressing the root causes of poor oral health, such as inadequate access to care and unhealthy lifestyle habits, it is possible to reduce the burden of oral diseases in these communities and promote overall well-being.

This study has provided valuable insights into the oral health conditions of lead battery factory workers in Udaipur, Rajasthan, highlighting the significant impact of socioeconomic status (SES), lifestyle choices, and working conditions on the oral health of this population. The findings emphasize the need for targeted oral health promotion initiatives that integrate both preventive and curative measures, with a particular focus on the disadvantaged segments of society. Oral health is an often-overlooked but integral aspect of overall health, and its neglect, particularly in lower SES populations, can lead to a wide range of oral and systemic health problems.

The study found that the workers, primarily male and from lower SES backgrounds, exhibited poor oral health, with high rates of dental caries, periodontal disease, and fluorosis. Notably, the prevalence of adverse habits such as smoking and alcohol consumption, along with the consumption of acidic foods and drinks, was found to be significantly higher in this group. These habits, combined with limited access to oral health care and a lack of proper oral hygiene practices, exacerbated the oral health issues faced by these workers. The lower use of toothbrushes and preventive dental care in the lower SES group further compounded these challenges.

One of the key strategic objectives for global oral health, as outlined by the World Health Organization (WHO), is to reduce disparities in oral health across different socioeconomic groups. This study aligns with that goal, demonstrating the need for more equitable and inclusive oral health systems that not only address the technical aspects of oral care but also take into account the unique challenges faced by marginalized communities. The findings stress the importance of implementing oral health policies that provide basic dental services, raise awareness, and promote education, especially in underserved populations.

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