Safety and Health at Work 5 (2014) 136–139

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.org

Original Article

Oral Health of Stone Mine Workers of Jodhpur City, Rajasthan, India

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ARTICLE INFO

Article history:
Received 13 February 2014
Received in revised form
21 May 2014
Accepted 24 May 2014
Available online 6 June 2014

ABSTRACT

Background: Occupational injuries cause major health problems, which the developed, developing, and underdeveloped nations worldwide are facing today. The present study aimed to assess dental caries, periodontal health of stone mine workers, and the relationship between wasting diseases and the years of working experience.

Methods: The study population comprised 510 men, selected based on the stratified cluster sampling procedure. Clinical oral examinations were carried out, and periodontal disease, dental caries, and wasting diseases were recorded.

Results: Workers were in the age group of 17–56 years; the prevalence of dental caries in the workers was found to be 74%, with a mean decayed, missing, filled teeth index of 2.89. A periodontal pocket of more than 6 mm was observed in 6% of the workers.

Conclusion: The oral health of mine workers is in a poor state; steps should be taken so as to provide basic medical and dental care facilities.

1. Introduction

Occupational injuries cause major health problems that all developed, developing, and underdeveloped nations worldwide are facing. The majority of the workforce is deprived of occupational health services [1]. The estimated economic loss due to work-related injuries and diseases is equivalent to 4% of the world's gross national product [2]. The impact is much higher in developing countries [3]. According to Leigh et al [4], 100 million occupational injuries occur throughout the world each year. Mine workers are subjected to a number of subtly harmful risks to health and safety, such as a high concentration of mechanical equipment in a confined space. As a result, mine workers are often exposed to a high risk of work-related musculoskeletal injuries, according to the US Bureau of Labor Statistics [5].

A large number of laborers in India work in the stone crushing and mining industries [6]. Jodhpur is the second largest district of Rajasthan, India, where red stone mines are found. A large mining industry has developed here, which provides labor to a large section of the population. Mining is a tedious physical work, and involves exposure to colloidal silica and particulate matter. Workers are more prone to dental injuries due to a limited working area [7,8]. Due to the tedious working schedule, workers develop the habit of alcohol consumption and tobacco use, which leads to deterioration of their oral health [7,8].

Most of the mine workers are malnourished, have ill health, and suffer from physical impairments due to accidents at mining areas. According to the Mines and Geology Department, the Government of Rajasthan, the average life expectancy of a mine worker is 49 years. This is 10 years less than the life expectancy of workers who work outside the mines. In the workplace, workers are exposed to biological, chemical, and physical agents, which can result in adverse effects ranging from simple discomfort and irritation to debilitating occupational diseases such as lung fibrosis, neuropathy, deafness, organ damage, lung diseases (such as silicosis, tuberculosis, silicotuberculosis, and asthma), and cancers of various sites [9].

It has been reported that the standard of oral hygiene was poor for adults, and bleeding and calculus problems were frequent (17.6%), but the prevalence rate of advanced periodontal disease

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http://dx.doi.org/10.1016/j.shaw.2014.05.003

was low (0.9%). Dental caries was experienced by 67.5% of people, of whom 49.7% had a decayed, missing, filled teeth (DMFT) index of 1–3 [10]. The majority of people living in rural areas have limited access to essential oral health care due to geographic and economic barriers [11,12].

Therefore, keeping the abovementioned points in view, we developed the curiosity to conduct a study, in order to assess the oral health status of stone mine workers in Jodhpur district. This study was conducted with the aim to assess dental caries and periodontal health status, and to establish the relationship between wasting diseases and the years of working experience of stone mine workers of Jodhpur city, Rajasthan.

2. Materials and methods

Jodhpur district is located in the western part of Rajasthan. It shares a common border with five districts: Bikaner and Jaisalmer in the north and north-west, respectively; Banner and Pali in the south-west and south-east, respectively; and Nagaur in the east–northeast. Jodhpur is a zonal headquarter that controls all mineral-related activities in western Rajasthan. The geological configuration of Jodhpur district is interesting and is represented by rocks ranging from pre-Cambrian to the recent age. The main rock types found are sandstone, limestone, granite, rhyolite, schist, phyllite, and slate (Geology Department of the Government of Rajasthan).

Marwar supergroup is the oldest sedimentary sequence of western Rajasthan, comprising siliciclastic and carbonate sediments of the Cambrian age. Earlier, this supergroup was considered to be equivalent to Vindhyan rocks, but now its sediments are equated to those of the Indus basin. This supergroup has further been subdivided into Jodhpur, Bilara, and Nagaur Groups. Jodhpur Group is the oldest among these and contains rock assemblage shale, chert, and fine-grained to gritty sandstone. Rocks of this group cover a large part of Jodhpur, Bhopalgarh, and Kherapa areas. Quarries of famous Jodhpur building stone are located in the rocks of this group. Over 150 mines have been given on lease, employing over 20,000 workers (Mines and Geology Department, the Government of Rajasthan).

The study area in the present study comprises the mines on the outskirt of Jodhpur city near Mathaniya, Mandore, and Kaliberi. The stratified cluster sampling procedure was employed to collect the representative population; over 25 mines are located in the Mathaniya area, where 3,500 workers are employed. Each area was used as strata, and mines from that area were selected randomly. All the workers were informed about the study in advance so as to attain maximum attendance. The study group was selected from the workers who met the inclusion and exclusion criteria.

The inclusion criterion was that workers should be present on the day of examination. The exclusion criteria were as follows: (1) individuals suffering from any systemic illness; (2) individuals who are not willing to participate in the study; and (3) individuals with a habit of bruxism.

The study population comprised 510 men who were divided into age groups of 17–26 years, 27–36 years, 37–46 years, and 47–56 years.

Ethical clearance was obtained from the ethical committee of the institute, and permission was obtained from the mine association and owners.

2.1. Calibration

Oral examination of all the study participant was carried out by two examiners who were trained and calibrated in the Department of Public Health Dentistry, Vyas Dental College, Jodhpur. Training took 2 days, and a further 2–3 days for calibration. First, the examination was conducted on a group of 10 participants with a wide range of disease conditions. Twenty preselected individuals were examined twice consistently, with a time interval of at least 30 minutes between examinations. The interexaminer correlation coefficient for DMFT index was 0.80, and the intraexaminer correlation coefficients were 0.86 and 0.89 for the two examiners. For CPI scores, the interexaminer reliability was tested using kappa index and was found to be 0.90 (excellent). The corresponding kappa values for intraexaminer reliability were 0.92 and 0.88.

2.2. Examination and data collection

Data were collected through a cross-sectional survey that included examinations for periodontal disease, dental caries, and wasting diseases. Oral examination was carried out in a well-illuminated room. Clinical examination was performed using a mouth mirror and the World Health Organization (WHO) probe for dental caries and periodontal status. The CPI and LOA indexes were used to assess the periodontal status, according to the WHO oral health survey basic methods [13]. The presence or absence of wasting diseases, including attrition and abrasion, was recorded by visual examination. Demographic and personal information of each study participant was recorded on a structured pro forma, which was completed by the recorder during clinical examination.

2.3. Examination area and source of light

A clean and uncongested area was selected for examination to avoid crowding and noise. The workers were made to sit on a chair at a place with sufficient natural daylight. A table, on which instruments and other armamentaria were arranged, was placed within easy reach of the examiner. Clinical oral examinations were carried out by previously trained and calibrated dental surgeons, who were assisted by the recorder while examining the participants. The examiners examined the participant and called out the scores for each item of examination clearly, and the recorder then entered it in the appropriate place in the pro forma for each participant examined. The recording assistant was allowed to sit close enough to the examiner so that the instruction and codes can be heard easily and the examiner could see that the findings were being recorded correctly.

2.4. Statistical analysis

All the collected data were entered in the Microsoft Word Excel Sheet 2007 version. Calculations for each clinical parameter were performed using kappa statistics, Chi-square test, analysis of variance, and *post hoc* Tukey's test. Data were entered into a computer and analyzed using SPSS, version 16 (SPSS Inc., Chicago, IL, USA).

3. Results

A cross-sectional study was carried out to assess the oral health status of stone miners in Jodhpur city of the state of Rajasthan. A total of 510 samples were selected based on the stratified cluster sampling method. The workers were in the age group of 17–56 years; 36% of them were in the age group of 27–36 years and only 12.35% were in the 47–56-year group. It was found that 60.1% of the workers had only primary education and 34.9% were illiterate. Of them, 93.7% had the habit of either chewing (34.9%) or smoking (32.9%) tobacco; 38.8% had the habit of both alcohol consumption and tobacco use, and 8.8% stopped consuming alcohol. Oral hygiene of the workers was very poor. No worker used a toothbrush and toothpaste to clean their teeth; 43.1% of the workers occasionally

Table 1
Demographic variables of the study population

Variables	$N = 510$
Age groups (y)	
17–26	140 (27.5)
27–36	187 (36.6)
37–46	120 (23.5)
47–56	63 (12.35)
Education	
Illiterate	178 (34.9)
Primary	307 (60.1)
Senior Section	19 (3.72)
Graduate	6 (1.1)
Tobacco use	
Nonuser	32 (6.27)
Smoking	168 (32.9)
Chewing	178 (34.9)
Both smoking and chewing	132 (25.8)
Quitted tobacco use	0
Alcohol use	
Nonuser	30 (5.98)
Occasional drinker	58 (11.37)
Frequent drinker	179 (35.09)
Alcohol and tobacco user	198 (38.82)
Quitted alcohol use	45 (8.8)
Oral hygiene practice (no worker used toothbrush and toothpaste to clean their teeth)	
Do not clean teeth	180 (35.2)
Occasionally clean teeth	220 (43.1)
Clean teeth daily	110 (21.5)
Years of working in stone mines	
< 1	63 (12.35)
1–3	73 (14.3)
3–5	264 (51.7)
> 5	110 (21.5)

Data are presented as *n* (%).

cleaned their teeth using indigenous aids (neem or babool stick, ash, clove oil, or salt). It was observed that 51.6% of the workers have been working in the mine for 3–5 years, whereas only 12% have been working there for less than a year (Table 1).

The prevalence of dental caries in the workers was found to be 74%, with a mean DMFT of 2.89. The mean dental caries score was found to be maximum (3.59) in the age group of 37–46 years and the minimum (2.40) in the age group of 17–26 years. A highly significant difference was observed between the different age groups and the mean DMFT ($p < 0.001$) (Table 2).

The periodontal status was recorded using the CPI index. Healthy gingiva was observed only in 4.9% of the workers. A highly significant difference was observed between the different age groups and the periodontal health of stone factory workers (Table 3).

A highly significant relationship was observed between the years of working experience and dental attrition among stone mine workers ($p \leq 0.001$) (Table 4).

Table 2
Dental caries of stone mine workers of different age groups

Age groups ($N = 150$)	DMFT (mean ± SD)	DMFT (mean)	*F* value	*p*
17–26 (140)	2.40 ± 0.6	3	29.707	< 0.001
27–36 (187)*	2.76 ± 1.12			
37–46 (120)*,†	3.59 ± 1.23			
47–56 (63)*,‡	2.80 ± 1.11			

DMFT, decayed, missing, filled teeth; SD, standard deviation.
* $p < 0.05$ versus 17–26-year age group, with Tukey's multiple comparison test.
† $p < 0.05$ versus 27–36-year age group, with Tukey's multiple comparison test.
‡ $p < 0.05$ versus 37–46-year age group, with Tukey's multiple comparison test.

Table 3
Periodontal status of stone mine workers of different age groups

	Age group 17–26 (140)	Age group 27–36 (187)	Age group 37–46 (120)	Age group 47–56 (63)	Chi-square test	*p**
Healthy	25 (17.8)	0	0	0	—	0.000
Bleeding	67 (47.8)	72 (38.5)	43 (35.8)	15 (23.8)	41.518	0.001
Calculus	43 (30.7)	91 (48.6)	48 (40)	20 (31.7)	52.139	0.000
S. pocket	5 (3.5)	17 (9.09)	18 (15)	15 (23.8)	7.764	0.049
Deep pocket	0	07 (3.74)	11 (9.1)	13 (20.6)	1.806	0.405

Data are presented as *n* (%).
* A *p* value of < 0.05 is significant.

4. Discussion

Development in various fields such as technologic, industrial, political, scientific, and social fields has led to various occupational and environmental diseases. Improvement in technology has made jobs very easy in several aspects, but, at the same time, has created new occupational hazards that have drawn public attention. Oral health services are limited in India and have always been a mirage for the poor section of the society. The lopsided situation of 68.89% people of India residing in rural areas and 85% of dental surgeons practicing in urban areas needs to be balanced [13].

The rapid development of mines and factories has led to polluted air, polluted water, and an inordinate number of occupational diseases and accidents [14]. About 3 million workers are employed in marble mines in Rajasthan. They work in the mines for at least 10 hours a day and are paid miserly [7].

A cross-sectional survey was carried out to assess the oral health of stone miners in Jodhpur area of Rajasthan. The workers were in the 17–56-year age group. Most of the workers had primary education, and only six had education up to graduation level, who were the managers of different mines.

Almost all the workers were tobacco users (93.7%). Only 32 workers were found not to use tobacco in any form, and 38.89% used both tobacco and alcohol.

The results are in correlation with the findings of previous studies [8,15–17].

Table 4
Relation between years of working experience and dental attrition among stone mine workers

Age groups (y)		<1 y	1–3 y	3–5 y	>5 y	Chi-square test	*p**
17–26	No attrition	20	13	0	0	43.649	0.000
	1–3 teeth affected	13	35	59	0		
	4–7 teeth affected	0	0	0	0		
	7–10 teeth affected	0	0	0	0		
	>10 teeth affected	0	0	0	0		
27–36	No attrition	11	0	0	0	211.219	0.000
	1–3 teeth affected	0	0	49	3		
	4–7 teeth affected	0	20	69	12		
	7–10 teeth affected	0	0	23	0		
	>10 teeth affected	0	0	0	0		
37–46	No attrition	7	5	2	0	111.381	0.000
	1–3 teeth affected	0	0	2	0		
	4–7 teeth affected	0	0	0	0		
	7–10 teeth affected	0	0	39	34		
	>10 teeth affected	0	0	8	23		
47–56	No attrition	3	0	6	0	51.211	0.000
	1–3 teeth affected	0	0	0	39		
	4–7 teeth affected	0	0	7	8		
	7–10 teeth affected	0	0	0	0		
	>10 teeth affected						

* A *p* value of <0.05 is significant.

Oral hygiene of the workers was found to be very poor. It was observed that none of the workers used a toothbrush and toothpaste to clean their teeth, 35.2% never cleaned their teeth using any means, 43.1% cleaned their teeth occasionally with the help of indigenous aids (neem or babool stick, ash, clove oil, or salt), and only 21.5% cleaned their teeth regularly. This poor oral hygiene of the workers also affected their periodontal condition. According to the CPI index, 39.6% of the workers had calculus, 38.6% gingival bleeding, and 10% a periodontal pocket of 4–5 mm. The rate of periodontal disease was found to be 95.01%. All the findings are similar to those of Dagli et al [8] and Bali [10], who found that the rate of periodontal disease was 85.6% and 98%, respectively. Factors associated with the high incidence of periodontal disease could be the following: a high rate of tobacco consumption, most of the workers not cleaning their teeth at all, and none of them using a toothbrush and toothpaste to clean their teeth.

The prevalence of dental caries in the present study was 74%, with a mean DMFT index of 2.89. The findings of the present study coincide with those of Mandal et al [18]. The prevalence of dental caries and the DMFT index were 71% and 2.9, respectively. In the present study, the mean DMFT index was found to be 2.89, which is in harmony with the findings of Bali [10] (2.9). In another study by Duraiswamy et al [7], the mean DMFT index was found to be 3.13, as compared to 2.89 in the present study.

The present study results are in agreement with those of the study conducted by Petersen and Henmar [19], who had found the oral health condition of workers in the stonework industry, and described the prevalence and severity of dental diseases. They reported that workers exposed to dust had a high prevalence of dental caries. Their periodontal condition was also found to be poor.

The results of Petersen and Henmar [19] with respect to wasting diseases are similar to those of the present study. They found that the prevalence of dental attrition was 92%; in particular, abrasion was observed on the front teeth. However, the severity of attrition and the abrasion ratio increased with the duration of exposure to dust. In the present study, 87% of the workers had dental attrition; an association between attrition and stone mine jobs has been established. However, other factors, including age and habits like bruxism, also contribute to attrition. All these factors along with prolonged exposure to a dusty working environment enhance the chances of occurrence of attrition.

Data of the present study were used to carry out a dental treatment program, in which the workers were provided with all types of dental treatments at their door steps. Thereafter, regular dental camps were organized in these areas so that oral health needs of this neglected population could be met.

Workers should be provided with protective masks and safety goggles [7], and their use should be made mandatory. Periodic medical facilities should be provided. All the mine offices should have basic health care facilities so that emergencies can be dealt with on time [8]. From an oral health point of view, arrangements should be made for these workers to visit a dentist at least twice a year. All these measures can help identify susceptible workers in due time and reduce the burden of oral disease on this section of the population. This will also improve technical preventive measures, in turn decreasing the risk of occupational hazards.

In conclusion, in the present study, it was found that the oral health of stone mine workers is in a poor state. The prevalence of dental caries and periodontal diseases was also found to be high. Although it was found that the prevalence of wasting diseases increased with the increase in working years in the mines, a comparison should have been made between the control group (people who work in fields other than stone mines) and people working in stone mines, to have a better picture of the occupational hazards associated with other type of jobs. Various measures should be taken to provide basic medical and dental care in such setups. More such studies should be carried out with a larger sample size to highlight the oral problems faced by mine workers.

Conflicts of interest

All authors declare no conflicts of interest.

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