

# Impact of Food Insecurity on Oral Health Related Quality of Life among Brick Kiln Workers of Rayagada District, Odisha, India: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Food insecurity is a pressing public health issue that adversely affects both general and oral health, particularly among marginalised groups. Brick kiln workers, who are part of the informal labour sector, often lack access to adequate healthcare and nutrition. However, limited data exist on how food insecurity influences their Oral Health-Related Quality of Life (OHRQoL).

**Aim:** To assess the impact of food insecurity on OHRQoL among brick kiln workers in Derigaon Gram Panchayat, Rayagada District, Odisha, India.

**Materials and Methods:** A community-based cross-sectional study was conducted among 1,240 adult brick kiln workers selected through multi-stage stratified random sampling. A structured, pretested, and Odia-translated questionnaire was utilised, incorporating the Food Insecurity Experience Scale (FIES), Oral Health Impact Profile-14 (OHIP), and

sociodemographic details. Descriptive statistics, Analysis of Variance (ANOVA), and Pearson's correlation were applied for data analysis, with a significance threshold of  $p < 0.05$ .

**Results:** A high prevalence of food insecurity was observed in the study population. ANOVA revealed significant differences across FIES categories in OHIP domains such as psychosocial discomfort, physical disability, and psychological disability ( $p < 0.05$ ). Pearson's correlation showed weak but significant associations between food insecurity and functional limitation ( $r = 0.057$ ,  $p = 0.045$ ), physical pain ( $r = 0.075$ ,  $p = 0.008$ ), and psychological disability ( $r = -0.084$ ,  $p = 0.003$ ). The overall OHIP score did not significantly correlate with FIES.

**Conclusion:** Food insecurity significantly influenced several aspects of OHRQoL among brick kiln workers. Integrated strategies targeting both nutrition and oral health are essential for improving outcomes in these vulnerable labour populations.

**Keywords:** Food insecurity, Food supply, Occupational health

## INTRODUCTION

An integral part of overall health and life satisfaction is oral health. Poor dental health can significantly impact an individual's daily life, causing pain, discomfort, reduced function, social disengagement, and psychological suffering. In recent years, the concept of OHRQoL has gained recognition as a comprehensive metric that takes into account not only clinical outcomes but also the functional, social, and emotional effects of oral disorders on individuals [1].

Food insecurity, defined as the inability to consistently obtain enough nutrient-dense food for an active and healthy life, is a major worldwide concern with far-reaching effects on both physical and mental health. It is particularly threatening to the health and well-being of older individuals [2]. Socially disadvantaged and marginalised groups in India continue to be disproportionately affected by food insecurity. Brick kiln workers, many of whom are migrant labourers enduring hazardous living conditions, are particularly at risk. They frequently face poor living conditions, job dangers, restricted access to healthcare, and inadequate nutrition, all of which can lead to systemic and oral health issues [3,4].

While extensive research has been conducted on the connection between food insecurity and overall health outcomes [3-17], little is known about its effects on oral health and quality of life, particularly in unorganised labour industries like brick kilns. Food instability can lead to inadequate dietary intake, worsening oral health by increasing vulnerability to periodontal diseases, dental caries, and poor healing. Moreover, the psychological strain caused by food insecurity may affect individuals' perceptions of their dental health,

potentially leading to decreased self-care and delays in seeking medical attention [10,11].

In this context, the present study aimed to assess the impact of food insecurity on OHRQoL among brick kiln workers in Derigaon Gram Panchayat, Rayagada District, Odisha, India. The study will examine the association between levels of food insecurity and various domains of the OHIP, thereby contributing to a more holistic understanding of the social determinants of oral health in a vulnerable population. This manuscript is part of a larger mixed-methods study, within which the OHRQoL of 8 to 10-year-old children has already been reported [18].

## MATERIALS AND METHODS

This community-based cross-sectional study was conducted to evaluate the association between food insecurity and OHRQoL among brick kiln workers in Rayagada District, Odisha, India. Data collection was conducted between March 2025 and June 2025. Ethical approval was obtained from the Institutional Ethics Committee with approval number KIIT/KIMS/IEC/1912/2024.

### Inclusion criteria:

- Adult brick kiln workers aged 18 years and above.
- Participants who were permanent residents or migrant workers staying at the kiln site during the data collection period.
- Individuals who were willing to participate and provide written informed consent.

### Exclusion criteria:

- Individuals with cognitive or intellectual disabilities that impair their ability to understand or respond to the questionnaire.

- Workers who were seriously ill or physically incapacitated at the time of data collection.
- Participants who refused consent or were unavailable after two follow-up visits.
- Individuals with a history of major psychiatric illness or who were under treatment for severe mental health disorders.

**Sample size calculation:** A multi-stage stratified random sampling technique was employed to select the study participants. In the first stage, Padmapur block was randomly selected from the 11 blocks of Rayagada. In the second stage, Derigaon gram panchayat was randomly chosen from among the 22 gram panchayats within Padmapur. In the third stage, a comprehensive list of all brick kilns operating within Derigaon was prepared, and kilns were randomly selected to ensure representation of both local and migratory worker populations. All eligible adult brick kiln workers present at the selected sites during the data collection period were approached for participation [18].

The sample size was calculated using the formula for a single proportion:

$$n = Z^2 \times p \times (1-p) / d^2$$

where (Z) is the standard normal deviate at a 95% confidence level (1.96), (p) is the expected prevalence, and (d) is the margin of error. Using a prevalence of periodontal diseases among brick kiln workers of 86.27% ((p=0.8627)) from previous literature [19], a 95% confidence level, and a 5% margin of error ((d=0.05)), the required sample size was 1,121. After adding 10% to account for non-response, the final sample size was fixed at 1,240 participants.

### Study Procedure

Data were collected using a structured, interviewer-administered questionnaire consisting of three components: a sociodemographic schedule, the FIES and the OHIP-14 [20-22].

The first component captured sociodemographic and occupational details of the participants, including age, gender, marital status, educational level, and annual household income. This information helped contextualise the socioeconomic background of the brick kiln workers.

The second component was the FIES, developed by the Food and Agriculture Organisation (FAO) of the United Nations [20,21]. This 8-item test aimed to evaluate aspects of food insecurity related to access that had occurred during the past twelve months. Questions included concerns about food availability and surviving a full day without eating. Each question received a score of either "Yes" (1) or "No" (0); "Don't know" and "Prefer not to answer" were also scored as 0. The total score ranged from 0 to 8. Participants were classified as either food secure (score 0), mildly food insecure (scores 1-3), moderately food insecure (scores 4-6), or severely food insecure (scores 7-8) based on FAO recommendations. The FIES was translated into Odia using the World Health Organisation (WHO)-recommended forward-backward translation method [23]. The translated tool was reviewed by public health experts and pretested among 30 participants for clarity, cultural relevance, and internal consistency, yielding a Cronbach's alpha of over 0.80.

The third component of the questionnaire was the OHIP-14 [22]. The OHIP-14 measures the social impact of oral disorders across seven domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. Each domain consists of two items, making a total of 14 items. Responses were recorded on a 5-point Likert scale ranging from 0 ("never") to 4 ("very often"). The total score ranged from 0 to 56, with higher scores indicating a greater negative impact on OHRQoL. The tool was also translated into Odia following the forward-backward translation method and pilot-tested among brick kiln workers, yielding a Cronbach's alpha exceeding 0.85, indicating strong internal consistency.

These data collection tools were administered face-to-face by a single trained examiner to ensure comprehension and accuracy of responses. The use of validated and culturally adapted instruments allowed for robust measurement of both food insecurity and its potential impact on OHRQoL among this vulnerable population.

**Training and calibration of investigators:** To avoid any diagnostic variability among the study participants, a single examiner was trained, and the instrument was calibrated in the Department of Public Health Dentistry at KIDS, Bhubaneswar. All data collections were carried out by the investigator herself. This was done to ensure homogeneous interpretation, agreement, and application of the codes and criteria used for determination and transcription.

**Tool translation and back-translation:** The OHIP-14 questionnaire and the FIES were both translated from English into the local language of Odia using a forward-backward translation technique by two multilingual professionals [20-22]. The translations were evaluated for conceptual and semantic correctness by a group of public health experts. A bilingual interpreter performed the back translation into English. To evaluate the suitability and clarity of the items, thirty brick kiln workers participated in pretesting. Necessary adjustments were made to ensure cultural relevance and understanding based on the findings from the pilot study.

### STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics were computed for sociodemographic variables and outcome measures. The Chi-square test was used to assess associations between food insecurity categories and levels of oral health impact. Mean OHIP-14 scores were compared using ANOVA. Pearson's correlation analysis was performed to examine the relationship between FIES scores and individual OHIP-14 domain scores. A p-value <0.05 was considered statistically significant.

### RESULTS

The study included 1,240 brick kiln workers. Most participants were aged 39-48 years (559; 45.1%), followed by 59-68 years (306; 24.7%), while only 149 (12.0%) were aged 18-28 years. Males comprised 724 (58.4%) and females 516 (41.6%), reflecting a male-dominated workforce but with notable female participation [Table/Fig-1].

Food insecurity was widespread, with mild insecurity reported by 491 (39.6%) of males and 356 (28.7%) of females. Moderate and severe insecurity affected 172 (13.9%) and 61 (4.9%) of males,

| Variables              | Frequency (Percentage) |
|------------------------|------------------------|
| <b>Age range</b>       |                        |
| 18-28 years            | 149 (12.0)             |
| 29-38 years            | 166 (13.4)             |
| 39-48 years            | 559 (45.1)             |
| 49-58 years            | 60 (4.8)               |
| 59-68 years            | 306 (24.7)             |
| <b>Gender</b>          |                        |
| Male                   | 724 (58.4)             |
| Female                 | 516 (41.6)             |
| <b>Marital status</b>  |                        |
| Married                | 910 (73.4)             |
| Single                 | 210 (16.9)             |
| Divorced               | 50 (4.0)               |
| Widowed                | 70 (5.64)              |
| <b>Education level</b> |                        |
| Illiterate             | 395 (31.9)             |
| Primary                | 415 (33.5)             |
| High school            | 430 (34.7)             |

| Annual Income (INR) |               |
|---------------------|---------------|
| <50,000             | 480 (38.7)    |
| 50,000 - 100,000    | 530 (42.7)    |
| >100,000            | 230 (18.5)    |
| Total               | 1240 (100.0%) |

[Table/Fig-1]: Sociodemographic characteristics.

and 121 (9.8%) and 39 (3.1%) of females, respectively. Mild food insecurity was the most common category across both genders [Table/Fig-2].

| Food insecurity level | Male n (%)  | Female n (%) | Total n (%) |
|-----------------------|-------------|--------------|-------------|
| Mild                  | 491 (39.6%) | 356 (28.7%)  | 847 (68.3%) |
| Moderate              | 172 (13.9%) | 121 (9.8%)   | 293 (23.6%) |
| Severe                | 61 (4.9%)   | 39 (3.1%)    | 100 (8.1%)  |
| Total                 | 724 (58.4)  | 516 (41.6)   | 1240 (100)  |

[Table/Fig-2]: Gender-wise distribution of FIES categories.

Significant variations in OHIP domain scores were observed across age groups (all  $p < 0.001$ ). Functional limitation and psychosocial discomfort were highest among the youngest group (18-28 years). Physical pain peaked in the 29-38 years group, social disability in the 39-48 years group, and psychological disability in the 49-58 years group. Overall OHIP scores were greatest among workers aged 39-48 years ( $25.38 \pm 5.54$ ), followed by 18-28 years ( $25.02 \pm 6.42$ ), indicating substantial perceived oral health impact in these groups [Table/Fig-3].

Comparison of OHIP scores across food insecurity categories showed a significant association with overall OHRQoL ( $p = 0.032$ ). Psychosocial discomfort ( $p = 0.002$ ), physical disability ( $p = 0.003$ ), and psychological disability ( $p = 0.014$ ) varied significantly with food insecurity levels, while functional limitation, social disability, physical pain, and handicap showed no significant differences [Table/Fig-4]. Pearson's correlation analysis revealed weak but significant correlations between FIES and some OHIP domains. Food insecurity was positively correlated with functional limitation ( $r = 0.057$ ,  $p = 0.045$ ) and physical pain ( $r = 0.075$ ,  $p = 0.008$ ), while negative correlations were found with psychosocial discomfort, physical disability, and psychological disability. No significant

correlation was identified with social disability, handicap, or overall OHIP scores [Table/Fig-5].

| OHIP domain              | Pearson's r | p-value |
|--------------------------|-------------|---------|
| Functional limitation    | 0.057       | 0.045*  |
| Physical pain            | 0.075       | 0.008*  |
| Psychosocial discomfort  | -0.071      | 0.013*  |
| Physical disability      | -0.098      | 0.001*  |
| Psychological disability | -0.084      | 0.003*  |
| Social disability        | -0.022      | 0.443   |
| Handicap                 | 0.012       | 0.662   |
| OHIP total score         | -0.037      | 0.197   |

[Table/Fig-5]: Correlation between OHIP domains and FIES Score.

\*significant

## DISCUSSION

This study explored the impact of food insecurity on OHRQoL among brick kiln workers in the Rayagada district of Odisha, a marginalised population with limited access to healthcare and basic resources. The findings revealed a significant association between food insecurity and several domains of the OHIP-14, suggesting that compromised access to adequate and nutritious food may negatively influence various aspects of oral health and well-being.

However, a mixed-method study conducted among brick kiln workers in Bihar demonstrated that food insecurity was negatively associated with education and wealth, and positively associated with household size at the kiln, across both winter and summer seasons [14]. The majority of participants experienced some level of food insecurity, and ANOVA results showed significant differences in psychosocial discomfort, physical disability, and psychological disability across food insecurity categories ( $p < 0.05$ ). This aligns with findings by Soares GH et al., who reported that approximately 95% of participants lived in food-insecure families, with severe food insecurity present in 58% of the households [15].

Additionally, a significant association was found between the ability to chew solid food and tooth loss in the nutritional status of older adults in a study by Padma Sri Lekha P et al., It was further revealed that tooth loss acted as a moderator between chewing ability and

| Domain                   | 18-28 years | 29-38 years | 39-48 years | 49-58 years | 59-68 years | Total      | p-value |
|--------------------------|-------------|-------------|-------------|-------------|-------------|------------|---------|
| Functional limitation    | 3.85±1.61   | 2.61±1.23   | 3.37±1.39   | 3.20±1.55   | 3.24±1.34   | 3.28±1.43  | 0.001*  |
| Physical pain            | 3.58±1.90   | 4.21±1.51   | 3.47±1.55   | 3.07±1.36   | 3.28±1.77   | 3.51±1.66  | 0.001*  |
| Psychosocial discomfort  | 3.95±1.49   | 3.52±1.54   | 3.43±1.59   | 3.02±1.89   | 3.78±1.61   | 3.57±1.61  | 0.001*  |
| Physical disability      | 3.48±1.51   | 3.48±1.54   | 3.87±1.80   | 4.28±2.35   | 3.35±1.57   | 3.66±1.73  | 0.001*  |
| Psychological disability | 3.86±1.73   | 3.69±1.31   | 4.01±1.67   | 2.55±1.72   | 3.51±1.47   | 3.75±1.62  | 0.001*  |
| Social disability        | 3.11±1.54   | 3.69±1.94   | 3.51±1.71   | 2.27±1.59   | 3.12±1.65   | 3.33±1.73  | 0.001*  |
| Handicap                 | 3.19±1.49   | 3.20±1.60   | 3.74±1.52   | 2.52±1.63   | 2.72±1.56   | 3.29±1.60  | 0.001*  |
| OHIP                     | 25.02±6.42  | 24.42±5.90  | 25.38±5.54  | 20.90±7.99  | 23.00±6.79  | 24.41±6.27 | 0.001*  |

[Table/Fig-3]: Association of OHIP domains with age.

\*significant

| Domain                   | Mild       | Moderate   | Severe     | Total      | F value | p-value |
|--------------------------|------------|------------|------------|------------|---------|---------|
| Functional limitation    | 3.27±1.46  | 3.33±1.36  | 3.32±1.35  | 3.28±1.43  | .239    | 0.788   |
| Physical pain            | 3.48±1.66  | 3.49±1.68  | 3.88±1.64  | 3.51±1.66  | 2.634   | 0.072   |
| Psychosocial discomfort  | 3.68±1.57  | 3.33±1.64  | 3.34±1.71  | 3.57±1.61  | 6.288   | 0.002*  |
| Physical disability      | 3.77±1.69  | 3.45±1.85  | 3.34±1.60  | 3.66±1.73  | 5.810   | 0.003*  |
| Psychological disability | 3.83±1.53  | 3.66±1.84  | 3.37±1.61  | 3.75±1.62  | 4.283   | 0.014*  |
| Social disability        | 3.36±1.69  | 3.29±1.87  | 3.14±1.63  | 3.33±1.73  | .851    | 0.427   |
| Handicap                 | 3.32±1.55  | 3.14±1.73  | 3.41±1.63  | 3.29±1.60  | 1.702   | 0.183   |
| OHIP total score         | 24.72±5.92 | 23.69±7.27 | 23.80±5.82 | 24.41±6.27 | 3.463   | 0.032*  |

[Table/Fig-4]: Association of OHIP domains with FIES categories.

ANOVA, \*significant

the risk of being underweight [24]. Similarly, another study by Chi DL et al., found a significant relationship between household food insecurity and poor oral health status among children in low-income U.S. households [25].

In a study conducted by Chadhury A et al., food diversity was absent in half of the participants, while two-thirds were found to be food insecure [26]. Another study by Dutta Chowdhury S et al., found that 34.5% of brick workers were undernourished based on their BMI, while 40.12% were undernourished based on their Mid-Upper Arm Circumference (MUAC). This high prevalence of undernutrition not only reflected the poor health status of the workers but also indicated compromised immunity, making them more susceptible to respiratory disorders, allergies, musculoskeletal problems, and neurological issues [27].

Pearson's correlation in the current study showed a weak but statistically significant correlation between food insecurity and domains such as physical pain, functional limitation, and psychological disability. Interestingly, the total OHIP score did not show a significant correlation with the FIES score, indicating that while food insecurity may affect specific aspects of oral health perception, it may not always be reflected in overall scores. This is consistent with findings from Patel R et al., who emphasised that individual OHIP domains may be more sensitive to socioeconomic stressors than the total score in adult populations [28].

The high levels of oral health impairment observed in this study, particularly among middle-aged workers (ages 39-48), may also be attributed to cumulative exposure to occupational risks, poor dietary practices, and lack of oral health awareness. Previous research has established that vulnerable populations, such as migrant labourers and informal sector workers, are at a higher risk of poor oral health outcomes due to limited health literacy, financial barriers, and competing survival priorities [29].

The inverse relationship observed in some domains (physical and psychological disability and discomfort) may reflect adaptive behaviors or underreporting due to the normalisation of hardship, a phenomenon reported in other marginalised populations. A study by Van der Velde LA et al., highlighted similar discrepancies in perception versus clinical need in food-insecure populations, emphasising the need for culturally sensitive assessment tools [30].

The implications of these findings are considerable. Food insecurity not only affects systemic health but also contributes to poor oral health outcomes, further exacerbating the health inequities faced by low-income labourers. Integrating oral health into broader nutritional and welfare programs could be a strategic approach to improve the overall well-being of such vulnerable populations.

One of the key strengths of this study lies in its focus on a highly marginalised and underrepresented population—brick kiln workers—who are often excluded from mainstream health research. By assessing the impact of food insecurity on OHRQoL using validated tools such as the FIES and OHIP-14, both of which were culturally adapted and translated into the local language (Odia), the study ensured methodological rigor and contextual relevance. The use of a multi-stage stratified random sampling technique enhanced the representativeness of the sample within the selected district. Furthermore, the study provided domain-specific insights into which aspects of OHRQoL were most affected by food insecurity, offering valuable guidance for targeted interventions.

### Limitation(s)

However, the study also had several limitations. The cross-sectional design restricts the ability to infer causal relationships between food insecurity and OHRQoL. Since both food insecurity and oral health impact were self-reported, the findings may be subject to recall bias and social desirability bias. Additionally, the study was limited to a single gram panchayat in the Padmapur block, which

may affect the generalisability of the results to other geographic areas or occupational groups. Other potential confounders, such as dietary habits, oral hygiene practices, co-morbidities, and access to dental care, were not thoroughly controlled. Lastly, while the OHIP-14 is a validated tool, it may not fully capture culturally specific oral health perceptions in tribal or low-literacy populations, potentially underestimating the true burden of oral health impairment.

### CONCLUSION(S)

This study highlights a significant association between food insecurity and multiple domains of OHRQoL among brick kiln workers in rural Odisha. Participants with higher levels of food insecurity reported greater impairment in psychosocial, physical, and psychological aspects of oral health. These findings underscore the complex interplay between socioeconomic deprivation and oral health outcomes in marginalised communities. Integrating oral health promotion into broader food security and welfare programs is essential to address these interlinked determinants of health. Policymakers and public health planners should consider tailored, community-based strategies to improve both nutrition and oral health among informal sector labourers.

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