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Sharma A 1, Parkar S 2, Gaur A 1, Bagri B 3.

1 Department of Public Health Dentistry, Government Dental College and Hospital, Jaipur, India.
2 Department of Public Health Dentistry, Siddhpur Dental College and Hospital, Siddhpur, Patan, India.
3 Central Jail Hospital, Jaipur, India.

ABSTRACT

Aim: Prison is an especially difficult environment for promoting oral health and leads to the exacerbation of unhealthy behaviors. This study set out to assess the impact of incarceration on nutritional status and oral health among the male prison inmates of Central Jail of Jaipur city, Rajasthan, India.

Material and method: A cross sectional study was conducted among 181 male inmates. Dental caries and periodontal status were assessed by using modified the Decayed Missing Filled Teeth (DMFT) index and Community Periodontal Index (CPI) and Loss of Attachment (LOA) index as per the WHO methodology 1997. Nutritional status was assessed by Body Mass Index (BMI) and weight (kg)/height (m^2).

Results: Out of 181 inmates, 141 (77.90%) had normal BMI. The majority (n=128, 70.70%) of inmates were incarcerated for less than 6 years. A significant difference (P<0.05) was found between age and periodontal status. A significant difference was observed (P<0.05) in the CPI score 3 and LOA 0 and 1 score. However, no significant difference (P>0.05) was observed in DMFT and period of incarceration. Age was the significant (P<0.001) risk factor for CPI and LOA.

Discussion: Dental caries and periodontal health deteriorates with age and period of incarceration. Oral hygiene maintenance along with comprehensive oral care can be accomplished by establishing dental care facilities in prisons.

Keywords: body mass index, oral health, prisons, dental caries, periodontitis.

INTRODUCTION

Oral health is an integral part of general health. Various determinants like socio economic status, occupation, level of education, literacy and nutritional status play a part in maintaining general health, which in turn ultimately affects the oral health of the individual. One of the main goals of public health is to identify unique population groups and explore their health problems and methods for health care. Prisoners are considered to be a special population group as they are different from other populations in terms of their freedom of movement.

Prison is an environment with special difficulties in the promotion of oral health, and leads to exacerbations in unhealthy behaviors. Prisoners predominately come from a context already shaped by social exclusion. They have limited educational qualification, poorer housing conditions, are unemployed or underemployed, have substandard diets and limited access to health care when compared to the general population. Prisoners are exposed to a number of unfavorable health factors such as alcohol and drug abuse, smoking, chronic diseases, mental illness and psychiatric problems.

Several studies have reported the oral health status of prison populations in India, and showed a...
high prevalence of dental caries, oro-mucosal lesions, precancerous lesions, poor periodontal status, and missing teeth\(^6\).\(^8\). According to the National Crime Record Bureau 2015, the prison population in India consisted of 43,000,000 prisoners housed in 1,412 prisons designed with a capacity for 38,000,000 prisoners\(^9\). Such overcrowding may cause poor nutritional levels among prisoners, which has an effect on their physical and mental health\(^10\). Prison conditions are likely to affect a prisoner’s weight, through diet, physical activity and high levels of stress. Incarceration may be a major factor in weight gain\(^11\).

There is a growing recognition that there is a direct link between oral health and other lifestyle-related non-communicable diseases. This lack of attention in maintaining oral health is reflected in their overall health status. An assessment of their oral health is required, as there is a need to be more attentive to the oral health promotion of prisoners, given that they will return to the general population\(^12\).

An extensive review of the literature revealed few studies carried out in a prison setting, showing a higher prevalence of dental caries and periodontal diseases\(^6\),\(^13\)-\(^16\). However, in India no studies have been carried out on the impact of the duration of incarceration on the nutritional and dental status of these populations and hence information is scant. A study was therefore conducted to assess the impact of incarceration on the nutritional status and oral health of the male prison inmates of Central Jail of Jaipur district, Rajasthan, India.

MATERIALS AND METHOD

A cross sectional study was conducted among the male inmates of the Central Jail of Jaipur city, Rajasthan, India. A total 1,600 inmates were incarcerated in the Central Jail, of whom 500 were convicted inmates while 1,100 were awaiting sentence at the start of the study. Before commencing the study, the purpose and the possible benefits of the study to the prisoners in the form of oral health care were explained to the jail authorities. Permission to conduct the study among the male inmates was sought from the higher authorities (Director General of Police/Inspector General of Police) of Rajasthan Jail Department through the Jail Superintendent of Jaipur Central Jail. Written consent for oral examination was obtained from all 500 convicted inmates, and those who were willing to participate were included in this study as a sample. Out of the 500 inmates 181 (36.20%) inmates had given consent and showed their willingness to participate in the study. Hence, 181 inmates were included in the study for assessing oral health and nutritional status.

Data Collection

The oral health status dental caries status and periodontal status was assessed. The dental caries and periodontal status were assessed by using the modified Decayed Missing Filled Teeth (DMFT) index of the WHO\(^17\) and the Community Periodontal Index (CPI) and (Loss of Attachment) LOA index as per WHO methodology 1997\(^18\). The subjects were made to sit upright in a chair and screened under full natural light with an explorer and plain mouth mirror following the WHO’s basic guidelines for oral health surveys. Head cap, face mask, gloves and gauze were used in accordance with the infection control guidelines in the study. The nutritional status was assessed by anthropometric assessment prior to dental examination by using a 150 kg digital scale to measure weight and 200 cm tape to measure height in accordance with the World Health Organization (WHO) guidelines\(^19\). Body weight was recorded by using a standard beam balance scale with the subjects barefoot and wearing light clothing. Furthermore, body height was recorded with subjects wearing no shoes, heels together and head touching the ruler with line of sight aligned horizontally. BMI was calculated by using standard formula - weight (kg)/height (m\(^2\)). The subjects were further sub-classified into underweight (<18.5), normal weight (18.5-24.99) and overweight (≥25) as recommended by the WHO\(^20\). All the examinations were carried out by a single pre-trained person showing the inter-examiner variability of \(\kappa = 0.86\).

Statistical Analysis

The data was collected and then coded and entered in Microsoft Excel. Descriptive statistics that included mean, standard deviation and percentages were calculated for each of the variables. The values were compared by using one way ANOVA. Multiple binary logistic regression model was run to assess the confounding factors for dental caries and periodontitis. Statistical Package for Social Science (SPSS Inc., Chicago, USA) version 21 was used for statistical analysis. The level of significance was set at 5%.

RESULTS

The characteristics of the inmates are described in Table 1. The age of the inmates ranges from 20-69
years with mean age of 37.18 ± 11.77 years. Half of the population (n= 92, 50.80%) belong to the age group of 20-34 years. Most (n=128, 70.70%) of the inmates were incarcerated for less than 6 years. Out of 181 inmates, 141 (77.90%) had normal BMI.

Table 1. Characteristic of jail inmates.

| Variables              | Number (n=181) | %    | Mean value  |
|------------------------|----------------|------|-------------|
| Age groups (in years)  |                |      |             |
| 20-34                  | 92             | 50.80| 37.18 ± 11.77 |
| 35-50                  | 59             | 32.60|             |
| 51-65                  | 26             | 14.40|             |
| >65                    | 4              | 2.20 |             |
| Period of Incarceration (in years) |        |     | 5.51 ± 3.15 |
| <6                     | 128            | 70.70|             |
| 7-11                   | 46             | 25.40|             |
| >12                    | 7              | 3.90 |             |
| BMI                    |                |      |             |
| Underweight            | 10             | 5.50 | 22.28 ± 3.17 |
| Normal                 | 141            | 77.90|             |
| Over weight            | 30             | 16.60|             |

Note. %: Percentage; BMI: Body mass index.

Table 2. Comparison of mean values of clinical parameters comparison according to age groups.

| Clinical Variables | Age range (in years) | P Value |
|--------------------|----------------------|---------|
|                    | 20-34                | 35-50   | 51-65   | >65      |
| BMI                | 21.96±2.97           | 23.00±3.45 | 21.75±3.09 | 22.68±3.61 | 0.19  |
| DMFT               | 1.46±1.90            | 1.97±4.40 | 3.19±6.30 | 1.50±1.70 | 0.23  |
| CPI                |                      |         |         |         |       |
| CPI 0              | 2.87±2.80            | 2.51±2.80 | 1.50±2.50 | 2.0±2.80 | 0.18  |
| CPI 1              | 1.14±2.0             | 0.68±1.50 | 0.46±1.0  | 0        | 0.17  |
| CPI 2              | 1.76±2.30            | 2.03±2.30 | 2.31±2.0  | 1.25±1.80 | 0.65  |
| CPI 3              | 0.22±0.64            | 0.44±1.0  | 0.92±1.40 | 0.50±0.57 | 0.009*|
| CPI 4              | 0.01±0.10            | 0.07±0.36 | 0.46±1.0  | 0.75±0.95 | <0.001**|
| CPI X              | 1.14±2.0             | 0.68±1.50 | 0.46±1.0  | 0        | 0.18  |
| LOA                |                      |         |         |         |       |
| LOA 0              | 5.28±1.60            | 4.20±2.50 | 3.69±2.50 | 4.50±3.00 | 0.002*|
| LOA 1              | 0.52±1.30            | 1.07±1.90 | 1.00±1.70 | 0        | 0.14  |
| LOA 2              | 0.16±0.61            | 0.36±0.96 | 0.77±1.50 | 0        | 0.02* |
| LOA 3              | 0.02±0.20            | 0.05±0.28 | 0.19±0.63 | 0        | 0.13  |
| LOA 4              | 0.01±0.10            | 0.05±0.28 | 0        | 0        | 0.51  |
| LOA X              | 0                    | 0.27±1.10 | 0.35±1.20 | 1.50±1.30 | 0.003*|

Note. *P<0.05 significant; **P<0.001 highly significant; BMI: Body mass index. DMFT: Decayed Missing Filled Teeth. CPI: Community Periodontal Index. LOA: Loss of Attachment. One way ANOVA test.
Table 3 shows the multivariate binary logistic regression for the risk factors for dental caries and periodontitis. A weak correlation was found between the risk factors and dental caries and periodontitis. The significant (P<0.001) risk factors for CPI and LOA were age, having an odds ratio of 1.08 and 1.07 respectively. Period of incarceration and BMI variables were not significant (P>0.05).

Table 4. Comparison of mean values of clinical parameters according to period of incarceration.

| Clinical Variables | <6 yrs          | 7-11 yrs         | >12 yrs         | P Value |
|--------------------|-----------------|------------------|-----------------|---------|
| BMI                | 22.11±2.93      | 22.94±3.78       | 21.06±2.80      | 0.18    |
| DMFT               | 1.97±4.31       | 1.54±2.04        | 2.29±1.38       | 0.78    |
| CPI                |                 |                  |                 |         |
| CPI 0              | 2.68±2.85       | 2.39±2.85        | 0.86±2.26       | 0.23    |
| CPI 1              | 0.79±1.66       | 1.13±2.17        | 0.57±1.51       | 0.49    |
| CPI 2              | 1.86±2.30       | 2.0±2.40         | 2.43±1.98       | 0.79    |
| CPI 3              | 0.35±0.88       | 0.37±0.79        | 1.43±2.14       | 0.01*   |
| CPI 4              | 0.09±0.46       | 0.11±0.43        | 0.43±1.13       | 0.21    |
| CPI X              | 0.23±1.06       | 0.00±0.00        | 0.29±0.75       | 0.33    |
| LOA                |                 |                  |                 |         |
| LOA 0              | 4.84±2.12       | 4.54±2.37        | 2.71±2.75       | 0.04*   |
| LOA 1              | 0.60±1.39       | 1.00±2.02        | 2.00±2.51       | 0.04*   |
| LOA 2              | 0.27±0.84       | 0.35±0.99        | 0.86±1.86       | 0.25    |
| LOA 3              | 0.04±0.31       | 0.09±0.35        | 0.14±0.37       | 0.54    |
| LOA 4              | 0.02±0.19       | 0.02±0.14        | 0              | 0.94    |
| LOA X              | 0.23±1.06       | 0.00±0.00        | 0.29±0.75       | 0.33    |

Note. *P<0.05 significant; BMI: Body mass index. DMFT: Decayed Missing Filled Teeth. CPI: Community Periodontal Index. LOA: Loss of Attachment. One way ANOVA test.
DISCUSSION

Various studies\textsuperscript{4,6,7,13} have been conducted to assess the oral health status among jail inmates in India. However, the association between oral health status and period of incarceration was evaluated in only one study by Anup N et al\textsuperscript{4} and BMI is yet to be evaluated in India. Hence, this study is the first to evaluate the dental caries and periodontal status among jail inmates, and to assess the association between the oral health status for period of incarceration and BMI.

The age of the prisoners in the present study ranged from 20-69 years, showing a wide age range. This matched almost all previous studies conducted globally as well as in India, as described in the systemic review\textsuperscript{8,21}. The results of this study show that as age advances dental caries increase and periodontal health deteriorates. However, this result did not reach a significant level.

In this study, 77.90\% prisoners had a normal BMI range, which was in line with a study done by Rahman A et al\textsuperscript{10}. However, studies by LaMonaca K et al\textsuperscript{22}, Abera SF et al\textsuperscript{23} show a contrasting result. There was no significant difference (P>0.05) observed when the mean value of BMI was compared with the length of incarceration in this study. Clarke et al\textsuperscript{24} shows prisoners experienced weight gain during their incarceration but it did not reach a significant level. Similar results were observed in this study. A previous study by Houle B\textsuperscript{11} and Gates ML et al\textsuperscript{25} shows contrasting results where the BMI increases in line with the length of incarceration. A possible reason could be that as the period of incarceration progresses, there is increasing lean muscle mass, which would also show up as an increased BMI\textsuperscript{26}. Also, correctional centers control both diet and physical activities, and therefore it seems reasonable that exposure to these environments would influence BMI\textsuperscript{11}.

The prevalence of dental caries in this study was 54.14\%. This was in line with results obtained from a small number of studies\textsuperscript{27-29}, while studies conducted by Anup et al,\textsuperscript{4} Dhanker K et al,\textsuperscript{13} Osborn M et al\textsuperscript{15} show a prevalence of caries that is higher. The mean DMFT in this study is very low at 1.93; a similar low mean value was observed by Bolin K et al,\textsuperscript{30} Agrawal N.\textsuperscript{31} However, higher values of mean DMFT ranging from 9.8 to 22.5 were reported in the systemic review by Walsh T et al.\textsuperscript{21} The mean DMFT for the prisoners increased with age, as is the norm for any population. The high prevalence of dental caries might be due to the fact that dental caries is a multi-factorial disease that is influenced by many factors that include lifestyle, type of diet, lack of oral hygiene measures and cultural factors before coming to the jail. Inmates also depend on the prison authorities to arrange dental care\textsuperscript{4}. There is a decrease in the mean score of DMFT for the age of >65 years as compared to the younger

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Table 5. Multivariate binary logistic regression for dental caries and periodontitis.

| Variables    | B     | SE   | Odd ratio | 95% CI       | P Value |
|--------------|-------|------|-----------|--------------|---------|
| DMFT         |       |      |           |              |         |
| Age          | -0.01 | 0.01 | 0.99      | 0.97-1.02    | 0.58    |
| Period of incarceration | 0.08  | 0.05 | 1.08      | 0.98-1.19    | 0.13    |
| BMI          | -0.03 | 0.05 | 0.96      | 0.88-1.06    | 0.49    |
| Constant     | 0.75  | 1.14 | 2.11      |              | 0.51    |
| CPI          |       |      |           |              |         |
| Age          | 0.07  | 0.02 | 1.08      | 1.04-1.11    | <0.001*  |
| Period of incarceration | 0.02  | 0.06 | 1.02      | 0.91-1.14    | 0.73    |
| BMI          | -0.07 | 0.06 | 0.93      | 0.83-1.05    | 0.26    |
| Constant     | -2.48 | 1.45 | 0.08      |              | 0.09    |
| LOA          |       |      |           |              |         |
| Age          | 0.07  | 0.02 | 1.07      | 1.03-1.11    | <0.001**|
| Period of incarceration | -0.02 | 0.06 | 0.98      | 0.87-1.11    | 0.78    |
| BMI          | -0.04 | 0.07 | 0.96      | 0.84-1.09    | 0.52    |
| Constant     | -3.12 | 1.62 | 0.04      |              | 0.05    |

Note. *P <0.001 highly significant; BMI: Body mass index. DMFT: Decayed Missing Filled Teeth. CPI: Community Periodontal Index. LOA: Loss of Attachment.
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Rev Esp Sanid Penit. 2020;22(3):96-103

doi: 10.18176/resp.00018

Correspondence
Sujal Parkar
B-25 Krishna Bungalows-1.
Gandhinagar Highway, Motera.
Ahmedabad. 38005 India.
E-mail: drsujal_pcd@live.com

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One limitation of this study is the fact that the data collection was confined to a single jail, which might affect its application on a more general level. Hence, studies with a multi-center approach are recommended in future. Since a cross-sectional design was adopted, it limits the ability to identify causality between BMI and chronic oral disease, therefore, a longitudinal study design will be required to explore cause and effect relationships in this regard.

Conclusion
Within the limitations of this study, it can be concluded that dental caries and periodontal health deteriorate with the advancement of age and period of incarceration. A weak correlation was found between BMI and chronic oral disease, therefore, a longitudinal study design will be required to explore cause and effect relationships in this regard.

Correspondence
Sujal Parkar
B-25 Krishna Bungalows-1.
Gandhinagar Highway, Motera.
Ahmedabad. 38005 India.
E-mail: drsujal_pcd@live.com

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