



## Epidemiology of Dental Caries among Adults in a Rural Area in India

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### ABSTRACT

**Background:** Data on epidemiology of dental caries of adults in rural India appear to be sparse.

**Objective:** The purpose of the study was to assess the oral health status and dental treatment needs of a rural Indian population.

**Materials and methods:** The study population consisted of 189 volunteer subjects with a mean age of  $34.9 \pm 14.2$  years and 54% males. Decayed, missing due to caries and filled teeth (DMFT) and tooth surfaces (DMFS) assessed the dental caries experience. Structured interviews collected data on perception of health including oral health, oral hygiene practices and snacking habits.

**Results:** While only 38.1% perceived themselves to be in good or very good dental health, nearly 85% felt the same about general health. The most common sugar exposure was sweetened tea; 75% consumed the beverage at least once a day. More than 80% of the subjects had untreated caries with mean DMFT and DMFS scores of  $5.1 \pm 3.9$  and  $13.8 \pm 17.8$ , which lacked any gender differences. Dental treatment needs ranged from 16.9% two-surface fillings to 60.8% one-surface fillings; 23.8% crowns or bridges and 37.6% extractions. Those who perceived themselves to be in better oral health had significantly lower DMFT ( $4.0 \pm 3.2$  vs  $5.9 \pm 4.1$ ) and DMFS ( $8.4 \pm 11.7$  vs  $17.1 \pm 20.0$ ) scores ( $p < 0.05$ ). A similar trend was observed between perception of general health and DMFT ( $4.8 \pm 3.4$  vs  $7.0 \pm 5.6$ ) and DMFS ( $11.9 \pm 13.7$  vs  $24.1 \pm 30.7$ ) scores.

**Conclusion:** Results indicate high levels of dental caries as well as dental treatment needs among the study participants.

**Keywords:** Dental caries, Rural, Treatment needs, Perception, Gender, Diet, Sugar.

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### INTRODUCTION

Dental caries is one of the most common chronic diseases among both children and adults; however, it can be prevented

by judicious choices of preventive practices. Over the last few decades a trend of declining caries in developed countries<sup>1,2</sup> and an increasing caries experience in developing countries<sup>3,4</sup> has been reported. India, too, has seen the increasing trend similar to that in the latter group of countries,<sup>5</sup> and the trend may continue in the future due to growing globalization. The globalization in turn, is bound to increase the availability of processed food items as well as sweets. The association between diet, particularly sucrose, and dental caries has been well-documented in cross-sectional, longitudinal and ecological studies.<sup>6-8</sup> Based on these findings, researchers have advocated limiting the annual sugar consumption to 15 kg per person, both in developing and developed countries.<sup>9,10</sup>

A majority of the epidemiological studies on dental caries in India has focused mainly on children rather than adults; the studies on adults living in rural areas appear to be even fewer and limited only to certain age groups. The prevalence rates of caries among rural adults in West Bengal, Orissa and Sikkim, aged 30 to 35 years, were 18.1, 24.5 and 20.1% respectively.<sup>11</sup> These study sites, however, may not be considered truly rural because they were only about 30 miles away from the urban centers. Patro and group<sup>12</sup> found a much higher prevalence of dental caries among a population from an urban settlement in New Delhi: 82.4% among 35 to 44 years old and 90.1% in those aged 50 years or more. Shah and Sundaram<sup>13</sup> found a prevalence rate of nearly 67% in a community-based elderly population from an urban area south of Delhi as well as four nearby villages. In another study of rural population, the dental caries prevalence rates ranged from 17.3% among 5 to 14 years old to 54.6% in those aged 55 and above.<sup>14</sup> In this study, however, nearly 58% of the population was more than 24 years old. The above studies, with the exception of the last one, were limited only to certain adult age groups, such as

the 30 to 35, 35 to 44 years or the elderly, and did not include the whole spectrum of rural adult age groups.

The distribution of dental caries has shown gender and socioeconomic differences as well as urban-rural variations.<sup>11,13,14</sup> Shah and group found a direct relationship between dental caries and education level, oral hygiene practices and methods, high levels of bacteria (*Strep. mutans*), and carbohydrate diet; higher socioeconomic status and higher literacy rates were inversely associated with the prevalence of dental caries.<sup>11</sup> Moreover, studies have found significant differences between rural and urban populations, with the latter group having higher prevalence and severity of dental caries.<sup>11,13</sup> The higher prevalence of caries in urban settings may be attributed to a higher intake of sticky and soft refined carbohydrates as opposed to rural populations who are more frequently exposed to foods that are natural, unrefined, coarse and rich in fiber.<sup>13</sup>

Combined effects of multiple factors such as fermentable carbohydrate diet, inadequate fluoride exposure, poor oral hygiene practices, etc. could compromise the dental caries status of rural communities. Dental caries is a chronic disease with its initial stages being painless; however, it causes increasing levels of pain as it advances through the dentin and closer to the pulp. Despite the early pain noticed through the progression of the carries, inaccessibility to dental care in rural areas of India and lack of awareness result in the majority of patients seeking episodic care, only after the symptoms have increased in severity.<sup>13</sup> The common tendency among many patients is to delay treatment until symptoms of caries have progressed to acute pulpitis or an abscess.<sup>16</sup> In this excruciating state, many patients then opt for extraction of the tooth to relieve the pain quickly and avoid any high expenses involving endodontic and restorative treatment. Shah and Sundaram demonstrated this trend with extensive caries treatment among 40.3% of their study sample who sought dental extractions as the only treatment option. Mandal and group, however, found that one or two surface fillings were the primary dental treatment need in their study of 2067 individuals aged 5 to 35 years, from West Bengal, Orissa and Sikkim.<sup>11</sup> High rates of dental extractions due to delayed dental treatment could be attributed to the differences between normative and perceived needs<sup>17</sup>, and symptoms of early stages of caries may not be very obvious to the subjects.<sup>18</sup>

Shah and Sundaram demonstrated that 60% of the elderly were unsatisfied with their masticatory status and function, and a high proportion did not follow adequate oral hygiene practices.<sup>13</sup> Despite the relatively high number of complications caused by dental caries, most patients in rural areas do not visit their dentists regularly and many still lack knowledge about proper oral hygiene techniques of cleaning teeth, such as the use of dental floss and mouthwash. Tewari

et al<sup>15</sup> found that 56% of the subjects cleaned their teeth with dattan (a native herbal method of cleaning teeth by chewing on branches from neem or bawar trees) in comparison to the 35% using a toothbrush. Among the relatively lower proportion using the toothbrush, only 25% brushed their teeth at least once a day.

Studies have shown a lack of health education, preventive services and adequate oral hygiene practices among the low income communities and rural areas.<sup>13,19</sup> In order to increase the general population's awareness of oral health, the phenomenon of inadequate dental health education must first be addressed. An understanding of the epidemiology of caries and levels of oral health awareness of the target population will also help us choose appropriate prevention and treatment strategies. Further, studies on perception of general as well as oral health among the rural populations also appear to be lacking. More than 70% of the population in India lives in rural areas<sup>20</sup> where there is a shortage of dental care providers and the infrastructure in the villages makes the availability and accessibility of dental care inadequate. Only about 25% of the dentists in India practice in rural areas where the dentist to population ratio is nearly 1:250,000.<sup>21</sup> The lack of public water supplies in the villages poses a huge barrier to fluoridating the drinking water. Other oral primary preventive programs are almost nonexistent in the villages, thus making oral diseases, such as dental caries an important public health problem. The purpose of this study was to assess the dental caries status and dental treatment needs, perception about health including oral health, oral hygiene practices and dietary habits among a rural Indian population.

## MATERIALS AND METHODS

The study sample of 189 volunteer subjects, aged 18 to 91, participated in this study while attending a dental clinic at the Bided Hospital in the rural village of Bidada, Kachchh (India). Kachchh is the largest district in the state of Gujarat in Western India and is surrounded by the Gulf of Kachchh and the Arabian Sea in the South and West. It consists of 966 villages; the village of Bidada is the location of one of the largest medical/dental health institutions in the district. Kachchh is one of the highly populated districts in India and the predominant group in the region is the Jains who follow Jainism which is one of the very old religions in India. Jainism preaches nonviolence toward all living beings. Cultural differences between Kachchh and other districts are mainly related to the rural aspects of the district; less westernized and less consumption of processed food. Bidada does not have a municipality and is governed by a 'gram panchayat system' in which the elected elders preside over the decision making process.

Each subject was assigned a numerical ID number to maintain privacy. The Institutional Review Board (IRB) at the university with which the authors are affiliated approved this study. Data were collected over a period of 13 days from the nearly 150 individuals who visit the dental clinic in Bidada daily. The inclusion criteria were that participants be above the age of 18 years and with a minimum of 10 natural teeth present. The study excluded those less than 18 years of age as well as with less than 10 natural teeth; no incentives were provided to the study subjects.

Structured face-to-face interviews collected data on demographics, oral hygiene practices, dietary habits and perception of overall health status including oral health. The perceived health status was coded on a scale of 1 to 5, ranging from very poor to very good. Supplementary information was accumulated on frequency of tooth brushing, the aides used to brush/clean teeth, exposure to sweet snacks and types and frequency of beverage consumption during the previous 24 hours. Sample questionnaire items included: ‘How many times did you clean your teeth yesterday? Which of the following drinks did you have yesterday and how many times? How many times did you have a sweet snack yesterday?’ While each interview lasted approximately 10 minutes and the clinical examination took 15 minutes.

One dentist utilizing the World Health Organization’s pathfinder survey methodology<sup>22</sup> conducted clinical examinations to assess the dental caries experience that was estimated by decayed, missing due to caries and filled teeth (DMFT) and tooth surfaces (DMFS). Additional information was collected about the dental treatment needs of each subject. Clinical data were first entered on modified WHO Oral Health Status paper forms, then entered into Excel, and subsequently exported to statistical package for social sciences (SPSS) for statistical analyses.

Statistical analyses consisted of descriptive and analytic/inferential phases; descriptive statistics for discrete variables are presented mainly in the form of percentages/proportions and frequency distribution. Means and standard deviations are the summary statistics for continuous, variables, such as age, sweetened beverage consumption and severity of dental caries as well as dental treatment needs. Descriptive data analyses for the questionnaire data are presented as frequency/percent distribution because a majority of them were categorical. Student’s t-test investigated any significant differences between mean decayed, missing due to caries and filled teeth (DMFT)/tooth surfaces (DMFS) scores and certain independent variables, such as gender, perception of health and dental health as well as the consumption of sweet drinks. Chi-squared tests assessed any gender differences in the caries prevalence and proportions of the study subjects

consuming sweetened tea. The significance level for the inferential tests, alpha, was set at less than or equal to 0.05.

## RESULTS

This study population consisted of 46% females with the mean age of  $34.9 \pm 14.2$  years. While only 38.1% perceived themselves to be in good or very good dental health, 84.6% of the subjects felt the same about their overall general health (Fig. 1). Thus, the proportion of subjects perceiving themselves to be in poor oral health was more than four times that of general health. As for oral hygiene practices, a majority of the study population, more than 80%, reported brushing their teeth at least once a day. Nonetheless, the use of the other oral hygiene aides was very low; less than 1% (0.5%) reporting the use dental floss and less than 2% (1.6%) using mouth rinse daily. Figure 2 illustrates the frequency of oral hygiene practices among the study subjects.

Table 1 presents the distribution of different beverages consumed by the study population during the previous

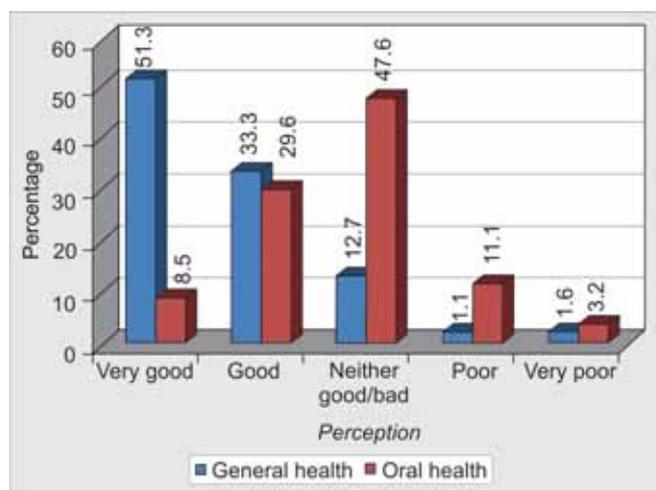


Fig. 1: Perception about general and oral health status among study participants

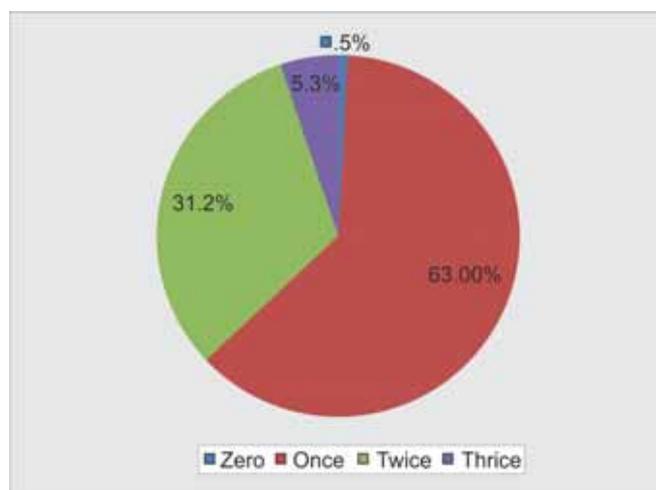


Fig. 2: Frequency of tooth cleaning during the previous 24 hours

24 hours. A variety of sweetened beverages were consumed by the participants from the rural area in India with the most common one being sweetened tea. Nearly 75% of respondents reported consuming this beverage at least once a day and on average the study participants consumed the sweetened tea almost twice a day ( $1.8 \pm 1.7$ ). A gender difference was observed in the sweetened tea consumption; a higher proportion of males (83.3%) drank sweet tea compared to females (65.5%), and the gender differences in the consumption of sweet tea was statistically significant ( $p = 0.005$ ). Similarly, the frequency of daily consumption of sweet tea was higher among males ( $2.2 \pm 1.9$ ) than females ( $1.3 \pm 1.3$ ), and the difference in the mean daily exposure to the beverage was also statistically significant ( $p = 0.001$ ).

The prevalence of dental caries among this rural Indian population, defined by an individual having at least one untreated carious lesion, was 87.8%. The severity of dental caries expressed as mean DMFT and DMFS scores were  $5.1 \pm 3.9$  and  $13.8 \pm 17.8$  respectively. No gender difference

was observed either in the prevalence (86.8% males and 89.7% females) or the severity of dental caries. The differences in the dental caries severity scores between males and females denoted by DMFT ( $5.0 \pm 3.7$  vs  $5.4 \pm 4.1$ ;  $p = 0.5$ ) and DMFS ( $12.3 \pm 16.7$  vs  $15.5 \pm 19.0$ ;  $p = 0.2$ ) scores were not statistically significant (Table 2). The caries prevalence and severity by age are also shown in Table 2; while in general significant differences in DMFT and DMFS scores were observed among different age groups ( $p = 0.0$ ), the differences in caries prevalence was not statistically significant. The difference in DMFT scores between the 31-40 and 41-50 years, however, was also not statistically significant ( $p = 0.9$ ).

The extent and severity of dental treatment needs among the study participants are shown in Table 3. Dental treatment needs of the subjects ranged from 16.9% two-surface-fillings to 60.8% one-surface fillings; 23.8% of the population needed crowns or bridges and 37.6% needed extractions. The severity of dental treatment needs ranged from 0.4 two-surface fillings per person to almost 2.0 one-surface fillings, and the proportion of D/DMFT among the study sample was 56.4%. Thus, the decayed component contributed to more than one-half of the DMFT score.

Table 4 illustrates the relationship between the perception of health status including oral health and dental caries experience. Those who perceived themselves to be in better oral health were found to have significantly lower DMFT ( $4.0 \pm 3.2$  vs  $5.9 \pm 4.1$ ;  $p = 0.004$ ) and DMFS scores ( $8.4 \pm 11.7$  vs  $17.1 \pm 20.0$ ; 0.001). A similar trend was also observed between the positive perception of general health and DMFT ( $4.8 \pm 3.4$  vs  $7.0 \pm 5.6$ ) as well as DMFS ( $11.9 \pm 13.7$  vs  $24.1 \pm 30.7$ ) scores ( $p = 0.001$ ). The prevalence of dental caries, however, was not significantly different between those who perceived themselves to be in better general and oral health compared to the cohorts who perceived themselves to be in poorer general and oral health.

**Table 1:** Distribution of certain beverage and sweet snack consumption by the study participants during the previous 24-hour period (n = 189)\*\*

Beverage	n	Proportion (%)	Mean
Regular sodas/colas	5	2.6	$0.1 \pm 0.4$
Fruit juices	4	2.1	$0.02 \pm 0.1$
Coffee with sugar	9	4.2	$0.1 \pm 0.3$
Tea with sugar	142	75.1	$1.8 \pm 1.7$
Plain milk	56	29.6	$0.4 \pm 0.7$
Sweet snacks	57	30.1	$0.4 \pm 0.6$

\*\*This is a multiple-response item

**Table 2:** Prevalence and severity of dental caries by age and gender among the study sample

Age in years (n)	Prevalence (%)	DMFT	DMFS
Total (n = 189)	87.5	$5.1 \pm 3.9$	$13.8 \pm 17.8$
Gender (n)			
Male (102)	86.8	$5.0 \pm 3.7$	$12.3 \pm 16.7$
Female (87)	89.7	$5.4 \pm 4.1$	$15.5 \pm 19.0$
18-20 (21)	60.8	$3.9 \pm 2.6$	$5.3 \pm 3.4$
21-30 (72)	16.9	$4.1 \pm 2.7$	$7.6 \pm 5.7$
31-40 (42)	23.8	$5.6 \pm 3.4$	$12.5 \pm 11.3$
41-50 (28)	23.3	$5.6 \pm 4.3$	$18.1 \pm 19.7$
>50 (26)	37.6	$7.9 \pm 5.8$	$35.4 \pm 31.3$

**Table 3:** Prevalence and severity of dental treatment needs among the study sample (n = 189)

Treatment need	n	Prevalence (%)	Mean
One-surface fillings	115	60.8	$1.8 \pm 2.2$
Two-surface fillings	32	16.9	$0.4 \pm 0.9$
Crown/bridge	45	23.8	$0.6 \pm 1.3$
Abutment	44	23.3	$0.6 \pm 1.3$
Extraction	71	37.6	$0.6 \pm 1.8$

**Table 4:** Relationship between dental caries experience and perception of health among the study participants (n = 189)

	General health		p-value*
	Good	Poor	
Prevalence (%)	78.4 (129)	81.3 (24)	0.6
DMFT	$4.8 \pm 3.4$	$7.0 \pm 5.6$	0.004**
DMFS	$11.9 \pm 13.7$	$24.1 \pm 30.7$	0.001**
	Oral health		p-value
	Good	Poor	
Prevalence (%)	81.0 (58)	80.2 (94)	0.6
DMFT	$4.0 \pm 3.2$	$5.9 \pm 4.1$	0.001**
DMFS	$8.4 \pm 11.7$	$17.1 \pm 20.0$	0.001**

\*p-value for independent sample t-test

\*\*Significant at  $p \leq 0.05$

The differences in dental treatment needs between the positive and negative perception of health status including oral health are shown in Table 5. In general, there were no significant differences in the need for simple restorative procedures between those who perceived themselves to be in better health and those who did not; a similar trend was seen for the perception of oral health as well. The need for dental extractions, however, was significantly higher among those who perceived themselves to be in poor general health ( $1.7 \pm 3.6$  vs  $0.6 \pm 1.2$ ) as well as poor oral health ( $1.0 \pm 2.2$  vs  $0.4 \pm 0.7$ ) compared to those with better perception of their health status including oral health ( $p < 0.05$ ).

**Table 5:** Relationship between dental treatment needs and perception of health/oral health among the study participants (n = 189)

	General health		p-value*
	Poor (n = 29)	Good (n = 160)	
One-surface fillings	1.3 ± 1.7	1.7 ± 2.2	0.3
Two-surface fillings	0.2 ± 0.5	0.3 ± 0.6	0.5
Crowns	1.0 ± 1.4	0.6 ± 1.4	0.2
Abutment	1.3 ± 2.9	0.4 ± 1.0	0.003**
Extraction	1.7 ± 3.6	0.6 ± 1.2	0.003**
	Oral health		p-value*
	Poor (n = 117)	Good (n = 72)	
One-surface fillings	1.7 ± 2.1	1.6 ± 2.0	0.8
Two-surface fillings	0.3 ± 0.6	0.2 ± 0.6	0.7
Crowns	0.8 ± 1.6	0.5 ± 1.0	0.2
Abutment	0.7 ± 1.8	0.4 ± 0.8	0.2
Extraction	1.0 ± 2.2	0.4 ± 0.7	0.002**

\*p-value for independent sample t-test

\*\*Significant at  $p \leq 0.05$

## DISCUSSION

The present study is one of the few studies that have investigated the epidemiology of dental caries among adults in rural India. The caries prevalence as well as dental treatment needs in the rural areas was quite high; prevalence of 87.8% and more than 60% of the study sample needed restorative treatment on at least one tooth surface. The high levels of caries in rural areas are consistent with results from previous studies,<sup>12-14</sup> and reiterate the burden of oral diseases among the rural communities in India. Thus, the need for oral health promotion as well as improved accessibility to dental care are quite paramount, particularly in light of increasing globalization which may result in an increased availability of fermentable carbohydrates including sweets, to the rural populations. Greater availability of sweets is bound to exacerbate the existing high levels of oral diseases. The high level of dental caries in the study population is dynamic and could be attributed to factors such as inadequate awareness of oral health, poor oral hygiene

practices and consumption of sweetened beverages. Our study confirmed the findings of Powell's et al<sup>23</sup> who found a significant difference in the consumption of sweet beverages by males and females. A high proportion of the current study sample drank sweetened tea, the most popular sweetened beverage, at least once a day. Males not only consumed the beverage more often than females, but also had a higher general intake of other sweet beverages.

A significant relationship was found between caries and perceptions of health with nearly 62% of the population identifying themselves to be in poor or very poor oral health. The low perception of oral health confirms the findings of a study by Shah in which 60% of the subjects surveyed were dissatisfied with their oral health status and function.<sup>13</sup> In our study, individuals who had a superior perception of both oral health as well as overall general health were in fact found to be in better oral health status indicated by lower DMFT and DMFS scores. Further, those with a negative perception of general and oral health had a greater need for dental extractions, which reiterates the concept that subjects perceive the need for dental care only in very late stages of dental diseases.<sup>17</sup>

The present study did not observe any significant gender differences in either caries prevalence or severity, and thus confirmed the findings by Shah.<sup>24</sup> Findings from the present study, however, differ from that of Rao et al<sup>25</sup> wherein females presented significantly with a greater number of sound teeth than males and that males had a greater number of missing teeth because of caries and periodontal diseases. Rajaratnam and group also found that the prevalence of dental caries was higher among females than males,<sup>14</sup> and attributed it to less frequent dental visits by females. The lower frequency of dental visits by women could be due to an increased fear and anxiety of dental treatment.<sup>26</sup> Powell et al found a higher caries rate among males, which was not necessarily because of etiologic factors, but because of a difference in overall health practices and lifestyle compared to females.<sup>23</sup> Other studies have also confirmed the phenomenon of men having higher dental caries experience than females.<sup>27</sup> The increased risk for oral diseases in women is attributed to lack of adequate prenatal care, domestic violence and stress of care giving.<sup>28</sup> Women are also believed to have a higher lifespan than men, perhaps resulting in a greater number of chronic health diseases and intake of relatively more medications, which also might have an influence on their oral health.<sup>29,30</sup> The equivocal findings of dental caries experience between males and females warrant further research.

Refined carbohydrate diet, along with high Mutans streptococci levels are important etiological factors of dental caries.<sup>13</sup> One way of reducing the number of bacteria in the

oral cavity is to keep the teeth clean and free of plaque. While the present study did not assess the bacterial counts in the oral cavity of the participants, we did find that oral hygiene practices in the rural population were inadequate. Although more than 80% of the population reported brushing their teeth at least once a day, very few used any other oral hygiene aides such as dental floss or mouth rinse to clean their teeth. This most common method of oral hygiene practice—toothbrushing was confirmed by Shah's study where 65.4% of the elderly subjects used toothbrushes and toothpaste to clean their teeth.<sup>13</sup> Tewari et al, however, found that only 35% of the individuals used a toothbrush to clean their teeth.<sup>15</sup> The use of dattan and other native alternatives to clean the teeth were used by a small proportion of the subjects in our study, which is much lower than the 56% found in the study done by Tewari et al.<sup>15</sup> The proportion of respondents reported using a tooth brush in our study, however, was higher than that from previous studies<sup>13-15</sup> and could be attributed to temporal variation. The observed differences among the various studies could be due to regional as well as sampling variations and reporting bias. The high usage of toothbrushes in the present study could be construed as an increased awareness of oral hygiene practices and oral disease prevention among the study sample. The improved awareness and preventive practices, however, did not result either in a lower prevalence or decreased severity of dental caries.

Findings of this study need to be interpreted with caution because of certain inherent limitations. The study population includes a group of volunteer subjects attending a dental clinic, which might have introduced certain level of selection bias. The age range of the study sample was quite large with relatively few subjects in certain age subgroups. Oral hygiene practices were assessed from self-reports and no oral hygiene index was utilized in the study. The gender distribution of the study sample, however, was similar to that of the city of Bidada; we had 54% males in the study compared to 50.6% in the city. Despite the limitations, this is one of the few studies on rural adults in India and also one of the first in this region.

Results of the present study indicate high levels of dental caries as well as dental treatment needs among a rural Indian population. Dental caries levels were found to be associated with higher sweetened tea consumption and negative perception of oral and general health. The high prevalence of caries and levels of dental treatment needs, including extractions, show that the population in rural areas is not receiving adequate dental care. The findings reiterate the urgent need for prevention and treatment programs. The study subjects appear to be not knowledgeable of the consequences of delaying dental treatment and also unaware

of the early signs of dental caries. Health education is one of the keys to prevention of dental diseases and early dental visits are imperative for better oral health. Prevention of oral diseases in the rural areas is not an immediate goal, and long-term preventive and treatment strategies need to be implemented. Therefore, children, youth and adults in rural areas should be made aware of the basic concepts of dental disease prevention so, that they can continue to practice optimal oral hygiene practices throughout their respective lives.

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