

Original articles

RESP

Impact of incarceration on nutritional status and oral health among male inmates of central jail of Jaipur city, India

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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 (m²).

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.

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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 movement¹.

Prison is an environment with special difficulties in the promotion of oral health, and leads to exacerbations in unhealthy behaviors^{2,3}. Prisoners predominately come from a context already shaped by social exclusion¹. 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 population⁴. Prisoners are exposed to a number of unfavorable health factors such as alcohol and drug abuse, smoking, chronic diseases, mental illness and psychiatric problems⁵.

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 teeth⁶⁻⁸. 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 prisoners⁹. Such overcrowding may cause poor nutritional levels among prisoners, which has an effect on their physical and mental health¹⁰. 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 gain¹¹.

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 population¹².

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 WHO¹⁷ and the Community Periodontal Index (CPI) and (Loss of Attachment) LOA index as per WHO methodology 1997¹⁸. 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) guidelines¹⁹. Body weight was recorded by using a standard beam balance scale with the subjects bare-foot 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 (m²). The subjects were further sub-classified into underweight (<18.5), normal weight (18.5-24.99) and overweight (≥25) as recommended by the WHO²⁰. 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)			
<6	128	70.70	5.51 ± 3.15
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 shows the comparison of the mean values of clinical parameters with age. No significant result ($P=0.19$) was found when the mean values of BMI with regard to age were compared. The mean DMFT value was highest (3.19 ± 6.30) in the age group of 51-65 years followed by a mean DMFT value of 1.97 ± 4.40 in the age group of 35-50 years. This result was found to be statistically insignificant ($P=0.23$). A significant difference ($P<0.05$) was found when the mean values of CPI score 3 and 4 and mean values of LOA score 0, 2 and X were compared with regard to age.

Table 3 shows the distribution of clinical parameters according to the period of incarceration. No significant difference ($P=0.21$) was found among the BMI groups, dental caries and periodontal status. The prevalence of dental caries was 54.14%. Out of 181, 67 (37.01%) had healthy sextant (CPI 0) while 121 (66.85%) had an LOA score 0 (LOA of 3-4 mm).

A comparison of mean values of clinical parameters was made according to the period of incarceration (Table 4). A significant difference ($P<0.05$) was found for CPI score 3 and LOA score 0 and 1. The remaining scores for CPI and LOA were not statistically significant ($P>0.05$) in terms of period of incarceration.

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 5 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 3. Distribution of clinical parameters according to period of incarceration.

Clinical Variables	Period of Incarceration				P Value
	<6 yrs n (%)	7-11 yrs n (%)	>12 yrs n (%)	Total n (%)	
BMI					
Underweight	7 (3.86)	2 (1.10)	1 (0.55)	10 (5.52)	0.21
Normal	103 (56.91)	32 (17.68)	6 (3.31)	141 (77.90)	
Over weight	18 (9.94)	12 (6.63)	0	30 (16.57)	
Caries					
No Caries	63 (34.80)	19 (10.49)	1 (0.55)	83 (45.86)	0.15
Caries Present	65 (35.91)	27 (14.91)	6 (3.31)	98 (54.14)	
CPI					
CPI 0	49 (27.07)	17 (9.39)	1 (0.55)	67 (37.01)	0.44
CPI >0	79 (43.65)	29 (16.02)	6 (3.31)	114 (62.99)	
LOA					
LOA 0	88 (48.62)	31 (17.13)	2 (1.10)	121 (66.85)	0.08
LOA >0	40 (22.09)	15 (8.29)	5 (2.76)	60 (33.15)	

Note. BMI: Body mass index. CPI: Community Periodontal Index. LOA: Loss of Attachment.

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

Clinical Variables	Period of Incarceration			P Value
	<6 yrs	7-11 yrs	>12 yrs	
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.

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

Variables	B	SE	Odds 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.

DISCUSSION

Various studies^{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 al⁴ 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^{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.¹⁰ However, studies by LaMonaca K et al²², Abera SF et al²³ 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 al²⁴ 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 B¹¹ and Gates ML et al²⁵ 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 BMI²⁶. Also, correctional centers control both diet and physical activities, and therefore it seems reasonable that exposure to these environments would influence BMI¹¹.

The prevalence of dental caries in this study was 54.14%. This was in line with results obtained from a small number of studies²⁷⁻²⁹, while studies conducted by Anup et al,⁴ Dhanker K et al,¹³ Osborn M et al¹⁵ 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,³⁰ Agrawal N.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.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 care⁴. There is a decrease in the mean score of DMFT for the age of >65 years as compared to the younger

age groups. This might be because the particular index of caries for DMFT was used to assess the status of caries. According to the DMFT index, only coronal caries and teeth that are missing due to caries are considered for scoring. However, in the case of ages over 65 years, cervical and root caries are more prevalent than coronal caries, and in this age teeth are missing due to other reasons such as periodontal diseases. The results of this study show no correlation between DMFT and the risk factors. This can be attributed to the dietary habits of the study subjects. Furthermore, there is no provision for food from outside prison for convicted prisoners. They only consume food from the common mess in the prison, which provides a less cariogenic diet.

In this study, 67 (37.01%) of the prisoners had a healthy sextant (CPI score 0), while the majority of the prisoners (n=121, 66.85%) had an LOA score of 0. This finding was very low when compared to the previous study conducted by Anup et al,⁴ Vinnakota NR et al,¹⁴ James H Clare et al²⁸ and McGrath C.³² The periodontal health deteriorates as age and period of incarceration increases. However, the results reach a significant level for the score of CPI 3, LOA 0 and LOA 1. The mean of 2.43 sextants shows calculus among the prisoners. The deposition of calculus was in line with previous studies^{4,32}. Formation of calculus may be attributed to various factors like negligence of oral health, improper brushing techniques, unavailability of oral hygiene aids and lack of access to dental care³³. A significant correlation was found between age and periodontal scores. Long waiting periods for treatment required may be one of the reasons for poor periodontal health among the older inmates, as limited treatment can be rendered to inmates inside prison hospital. They have to visit the district level government dental hospital for complex and surgical procedures. Due to lack of supporting staff, transport and other administrative issues, inmates cannot access treatment facilities, which is one of the reasons for poor periodontal health. A significant correlation was observed between the periodontal status and BMI. This matched previous studies^{34,35}. Obesity is hypothesized to involve immune-inflammatory alterations, and the condition has been related to increased susceptibility to periodontitis³⁶.

Due to the limited number of dental professionals and resources in most prisons, especially in the developing countries, it is difficult for prisoners to receive routine and appropriate oral health care. Hence, the burden of oral diseases is substantially higher among this vulnerable group when compared to the general population. More awareness and research is needed

to identify factors that affect the oral health of the prison population. It is equally critical to understand whether the high rate of oral health problems is exacerbated by imprisonment or other systemic factors. Oral hygiene maintenance along with comprehensive oral care can be accomplished by establishing dental care facilities in prisons and involving local health care entities⁸.

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 periodontitis. Poor oral hygiene practices and the virtual absence of oral health care facilities make it necessary for health policies to work on establishing optimal levels of oral health for prisoners.

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