Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

Comparative Analysis of Diets in Rural and Urban Areas: Its Impacts on Oral Health, Dental Strength and Disease Susceptibility

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(Received: 28 January 2026 Revised: 16 March 2026 Accepted: 09 April 2026)

KEYWORDS

Diet

Caries

Lifestyle

Oral Health

Gingivitis

ABSTRACT:

Aim & Background: Oral health is closely influenced by dietary habits, which vary significantly between rural and urban populations due to differences in lifestyle, food availability, and socioeconomic factors. Refined sugars, processed snacks, and acidic beverages in diet often impact dental strength, enamel integrity, and prevalence of oral diseases. Understanding how diet affects oral health across different populations is essential for developing targeted preventive strategies. To evaluate and compare dietary habits in rural and urban areas and their impact on oral health, dental strength and disease susceptibility.

Materials & Methods: A cross-sectional, face-to-face survey was conducted among 200 participants. Dietary patterns were assessed using structured questionnaires, and oral health was evaluated using indicators like dental caries, self-reported oral hygiene practices, etc. Data were analyzed considering a p-value of 0.05 as statistically significant.

Results: Result found certain differences in consumption of processed foods between rural and urban participants. Sugar intake was paradoxically higher in rural (34%) than urban (23%), though urban diet included more acidic and fast foods. Higher prevalence of dental caries was observed in urban (62%) compared to rural (48%) ($p < 0.01$). Rural individuals had significantly better enamel strength (4.2 ± 0.8 vs..5 ± 1.1, $p < 0.05$). Gingivitis and periodontitis were significantly more prevalent in the urban (58% and 35%) than rural (42% and 22%) ($p < 0.05$).

Conclusion: Rural populations demonstrated better oral health outcomes compared to urban areas. These findings highlight role of diet in oral health and the need for targeted preventive strategies.

1. Introduction

Oral cavity is often described as an integral part of overall health and serves as a window to the relationship between general and oral health of an individual [1]. There is a saying by Mark Twain that ‘the only way to keep your health is to eat what you don't want, drink what you don't like, and do what you'd rather not.’ This statement emphasizing the importance of self-discipline and useful thinking in making difficult choices for long term health and also suggests a laissez-faire approach to healthy food choices.

Another quote by Linford Christie, a British athlete, is that ‘adopting a new healthier lifestyle can involve changing diet to include more fresh fruit and vegetables as well as increasing levels of exercise.’ A balanced diet is fundamental not only for overall health but also for maintaining optimal dental health. Nutrients like calcium, phosphorus, and few vitamins like vitamin A, B complex, C and D play a vital role in supporting strong teeth and gums, while poor dietary habits can lead to oral health issues such as tooth decay, dental erosion and gum diseases [2].

Diets high in sugar and acidic foods create an environment conducive to harmful bacteria, leading to cavities and gum inflammation.

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JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

Furthermore, foods rich in antioxidants, fibre, and healthy fats help promote gum health and reduce the risk of periodontal disease. Research consistently shows that the foods we consume are directly linked to the health of our teeth and gums, highlighting the importance of adopting a nutrient-rich diet for long-term dental well-being [3-5].

By understanding the connection between diet and dental health, individuals can make informed choices that protect their smiles and improve their overall quality of life [6].

Many authors and researchers believe and suggest diet as a key determinant of oral health, influencing dental strength, disease susceptibility, and oral conditions such as cavities and gum disease. The dietary habits in rural and urban areas differ significantly, shaped by factors such as accessibility to food, socioeconomic status, and cultural practices [7].

Research has found that urban areas tend to have higher access to processed and sugary foods, in turn leading to an increased risk of cardiovascular and metabolic diseases, oral diseases like dental caries, and periodontal disease [8]. In contrast, rural diets, though often lower in refined sugars, may be deficient in essential nutrients like calcium, vitamin D, and other micronutrients vital for maintaining strong teeth and gums [9]. All these factors directly or indirectly contribute to differences in oral health outcomes between rural and urban populations. A study to analyse these differences and dietary influences is very much essential in understanding its impact on dental health and identifying strategies to improve oral health across different populations is of necessity.

So, the present study was devised to evaluate and to compare the dietary practices in rural and urban Indian population and to analyse their holistic impact on oral health, dental strength and disease susceptibility.

2. Materials and Methods

Design, setting, participants: This is a cross-sectional comparative study conducted between the months October and November of 2024. The study population was comprised of 18–60-year-old individuals from both the rural and urban areas of Guntur district of Andhra Pradesh, grouped theoretically using a stratified random sampling method. The sampling technique was strictly followed to make sure that such sampling units were included to be representatives of the rural-urban population.

Inclusion criteria: Individuals aged 18-60 years old with no recent medical illness involving hospitalisation or any other significant health issues and have given consent to participate in the study.

Exclusion criteria: Individuals with recent dental treatments, pregnancy or lactating, physically challenged or handicapped and are not residing in the study area.

Ethical approval for the study: Ethical approval for the present study was obtained from the Institutional Ethics Committee (IEC) of the institution with the protocol no: Pr.484/IEC/SIBAR/2024

Study questionnaire:

An interview-based questionnaire was designed to assess the demographic characteristics of the study population, along with the participant's dietary practices, oral health related information and various other lifestyle practices.

The questionnaire was pre-tested for validity using a pilot study and obtained a reliability value of (Cronbach's alpha value) 0.82. The examiner was pre-trained and calibrated.

Sample size calculation:

The required sample size for the present study was obtained using the following formula N = 4 pq / r2

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JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

where p = prevalence; q = 100-1; r = sampling error / precision. Upon calculation, it was obtained that a minimum of 200 people is required in both the groups.

Data Collection:

Dietary Assessment was done using a modified Food Frequency Questionnaire (FFQ) [10]. Oral Health Examination: Using the DMFT index (Decayed, Missing, and Filled Teeth) [11].

Dental Strength Measurement: Using visual inspection, simple percussion test, tooth mobility test, bite test using cotton roll or chew stick, cold and heat sensitivity test

Disease Susceptibility Assessment: questions related to oral health and simple diagnostic procedures to assess caries and periodontal disease risk.

Study procedure:

A total of 200 participants, 100 individuals each from rural areas and from urban areas were included in the present study. After administering the questionnaire, oral health examination using mouth mirror, No.23 dental explorer and WHO probe was performed under natural day light to assess the dental caries experience among the individuals in both groups using decayed, missed and filled teeth index (DMFT index).

In order to measure dental strength and to assess the structural integrity of a tooth teeth few tests were performed like visual inspection methods, percussion, mobility, bite, and heat and cold sensitivity test.

Visual Inspection: Carried under natural light using a mouth mirror and explorer to assess the tooth's external condition for any signs of wear or fractures, discoloration or decay, previous treatments if any, etc. signs of wear, fractures, cracks, or decay. Also looked for surrounding gum tissue health. All of these issues may in turn affect the strength of the tooth.

Simple Percussion Test: Carried out to evaluate the tooth's response to mechanical impacts, also assessing the presence of any inflammation or infections within the surrounding tissues using an instrument handle or finger. By gently tapping the coronal aspect of the tooth to find any signs or reactions by the patient pertaining to discomfort or pain. A positive response towards pain or discomfort suggests possible inflammation or infection in the pulp, questioning the tooth's strength and vitality. Usually, a healthy tooth should respond without any significant pain when subjected to external forces.

Tooth Mobility Test: To assess the tooth's stability and strength of supporting structures (periodontal ligaments and bone) using mouth mirror, explorer, or WHO probe. Using gentle pressure, the tooth was slightly moved in both horizontal and vertical directions and recorded the degree of mobility on a scale from Class 1 to 3 or slight to severe. For ex: Class 1 (Slight mobility): tooth can be moved slightly but not easily, Class 2 (Moderate mobility): tooth moves more visibly but remains stable and Class 3 (Severe mobility): tooth moves significantly and may be at risk of being lost. Increase in mobility may indicate weakened periodontal support or bone loss, directly impacting the strength of the tooth.

Bite Test (Using Cotton Roll or Chew Stick): To determine the tooth strength by pressure from biting or chewing forces using cotton roll or chew stick. By placing a cotton roll or chew stick on tooth or in the bite area and ask the person to bite down gently and observe for any pain, discomfort, or difficulty in biting. A tooth that responds to those forces with pain, discomfort, or inability to sustain biting pressure shows it may have compromised strength, due to many reasons like cracked or weakened enamel, infected pulp, or failed restoration.

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JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

Heat & Cold Sensitivity Tests: To assess the tooth's response to hot or cold stimuli, which can indicate pulp vitality or sensitivity by applying hot stimuli like heated gutta-percha or warm instrument and cold stimuli like ethyl chloride spray or ice cube on to the tooth's surface. When the level of discomfort or sensitivity was reported it indicates tooth sensitivity.

Responses were categorised as follows: Normal Response - Brief or mild discomfort that subsides once stimulus is removed. Positive Response - Prolonged, severe pain or discomfort could indicate compromised pulp (inflammation of pulp), which affects the overall strength and health of the tooth. It was made sure that the participants were always ensured for their comfort during the examination tests, and also were explained prior about the procedures to reduce the anxiety.

Descriptive statistics and comparative analyses using independent t-tests or chi-square tests were done using Statistical Package for Social Sciences software (SPSS) 20.0. Correlation analysis was performed between the two outcome variables dietary habits and oral health outcomes.

3. Results

The present study was conducted through a face-to-face interview survey among rural and urban populations. Mean age of the participants was 35.49±10.49 in the urban setting (51.5%) and 36.34+10.58 in the rural setting (48.5%) Fig.1 & 2. When the study participants were categorized based on gender and place of residence, it was found that 52.6% and 46.6% were males and 47.4% and 53.4% were females in both urban and rural settings respectively, showing that a majority of the participants were males in the urban setting and females in the rural settings.This study aimed to compare dietary patterns between rural and urban populations and analyse their effects on oral health, dental strength, and disease susceptibility. The following presents the key findings, including dietary differences, oral health outcomes, and disease susceptibility in both groups.

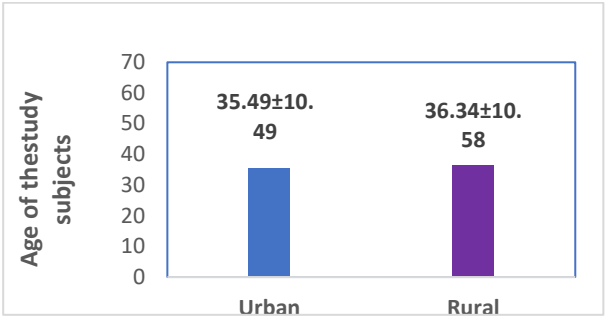

Fig. 1: Mean age of the study participants among both the groups

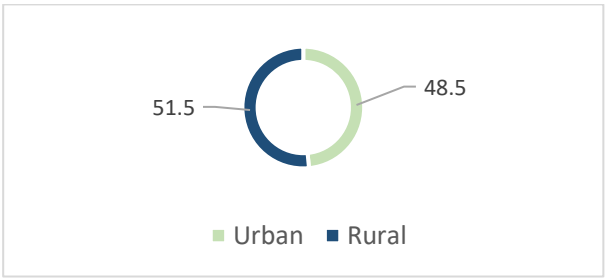

Fig. 2: Distribution of study participants among urban and rural population

Dietary Patterns in Rural and Urban Populations

When a total of 200 participants were screened for dietary practices, an analysis of the obtained findings revealed distinct differences in the food intake of both the populations. Some of the observations obtained from the interviews were as follow. The rural population predominantly consumed locally grown foods, such as fresh vegetables, and dairy products and a majority (45.4%) consumed twice daily meals. These foods were minimally processed, with a lower reliance on packaged and convenience foods. The average intake of sugars was 34% with a higher in between consumption (45.6%) among the rural diets compared to the counterparts, and the consumption of rice and vegetables was also significantly higher ($p < 0.01$) among this group.

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Question		Options	Urban	Rural
How many meals do you typically eat in a day or daily?		Once	7 (6.8%)	6 (6.2%)
		Twice	51 (49.5%)	44 (45.4%)
		Thrice	37 (35.9%)	41 (42.3%)
		Four	8 (7.8%)	6 (6.2%)
Do you consume snacks/sugars between the meals?		Yes	42 (43.3%)	47 (45.6%)
		No	14 (14.4%)	21 (20.4%)
		Sometimes	41 (42.3%)	35 (34%)
How often do you consume the following:	Fresh fruits	Never	45 (46.4%)	52 (50.5%)
		Daily	17 (17.5%)	10 (9.7%)
		Weekly	18 (18.6%)	9 (8.7%)
		Monthly	14 (14.4%)	15 (14.6%)
		Sometimes	3 (3.1%)	17 (16.5%)
	Processed foods	Never	75 (77.3%)	76 (73.8%)
		Daily	09 (9.3%)	7 (6.8%)
		Weekly	02 (2.1%)	3 (2.9%)
		Monthly	09 (9.3%)	7 (6.8%)
		Sometimes	02 (2.1%)	10 (9.7%)
	Sugary snacks	Never	36 (37.1%)	42 (40.8%)
		Daily	12 (12.4%)	7 (6.8%)
		Weekly	21 (21.6%)	28 (27.2%)
		Monthly	17 (17.5%)	19 (18.4%)
		Sometimes	11 (11.3%)	7 (6.8%)
	Fast foods	Never	53 (54.6%)	53 (51.5%)
		Daily	13 (13.4%)	9 (8.7%)
		Weekly	14 (14.4%)	12 (11.7%)
		Monthly	10 (10.3%)	19 (18.4%)
		Sometimes	07 (7.2%)	10 (9.7%)
How much water do you drink daily?		<1 litre	36 (37.1%)	44 (42.7%)
		1-2 litre	45 (46.4%)	39 (37.9%)
		>2 litre	16 (16.5%)	20 (19.4%)

Table 1: Distribution of study participants based on dietary habits

Question		Options	Urban	Rural
How often do you brush your teeth?		Once	8 (8.2%)	10 (9.7%)
		Twice	89 (91.8%)	93 (90.3%)
		Sometimes	0 (0%)	0 (0%)
		Never	0 (0%)	0 (0%)
Have you experienced any of the following dental issues in the past year?	Tooth decay	Yes	64 (66%)	63 (61.2%)
		No	33 (34%)	40 (38.8%)
	Gum bleeding	Yes	19 (19.6%)	19 (18.4%)
		No	78 (80.4%)	84 (81.6%)
	Tooth Sensitivity	Yes	5 (5.2%)	10 (9.7%)
		No	92 (94.8%)	93 (90.3%)
	Bad Breath	Yes	18 (18.6%)	16 (15.5%)
		No	79 (81.4%)	87 (84.5%)

Table 2: Distribution of study participants based on their responses about oral health

The urban population had lower intake of fresh fruits, processed foods, sugary snacks, fast foods, and carbonated soft drinks.

The sugar intake in the urban diet was approximately 23% lower than that in rural diets ($p < 0.05$). Additionally, it was also observed that there was a greater consumption of refined carbohydrates and a higher prevalence of low-fibre foods ($p<0.01$) among both the populations. Daily water intake consumption capacity (1-2 litres) was higher in urban. (Table. 1) More than 90% mentioned that they brush twice a day. In the contrary when they were asked about their previous experience of dental problems majority of them responded positively that they had issues with tooth decay in the past whereas only a few reported to be suffered with gum disease, teeth sensitivity and bad breath. (Table.2) When the study participants were asked about tobacco and alcohol consumption habits, majority (>80%) said that they do not consume any kind of tobacco or alcohol among both the groups. (Table.3)

Oral Health Outcomes: Oral health was assessed through clinical examinations focusing on dental caries, gum disease (gingivitis and periodontitis), and overall dental health.

Dental Caries: Significantly higher in the urban group, with 2% of urban participants showing signs of tooth decay, compared to 48% in the rural group ($p<0.01$). The average number of decayed teeth per participant was also higher in urban individuals (2.46±1.6) than in rural individuals (1.82±1.3, P=0.03). A mean DMFT score of 1.08+1.295 was found among the study participants, where a majority of the individuals had at least one teeth either decayed, missed or filled.

Questions	Options	Urban	Rural
Do you smoke?	Yes	6 (6.2%)	12 (11.7%)
	No	91 (93.8%)	91 (88.3%)
	Occasionally	0 (0%)	0 (0%)
Do you consume alcohol?	Yes	6 (6.2%)	9 (8.7%)
	No	80 (82.5%)	85 (82.5%)
	Occasionally	11 (11.3%)	9 (8.7%)

Table 3: Distribution of study participants based on lifestyle factors

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JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

Variables		Findings	Urban	Rural
DMFT (Caries experience)		0	27 (27.8%)	33 (32.0%)
		1	58 (59.8%)	51 (49.5%)
		2	6 (6.2%)	6 (5.8%)
		3	2 (2.1%)	5 (4.8%)
		4	1 (1.0%)	4 (3.9%)
		5	1 (1.0%)	1 (1.0%)
		6	2 (2.1%)	1 (1.0%)
		7	0 (0%)	1 (1.0%)
		8	0 (0%)	1 (1.0%)
Dental strength	Visual inspection test	Fractures or any other signs	26	13
	Percussion test	Positive	43	54
	Tooth mobility	Class 1	18	09
		Class 2	17	21
		Class 3	22	08
	Sensitivity to heat /cold	Present	31	22
	Bite test	Positive	21	08
Periodontal diseases		Yes	28 (28.9%)	32 (31.1%)
		No	69 (71.1%)	71 (68.9%)

Table 4. Distribution of study participants based on their oral health status

Dental strength: Other findings like tooth fractures, response to percussion test, tooth mobility, biting forces and heat/cold sensitivity were also assessed and the observations were presented in the Table 4. There were certain circumstances where these dental strength assessment tests were found positive in some of the participants which will have an effect on overall oral health of the individuals. Rural individuals had a higher average enamel integrity score (4.2 ± 0.8) compared to urban participants (3.5 ± 1.1, $p < 0.05$). Enamel erosion was more prevalent in the urban group (40%) than in the rural group (28%) ($p = 0.02$).

Gum disease: The prevalence of gingivitis was higher in urban participants (58%) compared to rural participants (42%) ($p < 0.05$). Periodontitis was also more common in urban areas, with 35% of urban participants exhibiting advanced periodontal disease compared to 22% in rural participants ($p < 0.01$). Rural participants showed healthier gums, with a lower plaque index (1.4 ± 0.6) compared to the urban group (2.0 ± 0.8, $p < 0.01$).

Disease susceptibility: The susceptibility to oral diseases, including tooth decay, gum disease, and enamel erosion, was significantly higher in the urban population.

Summary of key findings: Both the populations consumed more whole, unprocessed foods with moderate sugar content, refined carbohydrate, and processed food intake. Both the populations had an approximately similar incidences of dental caries, gum disease, tooth sensitivity and bad breath, which were associated with their diet and lifestyle factors. Both the populations had shown equally compared in terms of strength of enamel and fewer signs of tooth wear. Diets high in sugar and acidic foods were significantly associated with increased susceptibility to oral diseases, including tooth decay and periodontal conditions.

These findings underscore the significant impact of dietary patterns on oral health, with both the popular actions exhibiting better oral health outcomes primarily due to healthier dietary habits and lower exposure to processed foods and sugars.

4. Discussion

Present study provides a comparative analysis of the dietary patterns in the rural and urban areas along with their respective impacts on oral health, dental strength, and disease susceptibility. The study findings revealed minor disparities in diet patterns between both the populations, which indirectly contribute towards marked differences in dental health outcomes, particularly in terms of tooth decay, gum disease, and dental strength.

Dietary Differences Between Rural and Urban Populations

The diets in rural areas and urban areas were found to be more synonymous and reliant on traditional foods, often based on locally grown, minimally

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processed ingredients and carbohydrates. These findings were not much in consistence with previous studies that show urbanization leads to a dietary shift towards convenience foods and processed sugars, which are known to contribute to poor oral health [12-13].

The rural diet, rich in whole grains, fruits, andvegetables, tends to be lower in sugar and processed foods. Studies have shown that these dietary patterns are associated with lower rates of dental caries and periodontal disease [14] Whereas in a study conducted by F. Inchingolo et al [15] suggests that a vegetarian diet have a role in altering the oral health particularly regarding the periodontal health, tooth structure integrity and the oral microbiome. Moreover, the higher intake of acidic and sugary foods in rural diets supports the minor changes in enamel integrity and the oral health disease susceptibility synonymous with findings observed by F. Inchingolo et al [15] in contrary to the findings observed by Featherstone (2004) [16].

Impact on Oral Health

The rural populations who consume higher quantities of sugary drinks, show a lower incidence of dental caries, gum disease, and other oral health problems when compared to the urban counterparts. This is in contrary with the findings of other studies, which indicate that high sugar consumption leads to an increase in acid-producing bacteria in the mouth, resulting in enamel demineralization and tooth decay [17]

The occurrence of gum diseases was more prevalent in urban population (58%) in the present study. Whereas in a study conducted by Zhao et al (2018) [18] among rural populations, it was found that a diet higher in natural fibres, whole foods, and lower sugar content has been shown to reduce plaque buildup and lower the incidence of dental diseases. Research suggests that diet that includes calcium-rich foods like dairy and leafy green vegetables were helpful for maintaining strong teeth and bones [19]. But in the present study the diet consumption was not found up to mark with the literature, wherein if the said was followed it may help these populations to exhibit better overall dental health [20]

Dental Strength and Disease Susceptibility

Literature suggests that dietary habits are integral to the development and maintenance of dental strength. Nutrients such as calcium, phosphorus, and vitamins D and K play a crucial role in maintaining tooth enamel and bone health. Those populations that consume more natural and whole foods, usually benefit when they consume these at higher levels. Those individuals who tend to consume lower quantities of foods that were rich in nutrients and higher in sugars and acidic foods were more tend to have weaker dental structures and increased susceptibility to teeth decay and gum diseases [21-22].

Majority of the present study population do not have the habit of tobacco and alcohol consumption, so they were not exposed to these risk factors and their effects which may directly or indirectly exacerbate the impacts of poor nutrition on oral health [23]. If these individuals have also had these effects combined to their lifestyle practices, the burden could be more exacerbated on oral and general health.

Public Health Implications

The differences in diet and subsequent oral health outcomes among rural and urban populations have significant public health implications. This study suggests that interventions aimed at promoting better oral health that should focus not only on improving the dental hygiene but also need to address more on health dietary practices.

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Limitations and Future Research:

While this study provides important insights, it has certain limitations. The cross-sectional design does not allow for the establishment of causal relationships between diet and oral health outcomes. Future longitudinal studies and experimental research should explore how changes in diet over time influence general as well as dental health and disease susceptibility in both rural and urban populations. Furthermore, a more detailed examination of specific food groups, such as dairy products, fruits, and vegetables, and their impact on oral health would help refine the dietary recommendations, which can help the policy makers in taking rightful decisions.

Suggestions and future recommendations:

There is a need for targeted education on the importance of a balanced diet and its direct impact on oral health in both rural and urban areas. Outreach programs, provision of mobile dental services strategies to reduce sugar intake and improve dietary choices can benefit few populations on helping them accepting proper oral hygiene practices. Health campaigns need to encourage the reduction of sugars intake and consumption of nutrient rich diet, especially in areas where processed food consumption is high.

Additionally, improving access to dental care and educating communities about the links between diet and oral health is essential in both rural and urban settings. There is also a need for policy changes to regulate the marketing of sugary and processed foods, particularly to vulnerable populations such as children and low-income families

Policies need to address on preventive care, focusing on early diagnosis and treatment. Governments play a key role in implementing those policies that regulate the availability and marketing of sugary and processed foods. Nutritional guidelines and subsidies for healthy food options can help reduce the intake of harmful foods in both settings.

Further studies to explore the long-term effects of various diets on oral health in different socio-economic groups were needed.

This could provide deeper insights into the link between nutrition, oral disease prevention, and dental strength, offering more comprehensive solutions for improving oral health at both community and policy levels.

This study underscores the importance of considering both dietary habits and access to healthcare when addressing oral health disparities between rural and urban populations. By implementing multi-pronged strategies that include education, better healthcare access, and policy reforms, we can mitigate the negative impacts of diet on oral health and reduce disease susceptibility across these communities.

Conclusion

This comparative analysis of diets in rural and urban areas reveals significant differences in dietary patterns, which have a direct influence on oral health, dental strength, and disease susceptibility. Limited access to dental care, lack of awareness, inadequate oral hygiene practices and nutritional deficiencies that can impact oral health have also seen to influence the health of an individual. The results of the present study highlight the complex interplay between diet, lifestyle, and access to dental care in determining oral health outcomes.

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no specific grant from any funding agency in the public, commercial, or notfor-profit sector. Ethical approval This study protocol was approved by the Institutional Ethics Committee (IEC) of the institution with the protocol no: Pr.484/IEC/SIBAR/2024

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JCHR (2026) 16(2), 2267-2276 | ISSN:2251-6727

Data availability: The data supporting the findings of the study area available within the article and its supplementary material. Raw data of this study are available from the corresponding author, upon reasonable request.

Authors contribution: All the authors discussed the results and contributed to the final manuscript.

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