

Oral Hygiene Status, Knowledge, Perceptions and Practices among School Settings in rural South India

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Abstract

Aims: To assess oral hygiene knowledge, perceptions and practices, and assess oral hygiene status among school settings in rural Chennai, India.

Methods: A pilot cross sectional study was done during August-September, 2013 in a rural school in Chennai, South India. A convenient sample of 100 secondary (6-8 standards) and higher secondary (9-10 standards) school students was taken. A modified version of previously validated questionnaires was used to gather information on socio-demographic characteristics; oral hygiene knowledge, perceptions and practices; oral health utilization and perception on impacts of oral health on daily life. Oral Hygiene Index- Simplified (OHI-S) was used to assess oral hygiene status.

Results: Average age of participants was 13 years with 50% of participants being females. Nineteen per cent knew that teeth had to be cleaned with toothbrush and toothpaste. Seventeen per cent brushed twice a day. Females had more knowledge, perceptions, and practices than males ($p < 0.05$). Gender ($p < 0.05$), self-reported oral health perceptions ($p < 0.05$), tooth brushing ($p < 0.001$) and flossing ($p < 0.001$) practices, use of fluoridated toothpaste ($p = 0.006$), chewing sugar-based gum ($p < 0.05$) and drinking milk with sugar ($p < 0.05$) were significantly associated with oral hygiene knowledge. A relative majority (45%) of the participants had fair oral hygiene and this was significantly associated with school grade ($p = 0.001$).

Conclusions: Oral hygiene knowledge, status, and eating patterns were inversely associated with the school grade. There is an urgent need to enhance oral health and hygiene practices at an early schooling. A multipronged, multilevel public health intervention integrating oral health into the school curriculum beginning early schooling is needed.

Key Words: Oral health, Oral hygiene, Oral Hygiene Index, School, Rural

Introduction

Oral diseases have been a persistent public health problem globally, with almost every individual experiencing poor oral health at least once in their lifetime [1,2]. Oral health is a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity [3,4]. Oral health affects the general health, well-being, education and development of children and their families [5], and diminishes the quality of life [2,3]. Chronic oral infections can pose a risk for diabetes, cardiovascular diseases like stroke, respiratory diseases, low birth weight, preterm births [1,4].

Oral conditions affect 3.9 billion people globally; the global burden of which increased 20.8% from 1990-2010 [6]. Untreated caries in permanent teeth was the most prevalent condition followed by severe periodontitis and untreated caries in deciduous teeth [6]. Dental caries affects 60-90% of school-age children and most of the adults. Periodontal disease is prevalent in 50-90% of adults, becoming severe in 10-15% of them, while gingival diseases occur in majority of children and adolescents [1,7]. Oral disease burden is significantly higher among poor and disadvantaged population with an increase in developing countries [1]. Globally, poor oral hygiene occurring due to increasing plaque and calculus deposits with increasing age have been reported among children and adolescents [8-10]. In India, dental caries affects more than four fifths of children (6-19years) [1]. Prevalence of periodontal diseases ranges from 55% in adolescents to 80% in adults [11]. Only a minor proportion of Indian school

going children have good oral hygiene compared to larger population among developed countries [12,13]. Though no significant gender differences exist, rural areas experience higher rates of dental diseases compared to urban counterparts with similar trends in South India [1].

Personal and professional plaque removal, and professional calculus removal have been extensively accepted for prevention of gum diseases [14]. Stannous fluoride dentrifices have shown significant reductions in plaque, gingivitis, and gingival bleeding [15]. Dental caries and periodontal diseases can be effectively prevented by plaque removal, which serves as a standard to evaluate oral hygiene [2,6,16]. These in addition with routine recommended oral self-care [17,18] may be determined by socio-cultural factors, inadequate or improper use of fluoride containing products, poor oral health and hygiene knowledge, and lacking infrastructure that significantly hamper screening of oral diseases, especially in rural areas [1].

Oral health promotion through schools is recommended by the World Health Organization (WHO) for improving knowledge, attitude, and behaviour related to oral health and for prevention and control of dental diseases among school children [19]. In India, the National Oral Health Programme, initiated in 1999, consists of School Dental Programme to impart awareness about good oral habits at school targeted at children aged 9-14 years [20], including teachers and parents. National Rural Health Mission's School Health Programme includes an oral health awareness programme for children and also an oral/dental screening programme for early identification and prevention of oro-dental problems [21]. School

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oral health interventions have been shown to improve oral health and oral health related behaviour among adolescents [8]. However, the scenario is glum with lacunae in implementation of school dental programmes in India [22]. A study from Mumbai has demonstrated the low oral health-related knowledge, attitude and practices among students of both public and private schools. Government schools, in particular, lack the services of regular health professionals due to inadequate funds [23]. Oral health practices of junior secondary school students (9-15 years) has been said to 'reveal the nation's progress in promoting oral health' [2]. Surveys indicate that in spite of better tooth brushing behaviours, more children and adolescents had gingival inflammation, plaque and calculus accumulation when compared to 10-20 years back [24]. Since presence of plaque and gingivitis in these ages determine the periodontal health at later ages, such research has the potential to indicate future health of this population. However, though trends in dental caries among children and periodontal disease on adults abounds, information on oral hygiene and periodontal health of children and adolescents [24], and oral health attitudes and behaviour, especially from low- and middle-income countries [12,13,24] especially in rural areas [19], is lacking where mass oral health awareness has been reported to be low [1].

Aims: The aims of the study were

- (1) To assess the oral hygiene knowledge, perceptions and behaviour and;
- (2) To assess the oral hygiene status of students of secondary and high school children in rural Chennai, South India.

Methods

A pilot cross sectional study was performed by enrolling children from school in a rural setting of Chennai. The public schools were selected based on proximity from the medical college and willingness to participate in the study. Two schools were included in the study; one boys' and one girls' school. A total of 6 (3 boys' and 3 girls') schools were contacted and invited to take part in the study. Out of 6 schools, 4 (3 boys' and 1 girls') schools agreed to participate in the study and 2 schools (girls') declined to participate in the study. Only one girls' school agreed to participate in the study and was included. Of the 3 boys' schools, one school was randomly chosen to be included in the study.

A convenient sample of 100 children was enrolled during the period of August, 2013. Students aged 10-16 years, studying in grades 6-10 and residing in a rural setting and enrolled in a school that was located in a rural setting were included. Students denying giving assent and consent from their parents were excluded. In addition, those children who were either mentally or physically challenged were excluded from the study. The sample was chosen by simple random technique. From each of the schools, 50 students were selected, thus maintaining equal gender representation. This was achieved by the following: From each of the schools, the eligible students were assigned numbers and 10 students from each of the 5 grades were chosen by simple random technique in order to achieve the sample of 100. The study protocol (IRB#FHTS/033/2013) was approved by the IRB of the Foundation of Healthcare Technologies Society, New Delhi. Written informed consent from parents and written assents from children were obtained before enrolling the participants in the study. Confidentiality was maintained using unique identification codes for each of the participants.

Data collection

The questionnaire (Appendix) was a modified version of validated

questionnaires used to assess the oral health of children [24-27]. Oral hygiene status was assessed using the Oral Hygiene Index-Simplified by a suitably qualified dentist in daylight using a No. 5/ Shephard's hook explorer [7,24]. The variables information that was gathered included the following:

Socio-demographic characteristics: Information was gathered about age (years), gender, type of family, total number of household members, annual household income in Indian National Rupees, grade/class of study and guardian's occupation.

Knowledge, perceptions and practices regarding oral health and hygiene: Participants' knowledge was gathered about tooth cleaning; brushing and dental problems as well as question were asked for practices of oral health. Questions were asked to ascertain oral health and hygiene including self-perceived oral health, visits to dentists. Perception on impact of oral health on daily activities and information on oral hygiene practices was also gathered.

Eating patterns and oral health utilization: Information about the consumption of food items including fresh fruits, solid refined carbohydrates and sugars, semi-solid sugar-based food, sugar-based liquids and sugar-based chewing gum was gathered. Oral health utilization was also assessed.

Assessment of Oral Hygiene Status

Oral hygiene was assessed using the Oral Hygiene Index-Simplified by examination of debris, stains and calculus on specific surfaces of 6 index teeth. The surfaces examined were buccal surfaces of maxillary first permanent molar and right central incisor teeth and lingual surfaces of mandibular first permanent molar and left central incisor teeth. For the posterior teeth, the first permanent molar, or in its absence the second permanent molar was examined. In the absence of permanent molars, the first, or, in its absence, the second primary molar was assessed for oral hygiene. For the anterior teeth, the upper right and lower left central incisors were examined, in the absence of which, the adjacent central incisors were used.

Examination procedure

Oral examination of the children was carried by seating the students on a chair in daylight. The scores for oral debris were given as per the following scale: 0 (No debris or stain present), 1 (Debris covering <1/3 of the tooth surface or extrinsic stain without debris), 2 (Debris covering between 1/3 and 2/3 of the tooth surfaces), 3 (Debris covering >2/3 of the tooth surfaces). Oral calculus scores was accordingly given as: 0 (No calculus present), 1 (Supragingival calculus present covering <1/3 of the tooth surface), 2 (Supragingival calculus covering between 1/3 and 2/3 of the tooth surface, or scattered sub gingival calculus), 3 (Supragingival calculus covering >2/3 of the tooth surface, or, a continuous heavy band of sub gingival calculus around the teeth).

Scores were calculated separately for Debris Index (DI) and Calculus Index (CI). For both the indices, scores of individual teeth were summed. This sum was divided by the total number of teeth examined, thus giving a Debris Index (DI) and Calculus Index (CI). The DI and CI added together gave the Oral Hygiene Index-Simplified (OHI-S) [7,24].

Statistical analysis

Descriptive analysis was performed using univariate statistics to report means and standard deviations for the continuous variables and frequency distribution for the categorical variables. Correlation coefficient, t statistics and ANOVA were performed to compare

differences in the continuous variables. Multivariate regression analysis was also performed. Chi square and Fisher analyses were performed to compare the frequency of categorical variables. All analysis was performed using SPSS v. 16.

Results

A total of 100 students from rural school in Chennai participated in the study. Mean age of the participants was 13 years (SD=1.3). Half of the participants were females (50%, n=50) (Table 1). Majority of the participants lived in nuclear families (85%) with an average family size of 5 (SD=1), were studying in grade 5 to 8 (40%, n=40). Forty per cent of the fathers were skilled workers compared to 15% of the mothers. The school did not have a dentist. No oral health education was provided to students as reported by majority of the study participants (71%). Mean annual household income was 46,188 (SD=21,208) Indian National Rupees (INR).

Most of the students (97%, n=97) used tooth brushing to clean their teeth (Figure 1). All female (100%, n=50) and 94% (n=47) of male participants used tooth brush for cleaning teeth. Less than one fifth of the participants (females: 18%, n=9; males: 6%, n=3) used dental floss. Most of the female participants (18%, n=9) used

plastic toothpicks compared to male participants (2%, n=1) which was significant (p=0.007).

Knowledge: Most of the participants knew that toothbrush (96%) and toothpaste (90%) should be used for cleaning teeth (Table 2). More than half of the participants knew that teeth should be brushed twice a day (52%, n=52) and in the morning and night (51%, n=51). Majority of the study participants (82%, n=82) did not floss their teeth and about half (47%) of the participants did not know about flossing the teeth.

Perception: Thirty six per cent of the participants perceived that dental health can affect general health and equal number of participants believed it did not. Most of the participants (56%) perceived that their teeth and gums were in good or better health, while about one third perceived it to be average or less than average. Half of the participants were unaware of the frequency of dental visits to be made. Forty six per cent perceived that a dentist should be visited whenever there is a problem; majority of the participants being those who perceived their oral health status to be very good (n=61%, n=14) and perceived dental health to affect general health (56%, n=20). Among those participants who would regularly (once in 6 months) visit a dentist (4%, n=4), all of the participants (100%, n=4) perceived their oral health to be good/very good, and majority (75%, n=3) of the participants believed that dental health can affect general health.

Perceptions on Impacts of Oral health on Daily Activities: Majority of the participants perceived that oral health did impact daily activities. Participants studying in lower grade perceived oral health to impact all daily activities, especially eating (p=0.001), cleaning teeth (p=0.007), speaking (p=0.001) and smiling (p=0.011) which were significant. Female participants (60%) perceived oral health to significantly impact relaxing/ sleeping (p=0.012).

Practices: Sixty three per cent (n=63) of participants brushed once a day and 17% (n=17) brushed twice or more a day. Fifty four per cent (n=54) of participants did not know if they used a fluoridated toothpaste. One third of the participants who knew about fluoridated toothpaste used it. Sixty nine per cent (n=69) did not know the manner in which they brushed their teeth.

Among solid food, refined carbohydrates were among the most consumed (45%) several times a day followed by fresh fruits (35%) and sweets/candy/burfi (milk and sugar- based sweet)/gajak (sweet containing jaggery and peanuts) (33%). More than half (55%) of the participants consumed jam/honey once or more in a day (Table 3). Milk with sugar was the most frequently consumed sugar-based liquid food (several times a day; 55%) followed by tea with sugar (several times a day, 50%) and lemonade/shakes/soft drinks. None of the participants reported to have tea without sugar. Sixty nine per cent of the participants chewed sugar-based gum once or more in a day. None of the participants reported to use tobacco, either smoking or smokeless, or consume alcohol. Majority of the participants (93%) reported no teeth-related sickness absenteeism in the past month. Female participants consumed refined carbohydrates and sugar-based solids more frequently than males; this behaviour found to be significant (Biscuits: p=0.011; Sweets: p=0.017; Lemonades: p=0.012). Lower grade participants consumed sweets (p=0.013) and tea with sugar (p=0.025) more frequently than higher grade participants.

Results show that 36% of the participants had some tooth-related problem in the last 12 months (Table 4). Thirty eight per cent of the participants experienced it sometime in the last 12 months, while 22

Table 1. Socio-Demographic Characteristics.

Socio Demographic Variables	Results
Age (Years)	Mean=13; SD=1.3
Gender,	
Males	50% (n=50)
Females	50% (n=50)
Family structure	
Nuclear	85% (n=85)
Joint	11% (n=11)
Extended	4% (n=4)
Average household members	Mean=5; SD=1
Highest Education status	
Grade 6-8	60% (n=60)
Grade 9-10	40% (n=40)
Occupation of mother	
Unemployed	61% (n=61)
Skilled Professional	15% (n=15)
Unskilled	24% (n=24)
Occupation of father	
Unemployed	6% (n=6)
Skilled Professional	40% (n=40)
Unskilled	53% (n=53)
Don't know	1% (n=1)

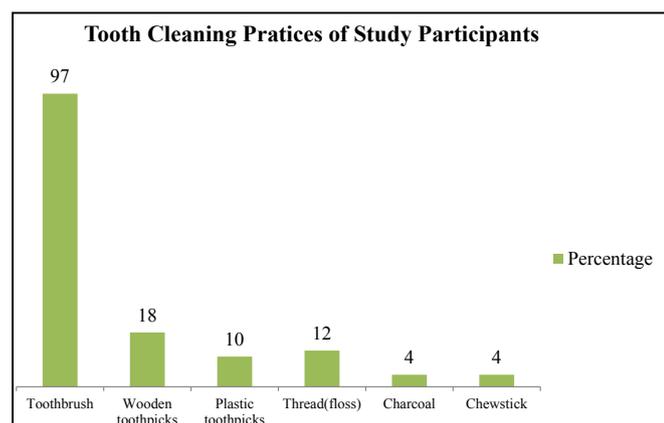


Figure 1. Tooth cleaning practices of study participants.

Table 2. Knowledge, perceptions and practices of oral hygiene among study participants.

Variables		Results (%)	
Knowledge			
What should be used for cleaning teeth? *			
Finger		4 (n=4)	
Toothbrush		96 (n=96)	
Neem stick		5 (n=5)	
How many times should you brush in a day?			
Once		47 (n=47)	
Twice		53 (n=53)	
When should one brush teeth?			
Morning and night		52 (n=52)	
Morning only		48 (n=48)	
Should one floss their teeth?			
Don't Know		47 (n=47)	
No		35 (n=35)	
Yes		18 (n=18)	
Perceptions			
Do you think dental problems can affect general health?			
Yes		36 (n=36)	
No		36 (n=36)	
Not sure		28 (n=28)	
How often should one visit a dentist?			
Regularly		4 (n=4)	
Whenever there is a problem		46 (n=46)	
Don't know		50 (n=50)	
How would you describe the health of your teeth and gums			
Poor		6 (n=6)	
Average		24 (n=24)	
Good		33 (n=33)	
Very good		17 (n=17)	
Excellent		6 (n=6)	
Don't know		14 (n=14)	
Oral health impact on daily activities*	Yes (%(n))	No (%(n))	Not sure (%(n))
Eating	56 (56)	26 (26)	18 (18)
Cleaning teeth	56 (56)	24 (24)	20 (20)
Speaking	51 (51)	32 (32)	17 (17)
Smiling	47 (47)	26 (26)	17 (17)
Emotional	45 (45)	36 (36)	19 (19)
Relaxing/Sleeping	44 (44)	35 (35)	21 (21)
Doing School work	46 (46)	39 (39)	15 (15)
Social contact	46 (46)	34 (34)	20 (20)
Practice			
How do you brush your teeth?			
Left to right, horizontal direction		23 (n=23)	
Up and down circular motion, involving gums		8 (n=8)	
I Don't know		69 (n=69)	
How often do you clean your teeth?			
Once a day		63 (n=63)	
2 or more times a day		17 (n=63)	
Never		13 (n=13)	
Several (2-3) times a month		5 (n=5)	
Once a week		1 (n=1)	
Several (2-6) times a week		1 (n=1)	
Do you use toothpaste containing fluoride?			
Yes		31 (n=31)	
No		14 (n=14)	
Don't know		54 (n=54)	
Don't use toothpaste		1 (n=1)	

*Multiple responses

% did not know about it. Seventy two per cent of the participants did not go to dentist in last 12 months or did not remember.

The average score of Debris Index was higher (Mean=1.67,

SD=.76) compared to Calculus Index (Mean=1.06, SD=.91) (Figure 2). Mean OHI-S score was 2.73 (SD=1.42). Majority of the participants (45%, n=45) had fair oral hygiene status with an average

Table 3. Eating patterns of study participants.

How often do you eat or drink any of the following foods, even in small quantities?	Several times a day (% (n))	Every day (% (n))	Several times a week (% (n))	Once a week (% (n))	Several times a month (% (n))	Never (% (n))
Fresh fruit	35 (35)	23 (23)	18 (18)	17 (17)	5 (5)	2 (2)
Biscuits, cakes, cream, cakes, wafers, buns, bread etc	45 (45)	20 (20)	17 (17)	12 (12)	4 (5)	2 (2)
Lemonade, Mango shake, Cola or other soft drinks	33 (33)	25 (25)	17 (17)	13 (13)	8 (8)	4 (4)
Jam/ Honey	31 (31)	29 (29)	14 (14)	13 (13)	9 (9)	4 (4)
Chewing gum containing sugar	50 (50)	19 (19)	9 (9)	9 (9)	8 (8)	5 (5)
Sweets/Candy/Burfi/Gajak	33 (33)	22 (22)	16 (16)	14 (14)	12 (12)	3 (3)
Milk with sugar	55 (55)	25 (25)	12 (12)	5 (5)	2 (2)	1 (1)
Tea with sugar	50 (50)	36 (36)	6 (6)	4 (4)	4 (4)	0

Table 4. Oral Health Utilization among study participants.

Variables	Results (% (n))
How often during the past 12 months did you have toothache or feel discomfort on account of your teeth?	
Never	36 (36)
Rarely	29 (29)
Occasionally	9 (9)
Often	4 (4)
Don't know	22 (22)
How often did you go to the dentist during the last 12 months? (including orthodontist)	
Once	17 (17)
Twice	5 (5)
Three and more than three times a year	6 (6)
No visit during the last 12 months	39 (39)
I don't know/don't remember	33 (33)
What was the reason of your last visit to the dentist?	
Pain/troubles with teeth or gums	15 (15)
The appointment was initiated by the dentist	2 (2)
It was part of the follow up treatment	1 (1)
My parents had made an appointment	8 (8)
I made an appointment myself	1 (1)
I don't know/ don't remember	73 (73)

OHI-S score of 2.73 (SD=1.42). Mean scores of Debris Index and Oral Hygiene Index-Simplified was higher among females (DI: Mean=1.76, SD=0.73; OHI-S: Mean=2.75, SD=1.32) compared to males (DI: Mean=1.59, SD=0.79; OHI-S: Mean=2.71, SD=1.53). Males had higher mean scores of Calculus Index (CI: Mean=1.12, SD=1.76) compared to females (CI: Mean=0.99, SD=0.96). Male and female participant differences for individual components of OHI-S were not found to be significant (DI: $p=0.914$; CI: $p=0.095$; OHI-S: $p=0.098$).

Participants of lower grades (6-8) had higher mean scores of DI, CI and OHI-S (DI: Mean=1.85, SD=0.78; CI: Mean=1.2, SD=0.95, OHI-S: Mean=2.71, SD=1.53) compared to higher grade participants (DI: Mean=1.4, SD=0.66; CI: Mean=0.83, SD=0.80; OHI-S: Mean=2.23, SD=1.16). Majority of lower grade participants (78%, $n=29$) had poor debris scores compared to higher grades (22%, $n=8$), which was significant ($p=0.012$). Similarly, about two third (73%, $n=25$) of lower grade participants had poor oral hygiene status compared to higher grade participants (26%, $n=9$), while majority of higher grade participants (65%, $n=11$) had good oral hygiene status compared to lower grade (35%, $n=6$). This was found to be significant ($p=0.029$).

Association between variables and oral hygiene knowledge: Age was not significantly associated with oral hygiene knowledge ($r=-0.09$, $p>0.05$) (Tables 5 and 6). Knowledge was seen to be significantly high among females (Mean=2.42, SD=1.12, $p<0.05$),

those who brushed twice a day (Mean=3.09, SD=0.81, $p<0.001$), perceived their oral health status as very good (Mean=2.56, SD=1.27, $p<0.05$), flossed their teeth (Mean=3.33, SD=0.98, $p<0.001$) and used a fluoridated tooth paste (Mean=1.89, SD=1.11, $p<0.01$). Participants who chewed gum containing sugar once a week (Mean=3, SD=1.12, $p=0.02$) and consumed milk with sugar several times a day (Mean=2.5, SD=1.17, $p=0.019$) had significantly higher mean knowledge scores. Grade of studying, consumption of fresh fruits, biscuits, lemonade, jam, sweets/candies, tea with sugar, and use of wooden and plastic toothpicks were not significantly associated with knowledge.

Association between variables and Debris Index: Mean DI was significantly higher among participants who studied in lower grade, i.e. 6-8 (Mean=1.94, SD=0.9, $p<0.001$) and who had correct knowledge of tooth brushing twice a day (Mean=1.89, SD=0.83, $p=0.03$). Age ($r=-0.9$, $p=0.06$), frequency of tooth brushing ($f=2.39$, $p=0.09$), oral health perception ($f=0.44$, $p=0.78$), use of floss ($f=0.10$, $p=0.75$) and fluoridated toothpaste ($f=0.03$, $p=0.97$), wooden toothpicks ($f=0.66$, $p=0.44$) and plastic toothpicks ($f=1.13$, $p=0.29$), and consumption of fruits ($f=1.09$, $p=0.86$), biscuits ($f=1.39$, $p=0.23$), lemonade ($f=0.96$, $p=0.45$), jam ($f=1.08$, $p=0.37$), chewing gum containing sugar ($f=0.73$, $p=0.60$), sweet candies ($f=0.14$, $p=0.98$), milk with sugar ($f=0.62$, $p=0.68$), tea with sugar ($f=0.15$, $p=0.96$) did not show significant association with debris index.

Association between variables and Calculus Index (CI): Grade of

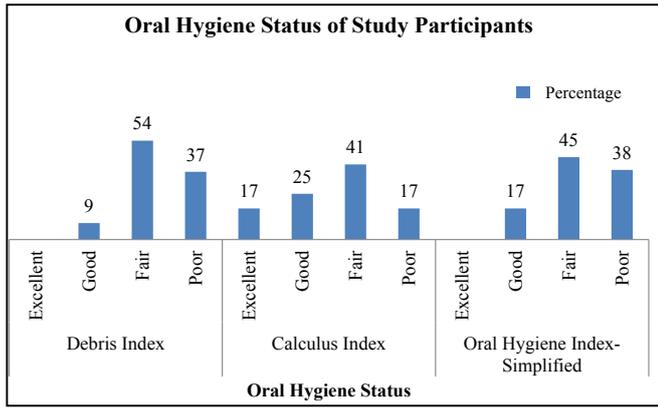


Figure 2. Oral Hygiene Status of Study Participants.

studying was the only significantly associated variable. Lower grade student, 6-8 standards had higher mean calculus index (Mean=1.29, SD=1.11) compared to higher grade, i.e. 9-10 standard (Mean=0.85, SD=0.89) which was found significant (t=2.16, p=0.03). Age (r=-0.11, p=0.29), gender (t=-0.83, p=0.41), knowledge of tooth brushing (t=-1.45, p=0.15), health perception (f=1.11, p=0.36), use

of tooth floss (f=0.00, p=0.96), wooden toothpicks (f=0.00, p=0.97), plastic toothpicks (f=0.14, p=0.70), frequency of tooth brushing (f=2.26, p=0.11), use of fluoridated toothpaste (f=0.17, p=0.84), and consumption of fresh fruits (f=0.38, p=0.86), biscuits (f=0.90, p=0.48), lemonade (f=0.56, p=0.73), jam (f=1.96, p=0.09), sugar containing chewing gum (f=1.10, p=0.36), sweets and candies (f=0.63, p=0.67), milk with sugar (f=0.76, p=0.57), tea with sugar (f=0.54, p=0.70).

Association between variables and Oral Hygiene Index-Simplified (OHI-S): Grade was significantly associated with OHI-S. Higher OHI-S was found among lower grade participants, 6-8 standards (Mean=3.32, SD=1.77) compared to higher grade, i.e. 9-10 standard participants (mean=2.25, SD=1.24) which was significant (t=-3.24, p=0.001). Age (r=-0.16, p=0.10), gender (t=-0.12, p=0.90), knowledge of toothbrush (t=-2.03, p=0.05), health perception (f=0.85, p=0.50), frequency of tooth brushing (f=2.74, p=0.07), use of tooth floss (f=0.45, p=0.64), fluoridated tooth paste (f=0.04, p=0.85), wooden toothpicks (f=0.17, p=0.68) and plastic toothpicks (f=0.10, p=0.74) and consumption of fresh fruits (f=0.59, p=0.71), lemonade (f=0.62, p=0.68), jam (f=1.88, p=0.16), chewing

Table 5. Association between different variables and oral hygiene knowledge and status.

Variable	Knowledge	Debris Index	Calculus Index	Oral Hygiene Index Simplified
Gender*				
Female	M=2.42; SD= 1.14	M=1.59; SD= 0.73	M=0.99; SD=0.96	M=2.75; SD=1.32
Male	M=1.96; SD= 1.12	M=1.59; SD=0.79	M=1.12; SD=0.85	M=2.71; SD=1.53
Education*				
6-8	M=2.3; SD = 1.21	M=1.94; SD=0.91	M=1.29; SD=1.11	M=3.32; SD=1.77
9-10	M=2.02; SD= 1.05	M=1.04; SD=0.66	M=0.85; SD=0.89	M=2.25; SD 1.24
Tooth Brush (knowledge)*				
Once	M=1.06; SD= 0.38	M=1.53; SD=0.86	M=0.95; SD=1.04	M=1.70; SD=2.48
Twice	M=3.19; SD= 0.48	M=1.89; SD=0.83	M=1.26; SD=1.04	M=1.54; SD=3.15
Oral Health perception†				
Poor	M=1.00; SD =1.09	M=1.85; SD=1.17	M=1.77; SD=1.40	M=3.62; SD=2.55
Average	M =2.04; SD=1.08	M=1.79; SD=0.94	M=0.98; SD=0.88	M=2.77; SD=1.48
Good	M=2.09; SD=1.04	M=1.59; SD=0.89	M=1.04; SD=1.09	M=2.63; SD=1.69
Very good	M=2.56; SD= 1.27	M=1.69; SD=0.81	M=1; SD=0.98	M=2.69; SD=1.68
Don't know	M=2.57; SD=1.02	M=1.92; SD=0.61	M=1.42; SD=1.14	M=3.34; SD=1.30
Tooth floss (knowledge)†				
Yes	M=3.39; SD= 0.92	M=1.62; SD=0.74	M=1.31; SD=1.07	M=2.93; SD=1.50
No	M= 1.91; SD=1.04	M=1.84; SD=0.87	M=1.17; SD=1.18	M=3.01; SD=1.78
I don't know	M= 1.94; SD=1.03	M=1.67; SD=0.90	M=0.99; SD=0.93	M=2.67; SD=1.61
Tooth brush (practice)†				
Once a day	M=1.84; SD=1.10	M=1.62; SD=0.74	M= .95; SD=0.94	M=2.58; SD=1.39
>2 times/day	M=3.09; SD= 0.81	M=1.72; SD=0.96	M=1.39; SD=1.20	M=3.10; SD=1.97
Never	M=2.38; SD= 1.04	M=2.19; SD=1.11	M=1.45; SD=1.16	M=3.65; SD=1.97
Fluoridated toothpaste†				
Yes	M=2.45; SD= 1.09	M=1.70; SD=0.98	M=1.16; SD=1.09	M=2.85; SD=1.80
No	M=2.85; SD= 1.09	M=1.72; SD=0.76	M=1.22; SD=1.04	M=2.94; SD=1.57
Don't Know	M=1.89; SD=1.11	M=1.04; SD=0.83	M=1.06; SD=1.05	M=2.80; SD=1.61
Chewing Gum containing sugar†				
Everyday	M=1.95; SD= 1.31	M=1.80; SD=1.04	M=1.45; SD=1.25	M=1.45; SD=1.25
Never	M=2.36; SD=1.06	M=1.76; SD=0.78	M=1.67; SD=1.02	M=1.67; SD=1.02
Once a week	M=3.00; SD= 1.12	M=1.92; SD=1.08	M=1.02; SD=0.79	M=1.02; SD=0.79
Several times a day	M=2.20; SD= 1.09	M=1.18; SD= 0.4	M=0.80; SD=0.46	M=0.80; SD=0.46
Several times a month	M=1.62; SD= 0.92	M=1.42; SD=1.16	M=0.52; SD=1.40	M=0.52; SD=1.40
Several times a week	M=1.44; SD=1.01	M=1.72; SD=0.43	M=0.90; SD=0.69	M=0.90; SD=0.69
Milk with sugar†				
Every day	M=2.47; SD= 1.10	M=1.78; SD=0.76	M=1.07; SD=1.02	M=2.86; SD=1.43
Never	M=1.64; SD= 1.11	M=1.56; SD=0.93	M=1.07; SD=1.09	M=2.62; SD=1.90
Once a week	M=1.50; SD= 0.71	M=1.25; SD=0.35	M=1.50; SD=0.71	M=2.75; SD=1.06
Several times a day	M=2.50; SD=1.17	M=1.86; SD=1.21	M=1.39; SD=1.24	M=3.25; SD=2.15
Several times a week	M=1.60; SD= 0.89	M=1.56; SD=0.74	M=0.68; SD=0.76	M=2.24; SD=1.37
Thread*				
No	M=2.05; SD= 1.08	M=1.77; SD=0.88	M=1.11; SD=1.07	M=2.88; SD=1.69
Yes	M=3.33; SD= 0.98	M=1.68; SD=0.84	M=1.09; SD=0.92	M=2.78; SD=1.64

*t statistics , † Analysis of Variance (ANOVA)

Table 6. Significance between different independent variables, oral hygiene knowledge and status.

Variable	Knowledge	Debris Index	Calculus Index	Oral Hygiene Index Simplified
Gender*	0.04	0.44	0.41	0.90
Education*	0.23	< 0.001	0.03	0.001
Tooth brush knowledge*	< 0.001	0.03	0.15	0.05
Tooth floss knowledge†	<0.001	0.61	0.52	0.64
Oral Health Perception†	0.02	0.78	0.36	0.50
Tooth brushing practice†	0.001	0.09	0.11	0.07
Fluoridated toothpaste use†	0.006	0.97	0.84	0.96
Thread (floss) use *	< 0.001	0.75	0.96	0.85
Chewing gum containing sugar †	0.02	0.60	0.36	0.39
Milk with sugar consumption †	0.019	0.68	0.57	0.61

*t statistics, † Analysis of Variance (ANOVA)

Table 7. Regression analysis between independent variables and Oral Hygiene Index.

Model		Coefficients ^a						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.918	2.691		0.713	0.494	-4.169	8.004
	Age	-0.101	0.161	-0.182	-0.623	0.549	-0.466	0.265
	Gender of Participant	0.746	0.729	0.363	1.024	0.333	-0.902	2.394
	Annual household income	2.106E-006	.000	0.064	0.170	0.868	0.000	0.000
	Type of family	0.518	0.282	0.442	1.836	0.100	-0.120	1.156
	Knowledge	0.105	0.143	0.183	0.730	0.484	-0.220	0.429

^a. Dependent Variable: OHIS

of sugar containing gum ($f=1.05$, $p=0.39$), consumption of sweets and candies ($f=0.19$, $p=0.96$), milk with sugar ($f=0.71$, $p=0.61$) and tea with sugar ($f=0.28$, $p=0.89$) were not significantly associated with OHI-S.

From the regression analysis between various independent variables and oral hygiene status, none of the independent variables were seen to be significantly associated with oral hygiene index (Table 7).

Discussion

To improve oral health worldwide, promoting oral health of adolescents through health promoting schools has been prioritized by the World Health Organization (WHO) [5,8,28,29]. Preventive strategies have been particularly advised for adolescents because of high prevalence of plaque accumulation [8,9,30].

This exploratory study attempted to assess the knowledge, perceptions and practices of oral hygiene and the oral hygiene status among the secondary and higher secondary school participants in a rural school in Chennai, South India. Clinical examinations of oral hygiene and health either substituted or supplemented with questions on oral hygiene related KAP have been used and recommended in the absence of validated tool for assessing oral health KAP [31]. To assess the oral hygiene status, the Oral Hygiene Index- Simplified was used. The simplified Oral Hygiene Index (OHI-S) by Greene and Vermillion, 1964 has been useful for evaluation of dental health education in public school systems [8] and is widely used in epidemiological surveys evaluate oral hygiene status as it is simple to ease with less time and minimum training needed and fairly reproducible [7,32].

Majority (45%) of the participants had fair oral hygiene with 38% participants having poor oral hygiene. Higher proportions have been reported from studies in Kuwait (Fair: 67%; Poor: 29%) [7], Nigeria (Fair: 72%) [2] and India (Fair: 68%; Poor: 2%) [33]. This is of importance as dental plaque is the prime factor causing chronic

gingivitis, and such findings indicate an increased risk for future periodontal diseases, thus needing improvement in oral hygiene conditions [24].

Oral hygiene status can reflect the toothbrushing practices of the participants [24]. Tooth brushing twice a day has been advised for good oral health [17]. Only 17% brushed twice or more in a day. This was higher compared to other studies in India reporting 4.1% [34] and 10% in Nepal [35]. Other studies found higher proportions from India [18,27,36] and globally [24,37,38]. A need to focus on instructions on correct oral hygiene practices for effective behaviour has been recommended [24].

Oral hygiene was significantly better among participants who brushed once compared to those who did twice a day. Similar findings were noticed in studies where participants who rarely brushed [2] and brushed once a day [2,24] had fair oral hygiene status. The manner of tooth brushing may lead to harbouring of microorganisms which can explain this observation. Involving parents in improving the oral hygiene practices of their children, may need more focus [2].

Refined sugar-containing carbohydrates were among the most frequently consumed foods. The damaging role of dietary sugars especially refined/ processed foods, consumption of sugary soft drinks have been emphasized in the aetiology of dental caries [39]. Sweets consumption could influence the rate of plaque proliferation and the composition of plaque. However, avoiding sugars are secondary to plaque and calculus control [14]. In communities with high sugar consumption, using fluorides as a preventive measure has been advocated [39].

Debris and calculus accumulation was lower among the higher grade (9-10) than lower grade (6-8) students. A Greek study reported better oral hygiene status among 15-year old adolescents than younger ones. However, the study also reported higher calculus accumulation, thus reflecting the need of professional scaling with oral hygiene instructions [24].

A high proportion of participants had correct knowledge and

practice of using toothbrush and toothpaste to clean the teeth. Females had more knowledge and better teeth cleaning compared to males. Better oral health perceptions and concern, and more frequent visits to dentists may be a reason for this among females as also reported from other studies [7,17,40]. Majority of students visited the dentist mainly due to tooth related pain. This is similar to studies and report pain as being the motivating factor [41].

Through the medium of schools, effective oral health promotion of school staff, students and their families occurs. Oral health promotion can be easily integrated with that of general health, school curriculum and activities. Oral health promoting interventions through school have been found effective when reinforced, given at shorter intervals of time and supplemented with affordable cleaning aides [29].

This was a cross sectional study which included a small sample and was limited to two schools. Since only rural settings were included, urban differences are not known. Causality could not be established due to the cross sectional research design, and thus a

longitudinal study is needed to understand the possible determinants of oral hygiene and its oral health seeking behaviour among children in different settings.

Conclusion

Oral hygiene knowledge, status, and eating patterns were inversely associated with the school grade. The role of self-perception of health status, especially in early schooling years, may need to be explored further as those with more positive perceptions were seen to have more correct oral hygiene practices, and lower debris and calculus accumulation. This warrants a multipronged, multilevel intervention integrating oral health into the school curriculum beginning early schooling is needed. A national policy is needed to incorporate oral health and hygiene in the educational curriculum at early levels of schooling.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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