Social capital and dental caries among 3–5-year-old Indian children. A cross-sectional study



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Abstract

Aim The aim of the study is to investigate the association between social capital and dental caries among 3–5-year-old preschool children in a rural region of southern India.

Methodology A cross-sectional study was conducted among 260 children ranging from 3 to 5 years-old and their parents from 13 preschools of the Udupi region of south India between December 2018, and February 2019. A 16-item Social Capital Scale (SCS) was used to collect data from the children's parents regarding their social capital. The diet history was collected from the parents and the children were examined for dental caries using the dmft index in their schools.

Results Dental caries had a negative association with social capital (B=-0.13; 95% CI: -0.22 to -0.04; p-value=0.01). Stepwise multiple regression analysis also showed that sugar exposures in solid and liquid form, household crowding and social capital were significantly associated with dental caries in the study population with variances of 13.0% (SE=2.85; p-value of <0.01).

Conclusion Dental caries among preschool children had a negative association with parental social capital, and significantly contributed to variances in dental caries along with socioeconomic and dietary factors.

KEYWORDS Dental caries, dmft, Preschool children, Social capital

Introduction

Caries experience is a function of both caries prevalence and access to dental services. While such services are usually available in developed countries, access to them may be limited to a few, usually privileged groups, in developing countries. Untreated decay is associated with negative oral health-related quality of life [Mota-Veloso et al., 2016]. Fisher-Owens et al. [2007] described five theoretical constructs, namely: genetic and biological factors, social environment, physical environment, medical and dental care system, and health behaviors that can influence child oral health outcomes at the individual, family, and community levels. The period from conception to the second year of life influences oral health for a lifetime [Paglia, 2022].

Social position is further known to determine social participation, support, stability, and cohesion, which positively affect health and health behavior [Lee & Divaris, 2014]. Recent studies have explored the concept of social capital and its potential application in health policy [Alvarez et al., 2017]. Research suggests that societies with high levels of social capital and norms that encourage cooperation [Woolcock & Narayan, 2000] have lesser mortality and morbidity than in low social capital societies [Kawachi et al., 2004]. Social capital has been defined as "the features of social organisation, such as civic participation, norms of reciprocity, and trust in others, which indicate a willingness to cooperate for mutual benefit" [Putnam, 2001]. Social capital exists in social structures such as societies or workplaces, being a resource that people access via their social networks. The possible effect of social capital on dental health has been emphasised by literature in adult populations, which stated that higher social capital was associated with lower levels of edentulism and improved dentate status [Aida et al., 2011], lower dental caries [Pattussi et al., 2006], better self-rated oral health [Knorst et al., 2021]., lower levels of periodontal disease [Sabbah et al., 2011] and lesser reporting of dental pain [Santiago et al., 2013]. A recent systematic review found social capital was positively related to oral health outcomes, such as dental caries, gingival bleeding, self-rated oral health and Oral Health related Quality of Life in children and adolescents [Knorst et al., 2021]. To the best of our knowledge, few studies have evaluated the associations of socio-economic factors, social capital and diet on dental caries among young preschool schoolchildren. In view of this lack of evidence, we aimed to study the association of social capital, dental caries among 3–5-year-old preschool children adjusting for dietary factors. The research hypothesis postulated that children living in communities with low social capital are more likely to have higher levels of dental caries when dietary factors affecting caries are controlled.

Methods

A cross-sectional study was conducted among preschool children in the Udupi district, in southern India between December 2018, and February 2019. Before the commencement of the study, ethical clearance was obtained from the Institutional Ethics Committee. The study protocol was registered in the clinical trials registry of India (CTRI/2019/01/017360). Permission to examine the preschool children was obtained from the local authorities following which a list of all preschools in Udupi district was obtained. The total number of preschools in Udupi district were 208 out of which 13 were randomly selected. A total sample of 170 was derived using the sample size formula for a mean deft of 1.89 and SD 3.3 of dental caries in 3–5-year-old children reported by a previous study. (Singh et al., 2012) Considering a design effect (D.E) of 1.5 the sample size was fixed at 252.

The self-administered questionnaire used in the study consisted of 3 sections. The first section collected information on age, gender, and name of preschool. It included details of

the educational qualification, and occupation of the parents, total number of family members in the house, rooms in the house and number of earning members. The second section included the Social Capital Scale containing 16 items—previously validated in an elderly population —to collect information on social capital from the parents of the child [Karkada et al., 2021]. The responses used options on a Likert scale, with the options being "Always" (3), "Sometimes" (2) and "Never" (1). The responses for questions 11 and 12 were "None" (1); "Few" (2) and "Many" (3). The scoring was reversed for questions 1 and 6 because they were negatively framed. The total score (range 16–48) of the social capital scale was taken as a sum of the scores for the individual questions. Higher scores suggested higher social capital. The third section consisted of a 24-hour diet recall chart to record the diet of the child and assess the total sugar consumption frequency and number of between meal sugar exposures. Sweet score was assessed according to the method proposed by Nizel and Papas, 1989.

All the children and their parents from these 13 randomly selected preschools were included in the study. An informed consent was obtained from the parents and the children prior to the survey. Informed consent and participant information forms were distributed to the children, explaining the objective of the study and the relevant details in simple language and queries were solved by the investigator. The questionnaires were sent through the children to be filled by their parents. On subsequent days, the clinical examination for dental caries was conducted and completed questionnaires were collected from the children. Children aged 3–5 years, residing in the Udupi District, with literate parents were eligible to participate in the study. All children present on the day of examination who consented and returned signed consent forms from their parents were included. Uncooperative children with any major systemic health problems that prevented oral examination and those who were absent on the day of examination were excluded. Examination of the study subjects was undertaken in the premises of the respective preschools. The examination of all the study subjects was performed by a single examiner. The examiner was blinded to the responses in the questionnaire given by the parents. Children examined for dental caries were scored using the dmft index. The investigator took the history regarding the cause of tooth loss at the time of clinical examination. The test-retest reliability was evaluated on 10% of the sample parents who filled the second copy of questionnaire with a 2-week interval. The ICC value was 0.95, indicating high reliability. The intra-examiner reliability for caries diagnosis was assessed by re-examining 10% of the sample of children, after 2 weeks from the first examination. Cohen's kappa coefficient for the assessment of dental caries was 0.89, indicating good

Intra-examiner agreement

The analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, version 20, SPSS Inc, Chicago, Ill, USA). A P-value of ≤ 0.05 was considered statistically significant. The education and occupation of parents were classified according to a widely used socioeconomic status scale (SES) (Saleem, 2018). Categories 3, 4 and 5 of the SES scale corresponding to middle, high school and intermediate certificate for parents' education were merged into a single category. The four categories for parent's education thus were primary school; intermediate/diploma; graduate and honors. Occupation was categorised as unskilled; semi-skilled and professional. Household overcrowding was calculated as the ratio of total family members to the number of rooms in the house. Dependency ratio was calculated as the ratio of dependent members of the family to the number of earning members. Interquartile range was

	Variable	N	(%)
Age	3 years	82	31.5
	4 years	104	40
	5 years	74	28.5
Gender	Male	123	47.3
	Female	137	52.7
Father's Education	Primary (Grade I-VII)	102	39.2
	Up to Pre-university (Grade XII)	112	43.1
	Graduate/Bachelors	16	6.2
	Postgraduate/Doctorate/Honors	30	11.5
Mother's Education	Primary (Grade I-VII)	103	39.6
	Up to Pre-university (Grade XII)	111	42.7
	Graduate/Bachelors	20	7.7
	Postgraduate/Doctorate/Honors	26	10.0
Father's Occupation	Unemployed/Unskilled	181	69.6
	Skilled	25	9.6
	Professional	54	20.8
Mother's Occupation	Unemployed/Unskilled	192	73.8
	Skilled	54	20.8
	Professional	14	5.4
Household	1st quartile	58	22.3
Overcrowding	2nd quartile	98	37.7
	3rd quartile	63	24.2
	4th quartile	41	15.8
Dependency Ratio	1st quartile	0	0.0
	2nd quartile	171	65.8
	3rd quartile	55	21.2
	4th quartile	34	13.0
Sugar exposures in liquid form	No/None	3	1.2
	Yes (≥1)	257	98.8
Sugar exposures in solid form	No/None	42	16.2
	Yes (≥1)	218	83.8
Dietary sugar exposures between meals	No/None	5	1.9
	Yes (≥1)	255	98.1
Dietary sugar exposures with meals	No/None	101	38.8
	Yes (≥1)	159	61.2

TABLE 1 Descriptive data of the sample population (n= 260).

used to split both variables into 4 categories. Frequencies and proportions were used to present descriptive data of the sample population. All independent variables (socioeconomic, social capital and dietary variables) and the dependent variable dmft were treated as continuous variables. Simple linear regression was performed to obtain a crude model depicting the association of dmft with each independent variable (Model 1). Stepwise multiple linear regression analysis was used to estimate the relationship between dmft and significant independent variables from the crude model to build up the best fitted model depicting dental caries in the study population.

A directed acyclic graph was used to visualise the underlying causal relationships between parental factors (like education, occupation), socio-economic factors (like household crowding and dependency ratios), demographic factors (age, sex), sugar consumption patterns of children and caries among the children. Demographic and sugar consumption variables were considered to be directly associated with caries whereas parental factors and socioeconomic factors were considered to be associated with caries and also with social capital, which in turn was again associated with caries. There were no colliders in this model. The variance inflation factor (VIF) was used to assess multi-collinearity in the adjusted multiple linear regression models. The significant sociodemographic variables (age, household crowding) and dietary variables (sugar exposures in liquid form, sugar exposures in solid form) were included as covariates in the first adjusted model (Model 2). The second adjusted model (Model 3) included all variables in Model 2 and social capital as covariates.

Results

A total of 350 questionnaires were distributed to children recruited from preschools of which 37 children did not return signed consent forms. Data from 53 incomplete questionnaires were also excluded from the analysis. Hence, the number of children examined and included in the analysis was 260. No child was excluded for health reasons in our study. The sample population consisted of 3–5-year-old children with an equal distribution between males (47.3%) and females (52.7%). Most parents had education levels in the lowest two categories; father's education (82.3%) and mother's education (82.3%) while most children father's held unskilled occupations (69.6). Most of the children had high sweet scores (92.3%). Additionally, more children (77.3%) had two or more sugar exposures that took place between meals (Table 1). The mean (SD) dmft of the total sample population was 2.30 (3.26).

The frequency of responses to the social capital questionnaire are presented in Table 2. Total social capital for each participant was taken as the sum of the scores of the social capital questionnaire and ranged from 24–48 with a median value of 37. Ninety-eight participants (37.7%) fell in the lowest quartile of social capital, whereas 22.3%, 21.2%, 18.8% were in the second, third and highest quartiles respectively.

Stepwise linear regression analysis for studying the association between dmft and each independent variable (Crude model) showed that dmft had a significant positive association with the child's age (unstandardised co-efficient (B)=0.56; 95% CI: 0.09 to 1.04; p-value=0.02), household crowding (B=0.36; 95% CI: 0.07 to 0.65; p-value=0.02), sugar exposures in liquid (B=0.58; 95% CI: 0.17 to 1.00; p-value=0.01) and solid form (B=0.76; 95% CI: 0.33 to 1.18; p<0.01), and sugar exposures between meals (B=0.46; 95% CI: 0.13 to 0.80; p-value=0.01). In contrast, dental caries had a negative association with social capital (B=-0.13; 95% CI: -0.22 to -0.04; p-value=0.01). The independent variable "sugar exposures between meals" was excluded from the adjusted models (Model 2 and 3) to avoid

Sl. No		Never/ None N (%)	Sometimes/ Few N (%)	Always/ Many N (%)
1	Do you think most people would try to take advantage of you if they got a chance?	63 (24.2)	118 (45.4)	79 (30.4)
2	Do you feel that you belong to the neighborhood?	26 (10.0)	98 (37.7)	136 (52.3)
3	Are you willing to work with others to improve the neighborhood?	15 (5.8)	95 (36.5)	150 (57.7)
4	Do you feel that the local area is friendly?	10 (3.8)	107 (41.2)	143 (55.0)
5	Do you have people that you can rely upon no matter what happens?	18 (6.9)	96 (36.9)	146 (56.2)
6	How often do you feel lonely?	106(40.8)	119 (45.8)	35 (13.5)
7	How often do you and people in your neighborhood do favors for each other?	8 (3.1)	151 (58.1)	101 (38.8)
8	When a neighbor is not at home, how often do you and other neighbors watch over their property?	42 (16.2)	128 (49.2)	90 (34.6)
9	If you were sick could you count on your neighbors to shop groceries for you?	74 (28.5)	128 (49.2)	58 (22.3)
10	How often do you meet/talk to your neighbors?	14 (5.4)	112 (43.1)	134 (51.5)
11	How many friends do you have in the neighborhood?	26 (10.0)	120 (46.2)	114 (43.8)
12	How many relatives or in-laws do you have in the neighborhood?	120 (46.2)	68 (26.2)	72 (27.7)
13	Do you feel there is a strong cohesion in your neighborhood?	27 (10.4)	124 (47.7)	109 (41.9)
14	Do you look after someone when he/she is sick and stays in bed for a few days?	24(9.2)	129(49.6)	107(41.2)
15	How often do you see neighbors taking care of each other?	14(5.4)	171(65.8)	75(28.8)
16	How often do you see neighbors and friends talking outside in the yard or on the street?	14(5.4)	143(55.0)	103(39.6)

TABLE 2 Frequency of responses to validated 16-item Social Capital Scale (n= 260)

Variable	Crude model				Adjusted models					
	Model 1				Model 2			Model 3		
	B	95% CI limits		p-value	B	95% CI limits		B	95% CI limits	
		Upper	Lower			Upper	Lower		Upper	Lower
Age	0.56	0.09	1.04	0.02	0.49	0.03	0.94	0.46	0.01	0.92
Gender	-0.70	-1.44	0.04	0.06						
Father's Education	-0.03	-0.14	0.07	0.53						
Mother's Education	-0.02	-0.11	0.08	0.74						
Father's Occupation	-0.09	-0.20	0.03	0.14						
Mother's Occupation	-0.04	-0.17	0.09	0.60						
Household Crowding	0.36	0.07	0.65	0.02	0.36	0.08	0.64	0.35	0.07	0.63
Dependency Ratio	-0.02	-0.33	0.29	0.89						
Sugar exposures in liquid form	0.58	0.17	1.00	0.01	0.56	0.16	0.96	0.57	0.17	0.96
Sugar exposures in solid form	0.76	0.33	1.18	0.00	0.71	0.29	1.12	0.66	0.25	1.07
Sugar exposures between meals	0.46	0.13	0.80	0.01						
Sugar exposures with meals	-0.10	-0.61	0.41	0.71						
Social Capital	-0.13	-0.22	-0.04	0.01				-0.11	-0.20	-0.02

B: Unstandardised coefficients
Model 1: Simple linear regression model depicting the association of caries with all independent variables.
Model 2: Multiple linear regression model depicting the association of caries with significant SES variables (age, household overcrowding) and dietary variables (sugar exposurees in liquid and solid form). The variable "Sugar exposures between meals" has been eliminated to avoid multi-collinearity in the multiple regression model as it is significantly correlated with sugar exposures in both liquid and solid form. Model was statistically significant at P<.01
Model 3: Multiple linear regression model depicting the association of caries with significant SES variables (age, household overcrowding), dietary variables (sugar exposures in liquid and solid form), and Social Capital. The variable "Sugar exposures between meals" has been eliminated to avoid multi-collinearity in the multiple regression model. Model was statistically significant at P<.01

TABLE 3 Regression analysis of the association between dental caries in 3-5-year-old children with socioeconomic variables, dietary sugar consumption, and social capital.

multi-collinearity, as it was significantly associated with the two other dietary independent variables i.e., sugar exposures in liquid form (p<0.01), sugar exposures in solid form (p<0.01). Stepwise multiple regression analysis showed that Model 3 was the best fitted model depicting dental caries in the study population, followed by Model 2 with variances 13.0% (SE=2.85; p<0.01) and 11.0% (SE=2.88; p<0.01) respectively. None of the independent variables in the either adjusted models exceeded a VIF >2.0(Table 3).

Discussion and conclusion

A model that included social capital, accounted for a greater percentage of variances in dental caries in our population of preschool children in comparison to socioeconomic and dietary factors alone. Our study confirmed that social capital has an impact on the prevalence of dental caries in conjunction with other known factors that influence this disease. A recent systematic review reported that there is moderate quality of evidence to support the association of sugar consumption and dental caries [Moynihan & Kelly, 2014].

Previous studies have found dental caries to be associated with social determinants like household crowding [Bhayade et al., 2016] similar to our findings. Diet and its composition can vary across regions within a country and each region or state may have its own style of cuisine. It is also influenced by community, family and individual factors, including availability and costs of foods [Paglia., 2019]. A large percentage of children in our study had high sugar consumption. This finding as well as mean dmft values of our study concurs with the findings of another study carried out in a neighboring state that has similar cuisine [Kuriakose et al., 2015].In Italy, high sugar consumption was associated with early childhood caries [Colombo et al.,2019; Severino et al., 2021]. To the best of our knowledge this is the first study to explore the role of parental social capital and its association with dental caries in a young population. Social cohesion [Pattussi et al., 2001] and social control [Kumar et al., 2019] have been associated with caries among 5–12-year-old children, while another study in Japanese 3-year-old children showed protective contextual effects of social cohesion on dental caries [Aida et al., 2008]. Social capital has also been associated with other aspects of oral health. A 7-year cohort study among preschool children confirmed that high levels of individual and neighborhood social capital in early childhood positively influenced children's oral health-related quality of life [Knorst et al., 2019]. In adolescents, neighborhood social capital was associated with self-rated oral health [Furuta et al., 2012]. However, it is difficult to directly compare our outcomes to the extant literature due to the wide variation in previous studies' measurement of social capital. As per 2011 census, 71.63% of the population of Udupi districts lives in rural areas of villages with only a smaller percentage of population living in urban areas. While the urban population has access to private preschools, most rural children attend public or government run preschools. Therefore, to obtain a representative sample, we included children who were enrolled in both public as well as private schools (average literacy rate of Udupi in 2011 was 86.24). If things are looked at gender-wise, male, and female literacy were 91.41 and 81.58 respectively which is slightly higher than the percentages obtained from our sample in terms of mother and father's education. The cross-sectional design prevents assertion of causality between the predictors and the outcome. However, cross-sectional studies are imperative tools for detecting risk and protection indicators for future longitudinal assessments. Only pre-school children participated in the study, though it is likely that not all children from the study area attend pre-school. Also, the sample was recruited from schools in a specific district, therefore, presence of selection bias cannot be ruled out. The self-reporting method used to gather information about the sociodemographic data and social capital may be subject to social desirability bias. Furthermore, the level of (oral) health literacy of the respondents

was not considered which could be an additional source of bias. The social capital scale used in our study was previously tested on an elderly population and its validity in a younger adult population is not yet established. Some recall bias can be expected in reporting diet history of the previous 24-hours. This study did not consider the potential confounding effects on the use of professionally or self-applied topical fluoridated products and dental caries and is a limitation of this study. The effects of parental attitude toward child dental hygiene, dental hygiene behaviours, and dental visits were not considered in the study. It is also possible that access to oral health care may have a diluting effect on the association of social capital and caries. The mechanisms underlying the relationship between social capital and health are complex and are yet to be fully explored. It has been reasoned that social capital may improve health by influencing health-related behaviors via rapid dissemination of health information and a greater likelihood of constructive behavioral customs adopted by the communities [Kawachi & Berkman, 2000]. In our study, social capital could have acted by affecting health-related behaviours that influence dental caries. One can speculate that social capital could act on oral health by nurturing and enabling the execution of oral health promotion schemes and services. Perhaps the most fascinating feature of social capital is that it does not depreciate with use like other physical assets. In contrast, there is a multiplier effect by which the more social capital is used the larger it becomes. Public health planners could deploy measures to improve social capital among communities through empowering community/neighborhood groups which could provide the necessary emotional cushion as well as institutional health linkages for last mile oral health care delivery. The institutional linkages could provide them with timely, relevant oral health information, health financing mechanisms as well as quality dental care. Oral health education given to care givers may also improve children's oral health [Sneha et al., 2022]. Community health insurance schemes supported by the local community and the government can be extended to cover primary dental care. Further, campaigns of oral health promotion directed at not only the children but also their care takers are essential. After examining the association between social capital and aspects of health, future studies must examine whether social capital can be manipulated through interventions and, if so, whether increased social capital leads to better oral health.

Author Contribution

VGD and SA conceived the idea; VGD, DK and DS collected the data and obtained permissions and reviewed the manuscript; VDC&DS did the data analysis; SA and DS led the writing. All authors reviewed and approved the final version of the manuscript.

Compliance with Ethical Standards

All procedures performed in this study were in accordance with the ethical standards of the institutional research committee (Kasturba Medical College and Kasturba Hospital Ethics Committee, Reference number: 897/2018) and with the 1964 Helsinki declaration and its later amendments (2002) or comparable ethical standards. The authors declare no conflict of interest and no external funding from any source was obtained for the conduct of this study. Informed consent was obtained from all participants prior to participating in the study.

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Conflict of Interests

The authors declare that they have no conflict of interest related to this study.

Availability of data and material

Data will be made available on request.

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