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Social and Behavioural Factors Associated with Dental Caries Experience among Adolescent School Children in Bengaluru City, India

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Authors' contributions

This work was carried out in collaboration between both authors. Author SK designed the study, wrote the protocol, managed the literature searches and wrote the first draft of the manuscript. Author SSH managed the analyses of the study, interpretation of the results and reviewed the draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: To assess the influence of social and behavioural factors on dental caries experience among adolescent school children in Bengaluru city, India.
Study Design: Cross sectional study.
Place and Duration of the Study: Primary schools of Bengaluru City, between November 2012 and March 2013.
Methodology: A cross sectional study was conducted on 11 year old 814 adolescents attending upper primary schools of Bengaluru city and their parents. Separate interview for adolescent students and parents was conducted on behavioural and social factors respectively. Dental caries was recorded according to WHO criteria using mouth mirrors and CPI probes under natural light. Statistical analysis included descriptive analysis, bivariate analysis using chi-square tests and t-tests. Later the variables were subjected to logistic regression analysis.
Results: Dental caries experience of the children studied was associated with social factors such

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as occupation of the mother (OR=1.9; 95% CI=1.3-2.3), presence of social support for mother during adulthood (OR=2.1; 95% CI=1.4-2.0), possession of television (TV)/computer at home (OR= 1.6; 95%=0.9-3.0); and behavioral factors such as adolescents who consume at least one serving of dairy/legumes/eggs/meat or poultry per day (OR=1.8; 95% CI=0.14-1.32), those who consume sweet snacks >1times in a day (OR=1.42; 95% CI=0.82-1.83). Influence of parents and TV on snacking, tooth brushing frequency and fluoridated dentifrice were also shown to be significantly associated with dental caries experience.

Conclusion: Social factors such as occupation of the mother and social support play an important role in shaping the more proximal behavioural habits such as snacking among 11 year old children. These interactions ultimately influenced dental caries experience in this age group.

Keywords: Social support; diet; snacks; dental caries; adolescents.

1. INTRODUCTION

There is clear evidence of persistently rising prevalence of dental caries among children and adolescents in different parts of the world. Recent studies indicate an alarming increase in the prevalence of dental caries in developing countries [1]. In India, dental caries is increasing in an alarming rate and varies from 33.7% to 90% in child population [2,3,4,5,6]. Bengaluru, a prominent cosmopolitan city in India shows caries prevalence of 41.32% with it being concentrated in younger age groups [7].

Different factors are known to be responsible for this increase in dental caries prevalence such as diet, oral hygiene practices and socioeconomic status. Shift in populations has been recognised as responsible for changes in oral health across the globe. Especially in Asia, large movements of population from rural to urban centres in search of new manufacturing jobs has resulted in negative changes in diet, lifestyle and health [1]. This phenomenon is also true in a city such as Bengaluru, a rapidly growing urban centre which has attracted a large section of rural population as well as population from other urban parts of India. This results in changes in the locally existing social and behavioural factors acting on dental caries experience among adolescents. Social disparity in dental caries prevalence has been studied in relation to socioeconomic status (SES) and age. The city shows caries prevalence of 41.05% and 45.75% in the 12 and 15 year old adolescent age groups belonging to lower SES respectively, which is greater than the caries prevalence in 35-44 years (39.26%) and 65-74 years (40.54%) of age groups [7]. Also caries prevalence of 83% and 80% in early adolescent age groups of 9-12 years and 6-12 years respectively is documented in Bengaluru City [8,9]. This clearly shows an inclination towards lower socioeconomic groups and younger population.

Social factors such as social support for mothers and material possession such as TV or computer at home are other important determinants of socioeconomic status which might play a role in the constantly changing living conditions of a metropolitan city such as Bengaluru. These factors are not usually assessed as a proxy for socioeconomic status among adolescent population in India.

The above mentioned social factors act as distal influencing factors modulating behavioural factors such as diet, snacking practices and tooth brushing frequency. These behavioural factors act as proximal influencing factors for dental caries. The influence of behavioural environment of the family with respect to parental snacking and influence of TV/Computer on snacking behaviour of adolescents are rarely explored among adolescents in India. Though diet and toothbrushing frequency among adolescents is assessed in descriptive studies [2,3,4,5,6], analytical studies with regression models to assess the relative influence of these factors on dental caries in Indian adolescent population are sparse. Hence this study was conducted with the hypothesis that adolescents who have adverse social and behavioural environment had increased dental caries prevalence.

2. MATERIALS AND METHODS

The cross sectional research protocol of this study was approved by Research Ethics Committee at Government Dental College and Research Institute, Bengaluru, India. Research was conducted in full accordance with the World Medical Association Declaration of Helsinki. Informed consent was obtained from parents of

adolescents participating in the study which was supplemented by adolescent's assent.

2.1 Sample Size

The required sample size for the study was estimated to be 814 adolescents and their families. The sample size was estimated based on the dental caries prevalence rate from previous studies [2-7]. This was calculated to have 80% power for demonstrating a statistically significant difference between adolescents who had adverse or favourable social and behavioural factors at 5% significance level and at 95% confidence level with 10% margin of error. The sample size was adjusted to allow for possible drop-outs (non-response).

2.2 Sample Selection

A multistage sampling method was adopted. In the first stage cluster sampling was used to select both private and public higher primary schools of Bengaluru city. In each cluster, simple random sampling method was used to select 11-year-old children who attend these schools and surveyed for selection of the sample after satisfying the inclusion criteria: Living with one of the biological parents, living in urban areas of Bengaluru.

2.3 Interview

The data regarding the social and behavioural factors were collected using a structured interview method. Two separate interview schedules were prepared for adolescents and parents. Adolescents answered questions pertaining to behavioural factors which included: Dietary habits such as consumption of full meals per day, protein markers and fruits/vegetables per day, frequency of sweets per day, sugar based health drinks, snacking during day, parental influence on snacking, TV influence on snacking, and snack as reward from parents and oral hygiene practices and use of fluoridated dentifrice. Questions on snacking behaviour were open ended to collect appropriate information. The parents answered questions on social factors such as SES, TV/Computer at home and social support for mother during adulthood. Socioeconomic status of the adolescents' family in this study was assessed by parents' education level, parents' occupation and family income. The Kuppuswamy scale was used for assessing SES of the adolescent's family by using the revised scale for 2012 at the time of the study [10].

2.4 Pilot Study

Interview schedule was pretested for content validity using Lawshe's method [11] and found to be valid. Ten percent of the sample size was used to pre-test the interview schedule for reliability and intra-interviewer's variability. The correlation coefficient for test-retest reliability was 0.89 and 0.82 and intra-interviewer's variability was 0.88 and 0.82 for adolescent and parents sections respectively. Calibration for dental caries examination was also conducted to test intra-examiner reliability using Kappa statistics which was found to be 93.97%.

2.5 The Interview Procedure

The structured interview was conducted by the investigator on adolescents in the school in a separate quite classroom. Separate interviews were conducted on parents on a scheduled day at the schools. The research scholar did the parent interview with the teachers helping in arrangements of the meetings. For the schools, which could not make arrangements for parents meeting, house visits were made to interview parents for the study. The socio-demographic and socio-economic items asked in the interview were confirmed by doing house-to house visits.

2.6 Oral Examination

Adolescents were examined for dental caries in a predetermined order at school during school hours in classrooms with good ventilation and natural light. WHO criteria for dental caries were used for the study [12]. Gauze squares, cotton buds, sterile sets of plane mouth mirrors and Community Periodontal Index (CPI) probes was packed in sufficient quantities for each working day. The same examiner conducted the examinations in each school.

2.7 Statistical Analysis

Descriptive statistics were derived for all the independent variables under investigation. Mean DMFT, DT, MT, FT were calculated for the adolescents. The Statistical Package for Social Science version 19 was used for the analysis. Bivariate analysis was performed to assess the differences in proportion (Chi-Square tests) and differences in means (Independent sample t-tests). Logistic regression analysis was used to

assess the relationship of significant independent variables with dental caries experience of adolescents. Odds ratios were calculated with 95% confidence levels at p=0.05.

3. RESULTS

Among adolescent school children studied in this investigation, 56.14% (n=457) were females and 43.83% (n=357) were males. Dental caries with DMFT>0 was present in 26.28% (n=223) of the adolescents. Mean DMFT value of 1.74±0.5 was found for which the mean decayed teeth contributed to 1.73±0.2 with mean missing teeth of 0.01±0.12. There were no filled teeth. About 72.6% (n=591) were caries free. Tables 1 and 2 depict the frequency distribution of social and behavioural factors respectively.

The bivariate analysis for independent variables collected from parents showed a significant relationship of dental caries with parents' education level and occupation, the socioeconomic status (SES) of family, presence of TV/computer at home and presence of social support for the mother at adulthood (p=.05). The gender of adolescents did not show significant difference with p>.05. The behavioural factors on diet and oral hygiene practices collected from adolescents were subjected to bivariate analysis for their relationship with dental caries. There was a significant difference in caries prevalence in relation to number of full meals per day, protein intake, frequency and time of intake of sweets consumed per day, consumption of sugar based health drinks, snacking during the day and parental influence on snacking, snack received as a reward, influence of TV/computer to consume snacks and presence of fluoride in dentifrice (p=.05). However, there was no significant difference in caries prevalence in relation to fruits or vegetables consumed per day (p>.05).

These factors were later subjected to regression analysis, depicted in Table 3, which demonstrated the relative influence of independent variables on dental caries. Social factors: Dental caries experience was associated with education of the father (OR=1.7; 95% CI=1.04-2.17), occupation of the mother (OR=1.9; 95% CI=1.3-2.3), SES of family (OR=1.7; 95% CI=0.9-2.1), possession of TV/computer at home (OR= 1.6; 95% CI=0.9-3.0) and presence of social support for mother during adulthood (OR=2.1; 95% CI=1.4-2.0).

Table 1. Frequency distribution of social factors of the adolescents' family

Variables	Number (total = 814)	Percentage (%)
Sex of the adolescent		
Female	457	56.1
Male	357	43.9
Education of father		
≤Intermediate or post high school	587	72.1
≥Graduate or postgraduate	227	27.9
Education of mother		
≤Intermediate or post high school	588	72.2
≥Graduate or postgraduate	226	27.8
Occupation of father		
Unemployed	20	2.5
Employed	794	97.5
Occupation of mother		
Unemployed	493	60.6
Employed	321	39.4
SES of family		
Upper	129	15.8
Lower	685	84.2
Possession of TV/Computer at home		
TV	620	76.2
Computer	86	10.6
Both	108	13.3
Social support for the mother during adulthood		
No	511	62.8
Yes	303	37.2
Total	814	100

Table 2. Frequency distribution of dietary and oral hygiene behaviour of adolescents

Variables	Number (total = 814)	Percentage (%)
Full meals per day		
≤1 meal	196	24.1
≥2 meal	618	75.9
Consumption marker for protein intake: At least one serving of dairy/legumes/eggs/meat or poultry per day		
No	643	79.0
Yes	171	21.0
Fruits or vegetables per day		
No	392	48.2
Yes	422	51.8
Snacking during day (confectionery)		
No	136	16.7
Yes	678	83.3
Frequency of sweets consumed per day		
<1 time	109	13.4
≥1 times	705	86.6
Time of intake of sweets		
During meals	103	12.7
In between meals	586	72.0
During and in between meals	125	15.4
Parental influence on snacking		
No	159	19.5
Yes	655	80.5
Snack received as a reward for accomplishing parent's wishes		
No	200	24.6
Yes	614	75.4
Influence of TV advertisements to consume snacks (confectionery, aerated drinks)		
No	175	21.5
Yes	639	78.5
Consumption of sugar based health drinks		
No	306	37.6
Yes	508	62.4
Frequency of tooth brushing		
≤1 per day	671	82.4
≥2 per day	143	17.6
Fluoridated dentifrice		
No	260	31.9
Yes	554	68.1

Behavioral factors: Dental caries experience was associated with adolescents having ≤1full meal per day (OR=1.9; 95% CI=1.2-2.4), those who consume less than one serving of dairy/ legumes/eggs/meat or poultry per day (OR=1.8; 95% CI=0.14-1.32), those who consume sweet snacks >1 times in a day (OR=1.42; 95% CI=0.82-1.83), and those who snack during the day (OR=1.72; 95% CI=1.12-2.81). Parental influence of snacking (OR=1.34; 95% CL=1.3-2.1) showed a weak association with adolescents dental caries experience. Nevertheless, parents giving snacks as reward to adolescents who accomplish their wishes showed to be strongly associated with dental caries experience of adolescents (OR=2.34; 95% CI=1.2-3.4). The influence of TV advertisements on snacking behaviour of adolescents was also positively associated with dental caries experience. Adolescents who brushed their teeth less than twice per day had an OR 1.7 times higher likelihood of having caries than those who brushed twice or more than twice per day. Adolescents who did not brush with a fluoridated dentifrice were shown to be positively associated with caries experience with an OR of 1.55.

Table 3. Explanatory factors found to be associated with DMFT >0 in the final stepwise logistic regression model

	Adjusted OR	95% CI	p-value
Education of the father	1.7	(1.04-2.17)	0.001
≤Intermediate or post high school*			
≥Graduate or postgraduate			
Occupation of the mother	1.9	1.3-2.3	0.021
Unemployed*			
Employed			
SES of family			
Upper	1.7	0.9-2.1	0.035
Lower*			
Possession of TV/Computer at home	1.6	0.9-3.0	0.002
Yes *			
No			
Social support for mother during adulthood			
Yes	2.1	1.4-2.0	0.001
No*			
Full meals per day	1.9	1.2-2.4	0.001
≤1 meal*			
≥2 meals			
At least one serving of dairy/legumes/eggs/meat or poultry per day	1.8	0.14-1.32	0.004
Yes			
No*			
Frequency of sweets consumed per day			
<1 times	1.42	0.82-1.83	0.023
>1 times*			
Snacking during day	1.72	1.12-2.81	0.001
Yes*			
No			
Parental influence on snacking (parents snacking)	1.34	1.3-2.1	0.03
Yes*			
No			
Snack received as a reward for accomplishing parent's wishes	2.34	1.2-3.4	0.001
Yes*			
No			
Influence of TV advertisements to consume snacks (confectionery, aerated drinks)	1.9	1.05-1.12	0.001
Yes*			
No			
Frequency of tooth brushing	1.7	1.05-1.13	0.001
≤1 per day*			
≥2 per day			
Fluoridated dentifrice			
Yes	1.55	1.12-1.90	0.001
No*			

4. DISCUSSION

The purpose of the present study was to elucidate the social and behavioural factors influencing dental caries experience of adolescents in a rapidly changing urban city. Decayed teeth contributed highly to DMFT indicating the urgent need for restorative care. The findings of the study also display the need for preventive care in this population. The social factors under investigation in this study were pertaining to the distal factors that are further back in the causal chain in a contextual environment. The factors that lead to the development of disease at a given point in time are likely to have their roots in a complex chain

of environmental events that may have begun years previously, events which in turn being shaped by broader socioeconomic determinants [13].

Socioeconomic status plays a major role in modulation of health/disease process [13,14]. Majority of the adolescent's family were from lower SES (84.2%) which was positively associated with dental caries experience (Table 3). This finding further confirms the existing evidence [13,14,15]. Also, father's education level and mother occupation were shown to influence their children's dental caries experience (Table 3). Although mother's education levels were most implicated to be associated with their children's dental caries experience [2,14,15,16], this study found father's education level to be significantly associated with caries experience even after controlling for other variables (Table 3). The influence of mother's educational levels on caries experience was removed when controlled for other variables in the regression analysis. This might indicate the influence of fathers' decisions in households based on their educational levels. Mother's occupation is a major social indicator positively associated with dental caries experience. This could be due to less time and attention given by mothers to their children in grooming their dietary and oral hygiene practices.

Although SES and income of the family have been commonly used as social predictor variables which play an important role in dental caries prevalence [2,17,18,19], in this study other social variables such as household items (possession of TV or computer) and social support for the mother were explored. TV/ computer has become a common commodity to be possessed by majority of households as also seen in this study population (Table 1). About 76% of adolescent households had TV which is a major source of information on dietary and basic grooming practices through a variety of advertisements. In this study population TV had a significant influence on dental caries experience as TV advertisements influenced 78.5% of adolescents to snack food items such as confectionery and aerated drinks and this was positively associated with dental caries (OR=1.9; CI=1.05-1.12; p=0.001). Although owning a computer by the household (10.6%) is an important finding, information on having an Internet connection to the computer was not assessed. Weather adolescents' snacking behavior was influenced by Internet through the computer at home could not be assessed.

Social support for mothers during their adulthood is an important factor for assessing the contextual influence on the behavioral pattern of their children. Social support is a psychosocial factor contributing to parental well being. Social support has long been recognized as an important component in stress process and a predictor of psychological well-being [20,21,22]. Social support may be a particularly critical resource for families during adolescence period of their children [23]. Mothers who have larger social support network have reported lower levels of anxiety and depression. Maternal psychosocial factors such as social support measured when children are young are important mediators for adolescent mean DMFT [24]. The present study also found a positive association between mothers receiving social support and their children's dental caries experience (Table 3). Although mother's education levels did not influence adolescents' dental caries experience in the present study, mothers receiving social support were shown to be consistently associated with caries experience in regression model. This exemplifies the influence of social support for the family, especially mother, during critical growth periods of their children entering into the phase of adolescence.

In this study, dietary habits, snacking, oral hygiene practices and fluoridated dentifrice were considered as proximal modifying risk behaviours for investigation. Proximal factors act directly or almost directly to cause diseases [13]. Diet has an important role in prevention of oral diseases including dental caries. The excessive intake of low molecular refined carbohydrates has an adverse impact on dental health status. Convincing evidence from experimental, animal, human observational and human intervention studies shows that sugars are the main dietary factor associated with dental caries [25,26]. Despite the indisputable role of fluoride in the prevention of caries, it has not eliminated dental caries and many communities are not exposed to optimal quantities of fluoride [25]. Controlling the intake of sugars therefore remains a challenge for caries prevention [26].

According to National Institute of Nutrition guidelines healthy eating habits are a priority for children and adolescents in India and should comprise of daily consumption of fruits and vegetables, proteins in the form of at least one serving of dairy, legumes, eggs, meat or poultry and at least two full meals per day [27]. The results of this study show that more than half adolescents (79%) did not consume the

recommended servings of protein markers in a day such as dairy, legumes, eggs, meat or poultry (Table 2). This result is a cause for concern for oral health since it was associated with increased dental caries experience (OR=1.8; p=0.004). Milk and milk products are a group of foods that are rich in nutritious protein, group A and B vitamins and easily assimilated calcium, crucial to dental health [28]. Fruits and vegetables are recommended in sufficient quantities in daily diet for children and adolescents [27]. Although daily consumption of these was significantly associated with dental caries they were no longer significantly associated under multivariable model. Even though consumption of fresh fruits and vegetables has a protective role against diseases of oral mucosa; epidemiological evidence suggests that intake of fruits is not significant in the development of dental caries [25,29,30].

Although 75.9% of adolescents had ≥2 full meals per day, about one fourth of the study population had ≤1 full meals per day. Those who had less than two meals per day had higher caries experience (OR=1.9; p=0.001). Studies which investigated similar dietary habits have shown that not having breakfast and meal time routines had an impact on having caries experience [31,32]. Information on adolescents having full meals routinely had less caries experience in the present study which signifies the importance of family routines such as having meals [32].

Snacking is an important proximal behavioural factor having influence on dental caries. Snacking food items rich in carbohydrates such as confectionery, chips, chocolates, buns is appealing because of their attractive packing and pleasing sweet taste. Their high sugar content is a cause for concern as eating such food items more than four times in a day tends to exceed the recommended sugar consumption of 15 kg/person/year which leads to higher levels of caries [25,26]. About 83.3% of adolescents snacked during the day and 86.6% of them had sweet snacks more than once in a day which was shown to be significantly associated with dental caries experience. An interesting finding of the present study was the significant parental influence on snacking. Parents snacking induced the snacking behaviour among their children which was shown to be associated with dental caries experience (Table 3). Parents also rewarded their children with snacks if they accomplished their wishes such as doing homework, participating in competitions, or some light household work. Snacks were used as a positive reinforcement because of their attractive appeal to the children. But as shown in the results, snack given as a reward was also significantly associated with dental caries among adolescents even in the multivariable model. As discussed earlier it is unfortunate that parents use sweet snacks rich in free sugars proved to be detrimental to dental health to bring about positive behavioural changes in their children. Educating parents regarding the deleterious effects of snacking on oral health should be a priority since incorporating healthy eating habits with snacks composed of fruits and vegetables is good both for general as well as oral health [26].

Oral hygiene practices such as frequency of tooth brushing and use of fluoridated toothpastes were assessed in this study (Table 2). About three fourth of the study population brush less than two times a day and this was significantly associated with dental caries experience. Fluoridated toothpaste was used by 68.1% of adolescents and this had a protective role on dental health (OR=1.55; p=0.001). Exposure to fluoride may increase the safe level of consumption of sugars to approximately 20 kg/year [33]. Poor oral hygiene, lack of parental control and appropriate health knowledge, together with frequent consumption of cariogenic foods, in addition to social demographic characteristics are the main risk factors for the development of caries in surveyed schoolchildren [34,35]. Hence good oral hygiene practices coupled with healthy dietary habits low in free sugars should be emphasised. This knowledge from various studies among adolescent students and relationship between diet, nutrition and dental caries should be used in preventive oral health programs and such programs should involve parents actively to disseminate scientific facts helping them to adopt healthy behavioural environment at home.

5. CONCLUSION

The study found that social factors such as SES and social support play an important role in shaping the more proximal behavioural habits of 11 year old adolescents. Behavioural factors such as dietary habits, oral hygiene practices and presence of fluoride in dentifrice have an influence on dental caries experience in adolescents. Snacking behaviour and the influence of parents and TV on such behaviour need attention in oral health promotion programs among adolescents. Since distal factors such as

social characteristics act along the life course of an individual and influence the more proximal individual behavioural characteristics, assessing the accumulated effects of these factors on dental caries is not sufficiently done in cross sectional studies. Hence, more suitable longitudinal studies with life course analysis should be carried out to understand these influences on oral health in adolescents.

CONSENT

All authors declare that written informed consent was obtained from the participant for publication of this paper and accompanying images.

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COMPETING INTERESTS

We state that there is no competing interest and the research did not receive any funding.

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