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Dentistry Section

The Oral Health Status and the Treatment Needs of Salt Workers at Sambhar Lake, Jaipur, India

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ABSTRACT

Background: Salt workers are exposed to the adversities of environmental conditions such as direct sunlight, salt dust and contact with brine, which have an impact on the health of workers. Since oral health is an integral part of the general health, we planned to determine its effect on the oral cavity.

Objectives: To assess the oral health status and the treatment needs among the workers of Sambhar Salts Limited at Sambhar Lake, Jaipur, India.

Material and Methods: A cross sectional, descriptive survey was conducted among 979 subjects (509 males; 470 females) who were aged between 19–68 years, who were the workers of Sambhar Salts Limited, Sambhar Lake, Jaipur, India. An interview on the demographic profile followed a clinical examination for recording the oral health status, based on the World Health Organization guidelines. The Chi–square test, t–test, One way Analysis of Variance and a Stepwise multiple linear regression analysis were used for the statistical analysis.

Results: Females had a significantly greater prevalence of dental fluorosis (71.7%) and periodontal disease (96.4%) as compared to males (p= 0.001). The mean number of healthy sextants (0.71 ± 0.09) and the mean DMFT (5.19 ± 4.11) were also significantly higher in females as compared to those in males (p=0.001). One surface filling (78.2%), followed by pulp care and restoration (76.1%) were the most prevalent treatment needs. The gender and oral hygiene practices for dental caries and periodontal disease were respectively identified as the best predictors.

Conclusion: Considerable percentages of salt workers have demonstrated a higher prevalence of oral diseases. Higher unmet treatment needs suggest a poor accessibility and availability of oral health care, in addition to a low utilization of preventive or therapeutic oral health services.

Key words: Cross sectional, Oral health, Prevalence, Salt lake workers, Treatment needs

INTRODUCTION

India is the third largest salt producing country in the World after China and USA, with the global annual production being about 230 million tonnes. Salt production is one of the major industries in India, which enthralls a huge work force. The Rajasthan state is next only to Gujarat in the production of salt from subsoil brine in India. Approximately 20,000 workers are engaged in the salt industry in Rajasthan, India [1]. Sambhar is the largest inland saline lake of India which covers an area of approximately 225 sq. km in central Rajasthan, India. It is a special lake, not only because of its geological importance, but also because of its peculiar physical and chemical characteristics. The lake brine is of the K–Na–CO_3–SO_4–Cl type. The water of Sambhar Lake has been used for centuries to prepare salt [2].

The manufacture of salt is highly labour oriented. Inland water or lake water which is rich in salt content is kept in wide and open pans which are manually constructed on the surface of the earth, from where water evaporates under direct sunlight and salt crystallizes at the bottoms of the brine pans. Salt workers are engaged in various processes of salt manufacturing – viz., sweeping the salt crystals with a wooden spade; heaping of the salt crystals at the edges of the pans; loading, weighing, milling, packing or the transportation of salt [3]. The workers who come in direct contact with brine are exposed to direct sunlight and they sustain frequent injuries to their hands and feet, whereas those who handle dry salt at the milling and processing units are exposed to salt dust in their working environment. A study which was conducted by Sinha [3] in revealed a fluoride concentration of more than 1.5 ppm in the water samples from 19 villages of Sambhar.

There is some evidence which is related to the general health morbidity of the salt factory workers in association with their work environment [4]. Work related general, skin and eye symptoms are significantly higher among the salt workers. Intervention measures such as gumboots and goggles are acceptable to the salt workers and they feel more comfortable with the use of Personal Protective Equipments (PPE) while they work with salt water [5].

Owing to the paucity of literature on the oral effects among this vulnerable population, the present study was taken up to assess the oral health status and the treatment needs of the workers of Sambhar Salts Limited (A subsidiary of Hindustan Salts Limited) in Sambhar Lake, Jaipur, Rajasthan, India. This also provides a baseline data for planning oral health care programs to improve the oral health status in this community.

MATERIAL AND METHODS

The Study Design and the Study Population

A cross sectional, descriptive survey was conducted among the workers of Sambhar Salts Limited in Sambhar lake, Jaipur, India. Located about 80 km northwest of Jaipur, in central Rajasthan, India, Sambhar is a shallow lake which reaches to only about 3m at its deepest, with its average depth not exceeding 0.61 m. The maximum length of the lake basin is 22.5 km, while its width ranges from 3.2 to 11.2 kms [6]. All the salt lake workers who were willing to participate in the study, irrespective of their age, sex, designation, work experience, etc, were studied.

Ethical Considerations

The study protocol was reviewed by the ethical committee of Pacific Dental College and Hospital and it was granted ethical clearance. An official permission was obtained from the Chairman of Sambhar Salts Limited (A subsidiary of Hindustan Salts Limited), in Sambhar lake, Jaipur, India.

Training and Calibration

Before the commencement of the study, the examiner was standardized and calibrated in the Department of Public Health Dentistry, by the Head of the Department, to ensure uniform interpretations, understanding, and application of the codes and criteria for the diseases to be observed and recorded and to ensure a consistent examination. The intra examiner reliability for DMFT (Decayed Missing Filled Teeth) and CPI (Community Periodontal Index) was assessed by using Kappa statistics, which were found to be 90% and 88% respectively.

The Proforma Details

The survey proforma designed with help of WHO Oral Health Assessment form (1997) [7] consisted of three sections:

1. **General information:** The demographic data which included the age, gender, education and the marital status.
2. Information about the oral hygiene practices and adverse habits.
3. The clinical parameters which were assessed were dental fluorosis, the community periodontal status, the loss of attachment, the dentition status and the treatment needs, the prosthetic status and needs and the dento–facial anomalies.

Pilot Survey

A pilot study was carried out among 35 salt lake workers to determine the feasibility and practicability of the study and the time which was required for the examination of each subject. It took around 15–20 minutes to assess each subject. It helped us in knowing and overcoming the practical difficulties which we encountered while we conducted the survey.

Clinical Assessment and Data Collection

Before the commencement of the study, a list of salt lake workers was obtained from the office of Sambhar Salts Limited. As per the list, there were a total of 988 workers. Among them, all the workers(n=979) who gave informed consent were included in the study. The examination was conducted during January 2012 to April 2012.

The examiner visited the site on the pre–determined dates according to the schedule. The subjects were made to sit on a chair in such a way that the maximum illumination was obtained and the oral cavity was examined by the examiner who stood on the right side of the chair. The examination was made with the aid of a mouth mirror and a CPI (Community Periodontal Index) probe according to the Type III examination which was described in the WHO Oral Health Survey Basic Methods 1997 [8]. On an average, the examination of each subject took about 15–20 minutes. Duplicate examinations were conducted on 5% (n=50) of the population during the course of the study, with Kappa statistics of 95%.

STATISTICAL ANALYSIS

The recorded data was compiled and entered into a spreadsheet computer program (Microsoft Excel 2007) and it was then exported to the data editor page of SPSS, version 15 (SPSS Inc., Chicago, Illinois, USA). The descriptive statistics included the computation of the percentages, means and the standard deviations. The statistical tests which were applied for the analysis were Pearson's Chi-square test (χ^2), t-test, One way Analysis of Variance and a Stepwise multiple linear Regression analysis. For all the tests, the confidence interval and the p-value were set at 95% and ≤ 0.05 respectively.

RESULTS

Of the total 979 subjects who participated in the survey; 509 (52%) were males and 470 (48%) were females. The mean age of the study population was 35.69 ± 9.04. A higher proportion of the participants was married (74.2%). None of the salt workers were educated above the middle level. A majority (n=422; 43.1%) of the study population used chew sticks for cleaning their teeth. The use of toothbrushes diminished significantly with increasing age, from the 19–28 years age group to the 49–58 years age group (p=0.001). A significantly higher proportion of the females used tooth brushes (n=169; 36%) as compared to males (n=66; 13%) (p=0.027). The usage of chewsticks was significantly higher in males (n=288; 56.6%) as compared to that in females (n=134; 28.5%). The prevalence of the consumption of smoking tobacco, smokeless tobacco, the combinations of smoking tobacco and smokeless tobacco, alcohol and the combinations of tobacco and alcohol were 24.7%, 10.5%, 14.2%, 8.7% and 5% respectively. The adverse habits showed a significant rise with increasing age (p=0.001).

Severe fluorosis was the most prevalent (n=232; 23.7%) form of Dental fluorosis observed among the study subjects. Only 5.5% of the participants had questionable fluorosis. A significant relationship between dental fluorosis and gender was evident (p=0.001).

Shallow pockets (4–5 mm) and calculus were demonstrated among 46.8% and 33.6% of the study subjects respectively. Bleeding, shallow pockets and calculus were reported, with the highest prevalence among the 19–28 years, 29–38 years and the 39–48 years age groups respectively (p=0.001). Among all, 569 (58.1%) subjects substantiated a loss of attachment of 4–5 mm. Six to eight mm and nine to eleven mm losses of attachment were evidenced by (n=83; 8.5%) and (n=86; 8.8%) of the study population. Losses of attachment of 4–5 mm and 6-8 mm were significantly higher in prevalence among males than among females (p=0.05).

The overall mean number of the sextants for bleeding was 0.21 ± 0.05, that for the calculus was 3.28 ± 1.46, that for the shallow pockets (4-5 mm) was 2.11 ± 0.51 and that for the deep pockets (6 mm or more) was 0.28 ± 0.08 respectively. The mean number of sextants with bleeding (0.30 ± 0.06) and calculus (3.47 ± 0.46) were significantly higher among males than among females. The mean numbers of the sextants which were affected by losses of attachment of 4-5 mm, 6-8 mm and 9-11 mm were 3.50 ± 2.17, 0.83 ± 1.43 and 0.39 ± 0.80 respectively. The losses of attachment of 4–5 mm, 6–8 mm and 9–11 mm were the highest among the 39-48 years age group (3.86 ± 2.05), the 49–58 years age group (2.91 ± 1.8) and the 29-38 years age group (0.59 ± 0.95) respectively [Table/Fig-1].

The mean DMFT of the study population was found to be 3.94 ± 3.54. The mean numbers of decayed, missing and filled teeth per person were observed as 3.34 ± 3.12, 0.42 ± 1.12 and 0.19 ± 0.61 respectively. The significantly lowest and highest DMFTs were depicted among the age groups of 39–48 years and 29–38 years respectively (p=0.001). Females had significantly higher mean DMFTs, decayed, missing and filled teeth as compared to males [Table/Fig-2].

One surface filling (n=766; 78.2%) was the most prevalent treatment need among the study population, followed by pulp care and restoration (n=745; 76.1%) and two surface filling (n=404; 41.3%). Extraction and crown for any reason were needed among 27.4% and 36% of the study subjects respectively. Other care was required among 53 (5.4%) subjects [Table/Fig-3].

Of the whole population, 409 (73.3%) subjects had no abnormality or a minor malocclusion; 44 (7.9%) had definite malocclusions which required elective treatment; 13 (2.3%) had severe malocclusions which required highly desirable treatment and 92 (16.5%) had very severe or handicapping malocclusions which indicated a mandatory treatment need. The proportion of females with no abnormality or a minor malocclusion, with no or a slight orthodontic treatment and a very severe malocclusion with mandatory treatment was greater as compared to that of males [Table/Fig-4].

The best predictors in the descending order for the DMFTs were gender, oral hygiene practices, educational status, age and the

Variables (n=979)	Community Periodontal Index (Mean ± SD)					Loss of attachment (Mean ± SD)				
	Healthy	Bleeding	Calculus	Pocket (4-5 mm)	Pocket (> 6 mm)	0-3	4-5	6-8	9-11	>12
Age group (in years)										
19-28 (n=297)	0.00	0.34±0.06	3.28±1.46	2.38±0.70	0.24±0.08	2.90±2.6	2.96±2.54	0.49±0.09	0.29±0.70	0
29-38 (n=324)	0.59±0.07	0.11±0.03	3.28±1.50	2.02±0.43	0.33±0.08	1.33±2.13	3.85±1.94	1.02±1.4	0.59±0.95	0
39-48 (n=255)	0.78±0.01	0.14±0.04	3.6±1.42	1.49±0.13	0.20±0.08	2.07±2.08	3.86±2.05	0.23±0.65	0.34±0.75	0
49-58 (n=89)	0.00	0.27±0.06	2.24±0.38	3.49±0.68	0.48±0.12	1.93±2.30	3.02±1.50	2.91±1.8	0.16±0.54	0
59-68 (n=14)	0.00	1.00±0.03	4.00±0.01	1.00±0.03	0.29±0.12	3.00±1.03	3.00±1.04	0	0	0
p-value	0.001	0.001	0.001	0.001	0.086	0.001	0.001	0.001	0.001	-
Gender										
Male (n=509)	0.11±0.07	0.30±0.06	3.47±0.46	2.13±0.61	0.35±0.01	1.20±1.64	4.66±1.62	1.09±1.6	0.45±0.83	0
Female (n=470)	0.71±0.09	0.12±0.03	3.07±0.05	2.09±0.41	0.21±0.07	3.03±2.65	2.24±1.97	0.55±1.1	0.32±0.76	0
p-value	0.001	0.001	0.012	0.821	0.746	0.001	0.001	0.001	0.001	-
Total	0.40±0.04	0.21±0.05	3.28±1.46	2.11±0.51	0.28±0.08	2.08±2.37	3.50±2.17	0.83±1.43	0.39±0.80	0

[Table/Fig-1]: Distribution of mean number of sextants affected by periodontal disease in the study population.
Test applied: One way ANOVA, t- test

adverse habits, with variances of 6.7%, 10.1%, 13.8%, 17.4% and 18.2% respectively. The best predictors in the descending order for CPI were oral hygiene practices, adverse habits, age and educational statuses, with variances of 3.2%, 4.7%, 5.5% and 6.6% respectively [Table/Fig-5].

DISCUSSION

The most prevalent oral hygiene practices among the study population were the use of chewsticks (43.1%) and the use of fingers with tooth paste/tooth powder (29.6%). This finding was analogous to the results which were reported by Sakthi et al., [9] at Chennai, India, where 76.9% of the building construction workers used toothbrushes and tooth paste for cleaning their teeth. In the present study, a greater proportion of females (36%) used tooth brushes than males (13%). This confirmed the previously established findings that females paid more attention to oral hygiene practices than males [10].

A combined tobacco usage [smoking tobacco, smokeless tobacco and combinations of smoking and smokeless tobacco] (49.4%) constituted the highest prevalence among adverse habits which were observed in salt lake workers. The tobacco prevalence in our study was lesser than those which were reported by Knutsson and Nilsson [8] and Ansari et al., [11] but it was greater than that which was reported by Mou et al., [12]. The present study demonstrated that the prevalence of the tobacco usage increased subsequently in the old age groups as compared to that in the younger age groups. Townsend et al., [13] also portrayed a similar pattern and attributed this finding to the fact that young people generally had relatively low incomes, with a high proportion of it being available for the discretionary expenditure, so that the changes in the income could more likely affect their tobacco consuming patterns.

The present study demonstrated a higher prevalence (59.9%), with a majority having severe dental fluorosis (23.7%), which could be explained on the basis of the high water fluoride level (1.5 ppm) which was reported by Sinha [3] in 19 villages of the Sambhar district. This needs further investigation in the aspects of time and the duration of the exposure.

Periodontal disease, as was assessed by the Community Periodontal Index (CPI), showed a prevalence of 96.4%, with only 0.40±0.04 healthy sextants per person. It was greater than that which was obtained in the National Oral Health Survey and Fluoride Mapping, 2002-03, of India [14] and Rajasthan [15] respectively. However, this finding was similar to the prevalence which was obtained among

Variables	Mean ± Standard deviation			
	DT	MT	FT	DMFT
Age group (years)				
19-28 (n=297)	2.87 ± 2.08	0.35 ± 0.97	0.31 ± 0.52	3.50 ± 2.43
29-38 (n=324)	3.09 ± 2.66	0.23 ± 1.68	0.29 ± 0.90	4.09 ± 3.52
39-48 (n=255)	2.22 ± 2.25	0.18 ± 0.87	0.02 ± 0.15	2.42 ± 1.52
49-58 (n=89)	2.75 ± 0.31	0.19 ± 0.39	0	2.94 ± 2.18
59-68 (n=14)	2.05 ± 0.12	0.50 ± 0.51	0	2.50 ± 1.59
p-value	0.001	0.001	0.001	0.001
Gender				
Male (n=509)	2.24 ± 1.88	0.24 ± 0.52	0.11 ± 0.36	2.58 ± 1.89
Female (n=470)	4.36 ± 3.63	0.59 ± 1.50	0.27 ± 0.77	5.19 ± 4.11
p-value	0.001	0.001	0.001	0.001
Total	3.34 ± 3.12	0.42 ± 1.12	0.19 ± 0.61	3.94 ± 3.54

[Table/Fig-2]: Mean DT, MT, FT and DMFT according to age groups and gender
Test applied: One way ANOVA, t- test

Treatment needs	n	%
Preventive care	34	3.5
Fissure sealant	34	3.5
One surface filling	766	78.2
Two surface filling	404	41.3
Crown for any reason	352	36
Veneer and laminate	66	6.7
Pulp care and restoration	745	76.1
Extraction	268	27.4
Need for other care	53	5.4

[Table/Fig-3]: Prevalence of treatment needs among study population

Variables	Malocclusion and orthodontic treatment needs n (%)			
	No abnormality or minor malocclusion	Definite maloc-clusion	Severe maloc-clusion	Very severe or handicapping malocclusion
	No/ slight need	Elective treatment	Highly Desirable	Mandatory
Age (Years)				
19-28 (n=297)	198 (66.7)%	44 (14.8)%	5 (1.7)%	50 (16.8)%
29-38 (n=324)	211 (80.8)%	0	8 (3.1)%	42 (16.1)%
Gender				
Male (n=509)	180 (71.4)%	34 (13.5)%	0	38 (15.1)%
Female (n=470)	229 (74.8)%	10 (3.3)%	13 (4.2)%	54 (17.6)%
Total	409 (73.3)%	44 (7.9)%	13 (2.3)%	92 (16.5)%

[Table/Fig-4]: Dental Aesthetic Index scores and orthodontic treatment needs among study subjects
Test used: Chi square test
For age groups: χ^2 = 134.31, df = 8, p=0.001* (Statistically significant)
For gender groups: χ^2 = 266.43, df = 2, p=0.054 (Statistically non-significant)

Model	R	R2	f-value	p-value
Dental caries				
1	0 .258 (a)	0.067	69.88	0.000(a)
2	0. 317 (b)	0.101	54.64	0.000(b)
3	0. 372 (c)	0.138	52.17	0.000(c)
4	0.417 (d)	0.174	51.33	0.000 (d)
5	0.427 (e)	0.182	43.29	0.000 (e)
a Predictors: (Constant), Gender				
b Predictors: (Constant), Gender, Oral hygiene practices				
c Predictors: (Constant), Gender, Oral hygiene practices, Educational status				
d Predictors: (Constant), Gender, Oral hygiene practices, Educational status, Age				
e Predictors: (Constant), Gender, Oral hygiene practices, Educational status, Age, Adverse habits				
Community Periodontal Index				
1	0 .179 (a)	0.032	32.34	0.000(a)
2	0. 216 (b)	0.047	23.93	0.000(b)
3	0. 235 (c)	0.055	18.97	0.000(c)
4	0.256 (d)	0.066	13.69	0.000 (d)
a Predictors: (Constant), Oral Hygiene Practices				
b Predictors: (Constant), Oral Hygiene Practices, Adverse Habits				
c Predictors: (Constant), Oral Hygiene Practices, Adverse Habits, Age				
d Predictors: (Constant), Oral Hygiene Practices, Adverse Habits, Age, Educational status				

[Table/Fig-5]: Stepwise multiple linear regression analysis with Dental caries and Community Periodontal Index as dependent variables

other populations of the building construction workers at Chennai, India (95.4%) [9].

The mean number of healthy sextants which was observed in the present study corroborated with the values which were obtained among the mining, cotton and the machine factory workers at Shanghai [16]. Calculus was most widespread among the 39-48 years age group (63.1%), whereas the shallow periodontal pockets showed the highest prevalence among the 29-38 years age group (69.4%), which confirmed the findings of the study of Lie et al (1988) [17] which was done on aluminium factory workers. Moreover, females (0.71 ± 0.09) had a greater number of healthy sextants per person than males (0.11 ± 0.07), which was in confirmation to other studies [18].

The predictors for periodontal disease, as were identified by stepwise linear regression were oral hygiene practices, adverse habits, the educational status and the marital status. In a study [19] which was carried out to ascertain the periodontal status among male industrial workers in Finland, it was found that smoking was the strongest independent factor which affected the periodontal status. The educational and marital statuses have been found to be the apparent risk factors for the periodontal disease in several studies [19,20].

The mean DMFT of the present study population (3.94 ± 3.54) was higher than the values which were obtained among the construction workers of Chennai, India [9]. However, it was lower than those which were obtained among the textile industry and sweet industry workers of Israel [21]. This might be due to the poor oral health knowledge and practices among the study population, as the subjects belonged to the rural communities of the third world countries.

Inspite of the better oral hygiene, the mean DT, MT, FT and the DMFT were found to be higher among females. Lukacs [22] cited in his meta analysis, that in addition to the negative influences of the female sex hormones and the changes in the physiology and the behaviour, which were associated with pregnancy and multiple social and religious factors may contribute to the sex differences in the oral health in south Asia. Apart from the gender, the predictors for dental caries, as were observed in the present study, were the marital status, the oral hygiene practices, the educational status and age. These were in confirmation to the observations which were made in previous researches [23, 24].

One surface filling (78.2%), pulp care and restoration (76.1%) and two surface filling (41.3%) were the most frequent treatments which were needed. A lack of knowledge on good oral hygiene practices, a lack of motivation, the low priority which was given to the dental care in the society, a lack of facilities for an early and a regular oral health check up and a prompt treatment and finally, the cost of the treatment may be the reasons for the accumulated treatment needs. Malocclusion was prevalent among 26.7% of the study population. This prevalence was higher than those which were reported in the National Oral Health Survey and Fluoride Mapping of India [14] and Rajasthan [15].

The workplace environment of the individuals has an influence on their oral health statuses through the behaviour and habits which are exerted by their personal and work characteristics. The intersectoral coordination of various departments (Salt manufacture, Health and Labour welfare) could play important roles in preparing strategies which may be effective in bringing about an improvement in the health and the oral health of the salt lake workers.

The nature of this study was cross–sectional study, which thus precluded the ability in drawing inferences about causal relationships. Secondly, the duration of the exposure of the adverse habits was not assessed in the present study. Furthermore , more research is required, which involves a longitudinal study on the same target population, which impinges the the risk factors which are involved in the causation of oral disease.

CONCLUSION

The findings of this study provide insight into the oral health statuses of salt lake worker population, which may be useful in designing investigations that aim at further exploring the causes for these findings and more importantly, at planning oral health promotion programs which implement both preventive and curative strategies.

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