

# Association of Dental Caries, Periodontal, and Nutritional Status with Body Mass Index among Incarcerated Women in Central Jail, Karachi, Pakistan

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## Abstract

**Objective:** To determine the association body mass index and the status of dental decay and gum health in women serving prison sentences.

**Methods:** A cross-sectional investigation took place at the Central Jail for Women, Pakistan, spanning from January 2021 to February 2022. The study included all incarcerated women and those awaiting trial aged between 18 and 65 years, while individuals who declined participation were excluded. Convenience sampling was employed, and each participant underwent examinations for dental caries and periodontal status. Sample size was calculated by considering the total number of women in prison to be 205, keeping the margin of error as 5%, and a confidence level of 95%, a sample size of 134 was calculated. Oral health was measured through DMFT index. Body mass indexes were recorded by measuring the height and weight of the participants. Furthermore, nutritional habits including height, weight, source of food and frequency of food were also documented. Oral health conditions were evaluated in 131 women currently serving prison sentences.

**Results:** About 23.7 % (n=31) were overweight and 6.1% were obese. Total 71.7% (n=94) of women had at least one decayed tooth, 63 (48.1%) had at least one missing tooth, and 7 (5.3%) had at least one filled tooth. The logistic regression analysis indicated a significant association between being overweight and the DMFT score, with an Exponentiation of B of 1.19 and a 95% confidence interval ranging from 1.03 to 1.38. The associated p-value was 0.021.

**Conclusion:** It was found that high BMI was significantly associated with higher DMFT score. The results of this study drives the attention of clinicians and researchers towards the unidentified health needs of incarcerated women. Among other medical conditions, sensitization to oral hygiene and oral health must also be prioritized. Further efforts should be directed towards making oral health accessible to the incarcerated population.

**Keywords:** Nutritional status, Jail, Quality of life, Oral Health, Health services accessibility.

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## Introduction

A balanced diet is extremely essential for prisoners as they are more susceptible to undernourishment<sup>1</sup>. Prisoners have the right to consume food

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that is healthy and nutritionally balanced. However, this vulnerable community rarely receives attention regarding basic violations of human rights. This issue is gaining global recognition, and lawmakers are concerned that basic necessities and access to healthcare should be mandated for all prisoners. However, there is limited evidence on poor nutritional status and contributing factors in low- to middle-income countries. Nevertheless, nutritional deficiencies are associated with other comorbid conditions and may delay the overall healing process<sup>2</sup>.

Incarcerated women are an extremely vulnerable subset of the community comparative to their male counterparts that is often neglected by both

the researchers and the authorities<sup>3</sup>. Their mental, physical and sexual health remains the topic of debate till date. Recently in an article on specific imprisoned Black woman concluded that more violence was associated with living conditions and availability of limited health care<sup>4</sup>. Similar results were reported by two other authors studying incarcerated woman of USA and Mexico<sup>5,6</sup>. Furthermore, several studies indicate the presence and association of nutritional deficiencies with growth and developmental disorders, irritability, and disruptive behaviors in Jail. Many women in prisons give birth with/ or raising their young within the premises of the jail, which means that adequate nutrition is not only important for the mother but also the offspring. Prenatal care's presence is more or less none, which along with insanitary conditions prone them to diseases<sup>7</sup>.

Literature shows strong evidence regarding deficiency of nutrients (micro or macro) as a causative factor of criminal ideation and antisocial conduct further leading to suicidal attempts<sup>8</sup>. It is one of the markers of social injustice and inequality. Nutritional sufficiency is highly critical in settings where food allocation is restricted and subsidized, such as prisons, hospitals, and nursing homes for the elderly population<sup>9</sup>. Inmates are more likely to acquire dietary deficiencies, particularly micronutrients, which are required to improve health status and the prevention of heart diseases and associated morbidities. Due to nutritional deficits, prisoners in impoverished nations are more likely to develop diseases. Due to economic constraints and compromise on the rights of prisoners, institutions in underdeveloped nations usually disregard prisoners' nutritional and social needs<sup>10</sup>. As a result, inmates frequently have limited access to health care and low quality of life.

Pakistan, being a developing country, often faces issues of low priority, corruption, and negligence within government institutions regarding their responsibilities. Prisoners, typically marginalized and stigmatized, are not always considered for equal human rights compared to the general population. Therefore, understanding the dental health

and nutritional status of prisoners becomes particularly crucial, alongside addressing their social and mental well-being during incarceration. Women, already a vulnerable group, are at an elevated risk of compromised dental health and nutritional deficiencies. Addressing these concerns can contribute to shaping women in prisons into productive members of society upon their release. Given the limited literature on female prisoners, this study was undertaken to explore the correlation between periodontal status, nutritional status, and body mass index among incarcerated women in Karachi, Pakistan.

### Methodology

A cross-sectional study was carried out at the Department of Community and Women's Prison in Karachi from December 2021 to February 2022. Data collection started after approval from the Institutional Review Board (JSMU/IRB/2021/579) and permission from the prison facility (HD/SO(PRS-I)/11-235/2021). This study was conducted as per guidelines outlined in the Helsinki Declaration.

Participants were enlisted in the study using the non-probability convenience sampling technique. For sample size, Select Statistics was used. In Pakistan, the incidence of dental decay among women was found to be 47%<sup>8</sup>. Using this figure, along with the total population of women imprisoned in Sindh prisons being 191, and maintaining a 5% margin of error and a 95% of confidence level, a sample size of 128 was determined.

The study encompassed female prisoners aged between 18 and 65 years, covering a range of sentences including life imprisonment, death row inmates, and those awaiting trial. However, women diagnosed with oral cancer that impeded the dental assessment, or those who declined to give their consent for participation, were not included in the study.

Data collection was initiated using predesigned structured questionnaires and oral assessment. The demographic information such as age, period of incarceration, literacy level, family size, marital status, occupation of husband, and dietary patterns was obtained using a preset proforma. The individu

als' body mass index (BMI) was calculated by measuring their height and weight. The WHO categories for BMI were used to categorize participants into<sup>10</sup>: i) Underweight (<18 kg/m<sup>2</sup>), ii) Healthy weight (18.5 - 24.9 kg/m<sup>2</sup>), iii) Overweight (25.0 - 29.9 kg/m<sup>2</sup>), iv) Obese (30.0 kg/m<sup>2</sup> and above). In addition, nutrition-related information that is height and weight to calculate BMI and furthermore, source of food and frequency of food intake. The self-reported history of hypertension and diabetes was also noted.

Oral examinations were conducted on each participant. The severity of periodontal disease (pocket depth) was labeled as: i) Healthy = <0.1 mm, ii) Mild = 0.1 - 1.0 mm, iii) Moderate = 1.1 - 2.0 mm, and iv) Severe = 2.1 - 3.0 mm<sup>11</sup>. Diagnosis of dental caries was made by a consultant dentist with over 10 years of experience by clinically examining the teeth of individuals, using the DMFT index to score dental caries<sup>12</sup>. All of the findings were extensively documented. To minimize the possibility of inter-rater bias, the examination was completed by a single dentist who was blinded to the purpose of the study.

The SPSS version 26 was utilized for data entry and analysis. Numerical variables such as age, DMFT Scores, substance abuse duration, frequency of food consumption, and so forth were represented by their mean and standard deviation. On the other hand, categorical variables like caries severity, socioeconomic status, etc., were displayed as percentages and frequency. The relationship between the severity of dental decay and gum disease and body mass index was examined using the Chi-square test. A significance level of less than 0.05 was set as the criterion for statistical significance. The logistic regression model was employed to identify significant associations between BMI and other independent variables, encompassing DMFT and sociodemographic factors.

## Results

Oral health conditions were assessed in 131 women currently in prison. The average age of these inmates at the time of data gathering was 34.73 years, with a standard deviation of 9.94 years, whereas it was 28.46 years with a standard deviation of 11.46 years at the onset of their imprisonment. The study population reported a total of 362 decayed teeth, 252 missing teeth, and 10 filled teeth. It was observed that only 35 women (26.7%) had experienced caries, while approximately 71.7% had at least one decayed tooth. Additionally, 63 women (48.1%) had at least one missing tooth, and 7 women (5.3%) had at least one filled tooth (refer to Table 3). Furthermore, only 37 women (28.2%) exhibited healthy gums.

The average DMFT score stood at 4.76 ( $\pm 4.46$ ), and a negligible percentage of women had DMT2. However, 16% of women exhibited hypertension. Most of the incarcerated individuals had not received formal education. The majority of women relied on the two meals provided by the prison management. Nearly half of the participants fell within the body mass index range of 18.5 - 24.9 kg/m<sup>2</sup>. About 23.7% were overweight and 6.1% were obese (Table 1).

Only 37 (28.2%) women had healthy gums. The study showed that about 76 (58%) participants had a DMFT score between 0-5, 42 (32.1%) had a score between 6-10, and 13 (9.9%) score above 11. There was a significant association between BMI and Periodontitis illustrated in Table 2 ( $p < 0.001$ ).

Furthermore, it was also observed that the obese patients were more likely to have a higher DMFT score indicating more dental caries ( $p < 0.0001$ ) (Table 3).

Logistic regression model revealed that there was a significant association between overweight and DMFT score ExpB: 1.19; 95% CI (1.03-1.38) with a p-value of 0.021. For underweight, none of the independent variables yielded significant results (Table 4).

**Table 1.** Demographic characteristics of Study Participants

Parameters	n (%)
<b>Age Groups</b>	
≤35 years	70 (53.4%)
> 35 years	61 (46.6%)
<b>Ethnicity</b>	
Sindhi	24 (18.3%)
Punjabi	36 (27.5%)
Baloch	16 (12.2%)
Pashtun	11 (8.4%)
Urdu	10 (7.6%)
Other	34 (26%)
<b>Education</b>	
No formal education	80 (61.1%)
Primary to Secondary	29 (22.1%)
Matric to Intermediate	18 (13.7%)
Bachelor's or above	4 (3.1%)
<b>Relationship Status</b>	
Married	54 (41.3%)
Divorced	25 (19.1%)
Unmarried	20 (15.3%)
Widowed	32 (24.4%)
<b>Number of Children</b>	
Not married	20 (15.3%)
No children	32 (24.4%)
1-3	56 (42.7%)
>3 to 6	18 (13.7%)
>6	4 (3.1%)
<b>Husband/Father Occupation</b>	
Driver	9 (6.9%)
Factory Worker	9 (6.9%)
Labor	15 (11.5%)
Salesmen	70 (53.4%)
Other	28 (21.3%)
<b>Employment Status (Prior to incarceration)</b>	
Employed	59 (45%)
Unemployed	72 (55%)
<b>If you were unemployed at the time of incarceration, who did you depend on:</b>	
Husband	53 (40.5%)
Father	16 (12.2%)
Son	5 (3.8%)
Brother	1 (0.8%)
Independent	56 (42.7%)
<b>Residence (Prior to incarceration)</b>	
Urban	101 (77.1%)
Rural	30 (22.9%)
<b>History of Diabetes Mellitus</b>	
Yes	10 (7.6%)
No	121 (92.4%)
<b>History of Hypertension</b>	
Yes	21 (16.0%)
No	110 (84.0%)
<b>History of Cardiovascular Disease</b>	
Yes	10 (7.6%)
No	121 (92.4%)

**History of Psychiatric Disease (Depression/anxiety, etc.)**

Yes	27 (20.6%)
No	104 (79.4%)

**Source of Food**

Prison provided	112 (85.5%)
Both	19 (14.5%)

**Home-made**

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**Frequency of Food**

Once daily	2 (1.5%)
Twice Daily	117 (89.3%)
>2 times a day	12 (9.2%)

**Body Mass Index**

Underweight (<18 kg/m <sup>2</sup> )	26 (19.8%)
Healthy weight (18.5 - 24.9 kg/m <sup>2</sup> )	66 (50.4%)
Overweight (25.0 - 29.9 kg/m <sup>2</sup> )	31 (23.7%)
Obesity (30.0 kg/m <sup>2</sup> and above)	8 (6.1%)

**Table 2.** Association between Body Mass Index and Severity of Periodontal Disease

Category of BMI	Severity:				p-value
	Healthy= <0.1 mm	Mild= 0.1 - 1.0 mm	Moderate= 1.1 - 2.0 mm	Severe= 2.1 - 3.0 mm	
Underweight 10 (27.0%) (<18 kg/m <sup>2</sup> )	9 (26.5%)	4 (7.8%)	3 (37.5%)	0.001	
Healthy weight (18.5 - 24.9 kg/m <sup>2</sup> )	23 (62.2%)	19 (55.9%)	20 (39.2%)	3 (37.5%)	
Overweight (25.0 - 29.9 kg/m <sup>2</sup> )	3 (8.1%)	6 (17.6%)	20 (39.2%)	2 (25.0%)	
Obesity (30.0 kg/m <sup>2</sup> and above)	1 (2.7%)	0 (0.0%)	7 (13.7%)	0 (0.0%)	

**Table 3.** Association between Body Mass Index and Severity of Dental Caries

Body Mass Index	DMFT Score			p-Value
	0-5	6-10	11-31	
Underweight (9.1%)	25 (75.8%)	5 (15.2%)	3 (<18 kg/m <sup>2</sup> )	<0.001
Healthy weight (18.5 - 24.9 kg/m <sup>2</sup> )	42 (66.7%)	16 (25.4%)	5 (7.9%)	
Overweight (25.0 - 29.9 kg/m <sup>2</sup> )	7 (24.1%)	19 (65.5%)	3 (10.3%)	
Obesity (30.0 kg/m <sup>2</sup> and above)	2 (33.3%)	2 (33.3%)	2 (33.3%)	

**Table 4.** Multinomial Logistic Regression Analysis of BMI and Dental Caries in Female Prisoners

Body Mass Index Category	Parameters	ExpB	95% CI		p-value
			Lower bound	Upper bound	
Underweight (<18 kg/m <sup>2</sup> )	DMFT Score	0.94	0.79	1.11	0.463
	Sindhi	1.06	0.21	5.3	0.940
	Punjabi	0.36	0.07	1.79	0.212
	Balochi	2.97	0.57	15.52	0.197
	Pashtun	1.16	0.15	9.38	0.886
	Urdu	1.15	0.26	5.13	0.857
	Employed prior to incarceration	2.4	0.85	6.76	0.098
	History of Psychiatric Disease	0.24	0.05	1.17	0.077
	Diabetes Mellitus	2.18	0.12	40.33	0.602
	Substance Use	0.96	0.32	2.83	0.936
	Periodontitis Severity: Healthy	0.27	0.02	4.4	0.358
	Periodontitis Severity: Mild	0.34	0.03	4.27	0.404
	Periodontitis Severity: Moderate	0.16	0.02	1.67	0.125
	Overweight and Obese (25.0 kg/m <sup>2</sup> and above)	DMFT Score	1.19	1.03	1.38
Sindhi		4.77	0.86	26.39	0.073
Punjabi		2.72	0.52	14.08	0.234
Balochi		1.44	0.18	11.81	0.737
Pashtun		10.16	1.09	94.97	0.042
Urdu		1.79	0.27	11.95	0.550
Employed prior to incarceration		1.06	0.39	2.85	0.913
History of Psychiatric Disease (Depression/anxiety, etc.)		0.38	0.1	1.5	0.167
Diabetes Mellitus		4.3	0.59	31.16	0.148
Substance Use		1.02	0.31	3.35	0.971
Periodontitis Severity: Healthy		1.15	0.05	28.13	0.932
Periodontitis Severity: Mild		3.15	0.18	56.42	0.435
Periodontitis Severity: Moderate		7.09	0.55	91.28	0.133

## Discussion

The association between nutritional status, specifically obesity, and the development of periodontal diseases has garnered significant attention in research, as evidenced by the work of Elfseiv and colleagues. While the exact underlying mechanisms are yet to be fully elucidated, their findings suggest a clear link between obesity and an increased risk of periodontal diseases. This understanding has been further supported by subsequent studies that have contributed to the body of evidence surrounding this relationship<sup>11-12</sup>.

For instance, a meta-analysis involving a substantial number of participants revealed that obese individuals have a 33% higher relative risk of developing new cases of periodontitis compared to their non-obese counterparts. Moreover, when considering both obesity and overweight status together, the

odds of developing periodontal diseases more than doubled<sup>13</sup>. Another systematic review echoed these findings, highlighting weight gain, overweight, obesity, and increased waist circumference as significant risk factors for periodontal diseases<sup>14</sup>.

However, despite the wealth of research focusing on the general population, there remains a notable gap in understanding periodontal health within vulnerable populations, such as incarcerated individuals. This subset of the population faces unique challenges in accessing healthcare services and maintaining overall health due to their constrained environment and limited resources. Consequently, studies investigating the periodontal health of incarcerated individuals are essential for addressing their specific healthcare needs.

One such study assessed the periodontal hea-

th of incarcerated women and found that nearly half of the participants maintained a healthy BMI. This could be attributed to the balanced diet provided within the prison environment, along with the physical activity associated with daily tasks<sup>11</sup>. However, despite these factors, the study revealed a significant association between periodontal diseases, adverse dental caries, and overweight or obese status among incarcerated women. This suggests that being overweight may impact their mental health and ability to perform daily tasks, with obesity potentially being a consequence of the stressful prison environment<sup>15</sup>.

Interestingly, a recent study involving male inmates in India did not find any association between BMI and periodontal disease, dental caries, or loss of attachment. This underscores the need for further research specifically targeting incarcerated populations to fully understand the relationship between obesity and periodontal health within this demographic<sup>16</sup>.

While evidence regarding this association remains limited in incarcerated populations, similar links have been observed in other vulnerable groups, such as pregnant women, children, and adolescents. However, establishing a concrete link may require studies with larger sample sizes or case-control designs.

Efforts to address the healthcare needs of incarcerated populations are crucial for promoting equality and ensuring access to essential services, including oral healthcare. Despite the challenges posed by incarceration, prioritizing oral hygiene and oral health education among inmates is essential to prevent and manage periodontal diseases<sup>17-24</sup>.

However, it's important to acknowledge the limitations of the existing studies, such as small sample sizes and a lack of pre-incarceration dental health data. Future research should focus on multi-penitentiary studies with longitudinal designs to better understand the relative risk of severe dental caries and periodontal diseases among prisoners with abnormal BMI.

In conclusion, the findings of studies focusing on incarcerated populations highlight the unrecognized health needs of this demographic, particularly concerning oral health. Addressing these needs requires concerted efforts from clinicians, researchers, and policymakers to ensure access to comprehensive healthcare services, including oral health education and treatment, within correctional facilities.

### Conclusion

It was found that high body mass index was significantly associated with higher DMFT score. Incarcerated people seldom have access to quality care and proper healthy food. It is important that they have access to basic health care facilities.

### Conflict of Interest

Authors have no conflict of interest and no grant funding from any organization.

### References

1. Edwards JS. The foodservice industry: Eating out is more than just a meal. *Food Qual Prefer.* 2013;27(2):223-229. [DOI: 10.1016/j.foodqual.2012.02.003]. Available from; <https://www.sciencedirect.com/science/article/abs/pii/S0950329312000250>. Accessed On, 16<sup>th</sup> February 2024.
2. Wondimu W, Girma B, Sinaga M, Taye A. Undernutrition and associated factors among incarcerated people in Mizan prison institute, southwest Ethiopia. *PLoS One.* 2021;16(5):e0251364. [DOI: 10.1371/journal.pone.0251364]. Available from; <https://pubmed.ncbi.nlm.nih.gov/33974638/>. Accessed On, <sup>th</sup> February 2024.
3. McNamara C, Cook S, Brown LM, Palta M, Look KA, Westergaard RP, Burns ME. Prompt access to outpatient care post-incarceration among adults with a history of substance use: Predisposing, enabling, and need-based factors. *J Subst Use Addict Treat.* 2023;160:209277. [DOI: 10.1016/j.josat.2023.209277]. Available from; <https://pubmed.ncbi.nlm.nih.gov/38142041/>. Accessed On, <sup>th</sup> February 2024.
4. Bagwell-Gray ME, Garcia-Hallett J, Lee J, Kepple NJ, Sisson M, Comfort M, Ramaswamy M. Black Women's Physical, Mental, and Sexual Health in the Criminal Legal System: Influences of Victimization, Healthcare Access, and Living Conditions. *Affilia.* 2024;39(1):128-47.[DOI: 10.1177/08861099231160184]. Available from; <https://journals.sagepub.com/doi/10.1177/08861099231160184>

- ?icid=int.sj-abstract.citing-articles.1. Accessed On, <sup>th</sup> February 2024.
5. Sarah Hirsch, Yiran E Liu, Fernando Alarid Escudero et al. Inequalities in Health Risks and Outcomes Faced by Mexico's Incarcerated Population. 2024, PREPRINT (Version 1) available at Research Square. [DOI: 10.21203/rs.3.rs-3831065/v1]. Available from; <https://www.researchsquare.com/article/rs-3831065/v1>. Accessed On, <sup>th</sup> February 2024.
  6. Jauk-Ajamie D. Women behind Bars in the United States: A Hidden and Vulnerable Population in Pandemic Times. In *Women and COVID-19*. 2024 (pp. 245-261). Routledge. Available from; <https://www.taylorfrancis.com/chapters/edit/10.4324/9781003267133-23/women-behind-bars-united-states-daniela-jauk-ajamie>. Accessed On, <sup>th</sup> February 2024.
  7. Muentner L, Holder N, Burnson C, Runion H, Weymouth L, Poehlmann-Tynan J. Jailed Parents and their Young Children: Residential Instability, Homelessness, and Behavior Problems. *J Child Fam Stud*. 2018;28(2):370-386. [DOI: 10.1007/s10826-018-1265-3] Available from; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9075341/>. Accessed On, <sup>th</sup> February 2024.
  8. Chatterjee D, Chatterjee SC. Food in Captivity: Experiences of Women in Indian Prisons. *Prison J*. 2018 Jan;98(1):40-59. [DOI: 10.1177/0032885517743444]. Available from; <https://journals.sagepub.com/doi/abs/10.1177/0032885517743444?journalCode=tpjd>. Accessed On, <sup>th</sup> February 2024.
  9. Lim JU, Lee JH, Kim JS, Hwang YI, Kim TH, Lim SY, Yoo KH, Jung KS, Kim YK, Rhee CK. Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. *Int J Chron Obstruct Pulmon Dis*. 2017 Aug 21;12:2465-2475. [DOI: 10.2147/COPD.S141295]. Available from; <https://pubmed.ncbi.nlm.nih.gov/28860741/>. Accessed On, <sup>th</sup> February 2024.
  10. Schürch Jr E, Minder CE, Lang NP, Geering AH. Comparison of clinical periodontal parameters with the Community Periodontal Index for Treatment Needs (CPITN) data. *Schweizer Monatsschrift für Zahnmedizin= Revue mensuelle suisse d'odonto-stomatologie= Rivista mensile svizzera di odontologia e stomatologia*. 1990;100(4):408-11. Available from; <https://pubmed.ncbi.nlm.nih.gov/2343283/>. Accessed On, <sup>th</sup> February 2024.
  11. Elfseyie M, Elsenussi S, Alaskandrani R, Huew R. Estimate of DMFT index using teeth most affected by dental caries in Benghazi, Libya. *International Journal of Applied Dental Sciences*. 2020;6(2):159-62.
  12. Nascimento GG, Leite FRM, Do LG, Peres KG, Correa MB, Demarco FF, et al. Is weight gain associated with the incidence of periodontitis? A systematic review and meta-analysis. *J Clin Periodontol*. 2015;42(6):495-505. [DOI:10.1111/jcpe.12417]. Available from; <https://pubmed.ncbi.nlm.nih.gov/25952821/>. Accessed On, <sup>th</sup> February 2024.
  13. Suvan J, D'Aiuto F, Moles DR, Petrie A, Donos N. Association between overweight/obesity and periodontitis in adults. A systematic review. *Obes Rev*. 2011;12(5):e381-404. [DOI: 10.1111/j.1467-789X.2010.00808.x]. Available from; <https://pubmed.ncbi.nlm.nih.gov/21348914/>. Accessed On, <sup>th</sup> February 2024.
  14. Wu Q, Zhang W, Lu Y, Li H, Yang Y, Geng F, Liu J, Lin L, Pan Y, Li C. Association between periodontitis and inflammatory comorbidities: The common role of innate immune cells, underlying mechanisms and therapeutic targets. *Int Immunopharmacol*. 2024;128:111558. [DOI: 10.1016/j.intimp.2024.111558]. Available from; <https://www.sciencedirect.com/science/article/abs/pii/S1567576924000766>. Accessed On, <sup>th</sup> February 2024.
  15. Plugge E, Hard J. *Prison Medicine and Health*. Oxford University Press; 2024.
  16. Sharma A, Parkar S, Gaur A, Bagri B. Impact of incarceration on nutritional status and oral health among male inmates of central jail of Jaipur city, India. *Rev Esp Sanid Penit*. 2020;22(3):96-103. [DOI:10.18176/resp.00018]. Available from; <https://pubmed.ncbi.nlm.nih.gov/33300940/>. Accessed On, <sup>th</sup> February 2024.
  17. C.S. Santinoni, Gabriel Leonardo Magrin, Ariadne Cristiane Cabral da Cruz, Marco Aurélio Bianchini, et al. (2024). [Mini-review] Periodontal Medicine: Impact of Oral Health on General Health. *Qeios*. [DOI:10.32388/NMUB5A]. Available from; <https://www.qeios.com/read/NMUB5A>. Accessed On, <sup>th</sup> February 2024.
  18. Genet A, Girma A. Magnitude, associated risk factors, and trend comparisons of identified tuberculosis types among prisons in Ethiopia: A systematic review and meta analysis. *Health Science Reports*. 2024 ;7(1):e1789. [DOI: 10.1002/hsr2.1789]. Available from; <https://pubmed.ncbi.nlm.nih.gov/38186928/>. Accessed On, <sup>th</sup> February 2024.
  19. Abraham SA, Cudjoe O, Nartey YA, Agyare E, Annor F, Tawiah BO, Nyampong M, Owusu KK, Abdulai M, Addo SA, Obiri-Yeboah D. Unravelling the experiences of incarcerated individuals living with HIV on ART: a qualitative study in Ghanaian prisons. *International Journal of Prison Health*. 2024. [DOI: 10.1108/IJOPH-06-2023-0031]. Available from; <https://www.emerald.com/insight/con>

- tent/doi/10.1108/IJOPH-06-2023-0031/full/pdf? title =unravelling-the-experiences-of-incarcerated-individuals-living-with-hiv-on-art-a-qualitative-study-in-ghananian-prisons. Accessed On,, 16<sup>th</sup> February 2024.
20. Bennett RE. Motherhood confined: Maternal health in English prisons, 1853-1955. Manchester University Press; 2024.
  21. Turney K, Wildeman C. Self-reported health among recently incarcerated mothers. *Am J Public Health*. 2015;105(10):2014-2020. [DOI: 10.2105/AJPH.2015.302743]. Available from; <https://pubmed.ncbi.nlm.nih.gov/26270294/>. Accessed On, <sup>th</sup> February 2024.
  22. Christian P, Smith ER. Adolescent undernutrition: global burden, physiology, and nutritional risks. *Ann Nutr Metab*. 2018;72(4):316-328.[DOI: 10.1159/000488865]. Available from; <https://pubmed.ncbi.nlm.nih.gov/29730657/>. Accessed On, <sup>th</sup> February 2024.
  23. Worobey J, Tepper BJ, Kanarek R. Nutrition and behavior: a multidisciplinary approach. New Jersey, NJ: CABI; 2006.
  24. Junejo JH, Sharif S. Profiling of Women Prisoners in Sindh. Committee for the Welfare of Prisoners-Legal Aid Office. 2019. Available from; <https://www.lao.org.pk/wp-content/uploads/2019/08/Profiling-of-Women-Prisoners-in-Sindh-by-CWP-LAO.pdf>. Accessed On, <sup>th</sup> February 2024.



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