

Original

Prevalence and risk factors for non-carious cervical lesions in children attending special needs schools in India

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Abstract: We assessed the prevalence and risk factors for development of non-carious cervical lesions (NCCLs) in children attending special needs schools in India. The participants were 395 children aged 12-15 years with disabilities in learning, communication, physical function, and/or development. A questionnaire was designed in order to collect information on sociodemographic characteristics, oral hygiene practices, dietary habits, and risk factors for NCCLs. The chi-square test, bivariate analysis, and logistic regression analysis were used to analyze the data. Presence of NCCLs was associated with use of toothpowder or other materials for teeth cleaning, use of harder toothbrushes, use of a horizontal scrub technique for toothbrushing, consumption of a vegetarian diet, and greater consumption of lemon. The overall prevalence of NCCLs was 22.7%. Most lesions involved minimal loss of contour or defects <1 mm in depth. The prevalence of non-carious cervical lesions was slightly higher than the global average. Effective policies should be developed for oral health

care among children attending special needs schools. (J Oral Sci 57, 37-43, 2015)

Keywords: non-carious cervical lesions; risk factors; special needs school.

Introduction

A non-carious cervical lesion (NCCL) is a loss of tooth structure at the cervical aspect of the tooth (1). The prevalence of NCCLs varies widely; one review reported a range of 5-85% (2). The appearance of NCCLs varies, from a shallow depression to a broad disk-shaped lesion to a large wedge-shaped defect. The floor of the lesion may be flat, indented, or sharply angled (2).

The cause of NCCLs is multifactorial (3,4), which makes it difficult to describe their etiology precisely (2,3,5). It is generally agreed that NCCLs are caused by a combination of abrasion, erosion, and tooth flexure (2). Erosion is caused by acid-mediated surface softening, (6) and abrasion results from wearing of dental hard tissues by mechanical processes involving foreign objects or substances repeatedly introduced into the mouth and contacting the teeth (7). The bucco-cervical region of the tooth is most vulnerable, and the hard tissues mainly affected are the cementum and dentin. The lesions are referred to as dental or cervical abrasion (8).

NCCLs are progressive. Several hypotheses regarding

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the origin of cervical lesions have been suggested, eg, abrasion of hard dental tissue during toothbrushing, chemical erosion via exogenous and endogenous acids, and occlusal loading (9,10). The relation of brushing technique and brushing force with the presence of cervical lesions has been confirmed in a number of studies (11,12). In addition, dietary factors such as consumption of lemon, citrus fruit, cola-flavored soft drinks, and citrus-flavored drinks have been implicated in the development of cervical lesions (13-15).

Epidemiologic studies indicate that children attending special needs schools frequently have poor oral health (16-18). Such children often have a greater number of severe oral pathologies, due to their disability or other medical, economic, or social reasons, or because their parents find it difficult to ensure proper daily oral hygiene (19). Lack of manual dexterity and abnormal oral hygiene behaviors may be related to development of NCCLs in these children.

Few studies have assessed the prevalence and severity of NCCLs in children attending special needs schools. Thus, we examined the prevalence and risk factors of NCCLs in children attending special needs schools in Indore city, in Central India. The study findings will help identify risk factors in the development of such lesions and suggest treatments that prevent NCCL development and progression.

Materials and Methods

This descriptive cross-sectional survey enrolled children attending special needs schools in Indore city, Central India. Children aged 12-15 years who were present on the examination day, cooperative, and with positive parental consent were included in the study. We excluded children whose parents did not provide consent and those who declined to participate, were uncooperative, or had any systemic disease for which oral examination was contraindicated. Four special needs schools from different zones of Indore city were selected. Children with disabilities in learning, communication (deaf-mute children), physical function (orthopedic impairment), and/or cognitive development were included in the study.

Ethical approval to conduct the study was received from the Institutional Review Board of the Regional Institute of Medical Sciences (IEC No 6/9/ (ii)/9/9/2014). Permission to conduct the study was obtained from the principals of the respective special needs schools. Informed consent was received from the children and parents participating in the study. The study was conducted from June through July 2014 (2 months), and 25-30 children were examined per day. A pilot study enrolled 25 randomly selected chil-

dren. On the basis of the findings of that study, a sample size of 395 children was selected for the present study.

A questionnaire was designed in order to collect information on sociodemographics, oral hygiene practices (frequency of brushing, material used, brushing technique, etc.), and dietary risk factors in the development of NCCLs. The dietary risk factors included consumption of acidic and citrus foods, which have been associated with development of NCCLs. Consumption was assessed using a Likert scale (several times a day, every day, several times a week, once a week, several times a month, seldom/never). The questionnaire was translated into the Hindi language and then back-translated into English by translators without access to the original questionnaire, to verify the validity of the questionnaire. The validity of the translation was verified by experts in both languages. The questionnaire was distributed to the children in their classroom, completed, and collected after 20-30 min. Teachers provided help for children with communicative difficulties.

Socioeconomic status was assessed using the modified Kuppaswamy scale (20). Data on income, education, and parental occupation were collected from the records office. Socioeconomic status was then categorized as upper, middle, and lower class.

Clinical examination of the oral cavity was done by a single examiner trained and calibrated at Sri Aurobindo College of Dentistry, Indore. Intra-examiner reliability was assessed using the kappa statistic, which was 0.82-0.86 for the lesions studied. For the examination, the participants were asked sit in a chair under natural light. The tools for the clinical examination included a mouth mirror, cotton roll, and Community Periodontal Index (CPI) probe. The Smith and Knight tooth wear index was used to identify NCCLs in the participants (21). The tip of the CPI probe was swiped gently across the buccal and lingual/palatal tooth surfaces, to check for the presence of NCCLs. All permanent teeth were examined for the presence/absence of NCCLs. After all teeth were examined, the highest score was recorded, and the participant was classified on the basis of the highest score obtained. To avoid interviewer bias, the same examiner performed the data collection, questionnaire administration, and clinical examination.

After the clinical examination, the participants and teachers received a 20-min lecture on oral health awareness, which was based on the study models.

Data analysis

Statistical analysis was performed using SPSS version 16.5. The chi-square test was used to assess differences

between categorical variables. Frequency distribution analysis was performed to evaluate NCCL prevalence, and logistic regression analysis was used to identify predictors of NCCL development. A *P* value of <0.05 was considered to indicate statistical significance.

Results

The study included 170 boys and 213 girls. Most children (80%) were of middle or lower socioeconomic status. Nearly 80% of participants brushed daily using a toothbrush and toothpaste. Nearly 70% used a medium or hard toothbrush for oral hygiene maintenance, and 71% had

never visited a dentist (Table 1). The overall prevalence of NCCLs was 22.7%. Prevalence was higher among girls (25.4%) than among boys (19.4%) (Table 2).

Of the 87 children with NCCLs, 52 (59.8%) had minimal loss of contour, 18 (20.7%) had a defect with a depth <1 mm, 12 (13.8%) had a defect with a depth of 1-2 mm, and 5 (5.7%) had a defect with a depth >2 mm, pulp exposure, or exposure of secondary dentin (Table 3).

Bivariate analysis of the whole sample, with presence of NCCLs as the dependent factor, showed that NCCLs were significantly associated with material used for oral hygiene maintenance, type of toothbrush used, technique of toothbrushing, type of diet, and frequency of consumption of soft drinks and lemon (Table 4).

Because the cause of NCCLs is multifactorial, logistic regression analysis using the Enter method was used to identify factors significantly associated with NCCL development. Participants who used toothpowder (odds ratio [OR], 1.63) or other materials (OR, 1.75) had a significantly greater tendency to develop NCCLs as compared with children who used toothpaste. The children who used a hard toothbrush had a significantly greater tendency (OR, 3.80; *P* = 0.044) to develop NCCLs than did children who used soft toothbrushes. Participants who used a horizontal scrub technique had a significantly greater tendency (OR, 2.05; *P* = 0.006) to develop NCCLs than did children who used a circular brushing technique. Participants who consumed a vegetarian diet had a significantly greater tendency (OR, 1.86; *P* = 0.027) to develop cervical lesions than did those consuming a mixed diet. Children who consumed lemon several times a day had a significantly greater tendency (OR, 7.28; *P* =

Table 1 Participant sociodemographic factors and diet

Variable	Category	<i>n</i> (%)
Gender	Male	170 (44.4)
	Female	213 (55.6)
Socioeconomic status	Upper	60 (15.7)
	Middle	152 (39.7)
	Lower	171 (44.6)
Oral hygiene aids	Toothbrush	344 (89.8)
	Finger	28 (7.3)
	Other methods	11 (2.9)
Material used	Toothpaste	283 (73.9)
	Toothpowder	63 (16.4)
	Other	37 (9.7)
Frequency of brushing	Once daily	320 (83.6)
	Twice daily	42 (11.0)
	More than twice daily	21 (5.5)
Type of brush used	Soft	108 (28.2)
	Medium	219 (57.2)
	Hard	56 (14.6)
Brushing technique	Vertical scrub	67 (17.5)
	Horizontal scrub	115 (30.0)
	Combination technique	162 (42.3)
	Circular method	39 (10.2)
Dental visit	Yes	111 (29.0)
	No	272 (71.0)
Type of diet	Vegetarian	167 (43.6)
	Mixed	216 (56.4)

Table 2 Prevalence of non-caries cervical lesions (NCCLs)

Prevalence of NCCLs	No. (%) of children
Overall NCCL prevalence	87 (22.7)
NCCL prevalence in boys	33 (19.4)
NCCL prevalence in girls	54 (25.4)

Table 3 Distribution of children attending special needs schools, based on the highest score obtained on the Smith and Knight index of tooth wear

Surface codes	Criteria	No. (%) of children, based on highest score obtained for dentition
Code 1	Minimal loss of contour	52 (59.8)
Code 2	Defect <1 mm in depth	18 (20.7)
Code 3	Defect 1-2 mm in depth	12 (13.8)
Code 4	Defect >2 mm in depth, pulp exposure, or exposure of secondary dentin	5 (5.7)

Table 4 Bivariate analysis of the entire sample, with presence of non-carious cervical lesions (NCCLs) as the dependent variable

Factors	Categories	NCCLs present No. (%)	NCCLs absent No. (%)	<i>P</i> value
Gender	Male	33 (19.4)	137 (80.6)	0.179
	Female	54 (25.4)	159 (74.6)	
Socioeconomic status	Upper	16 (26.7)	44 (73.3)	0.575
	Middle	36 (23.7)	116 (76.3)	
	Lower	35 (20.5)	136 (79.5)	
Oral hygiene aid used	Toothbrush	82 (23.8)	262 (76.2)	0.145
	Finger	5 (17.9)	23 (82.1)	
	Other methods (Datun, etc)	0 (0)	11 (100.0)	
Material used	Toothpaste	58 (20.5)	225 (79.5)	0.040*
	Toothpowder	22 (34.9)	41 (65.1)	
	Other (use of mouthwashes, etc)	7 (18.9)	30 (81.1)	
Brushing frequency	Once daily	74 (23.1)	246 (76.9)	0.635
	Twice daily	10 (23.8)	32 (76.2)	
	More than twice daily	3 (14.3)	18 (85.7)	
Type of brush used	Soft	11 (10.2)	97 (89.8)	<0.001*
	Medium	54 (24.7)	165 (75.3)	
	Hard	22 (39.3)	34 (60.7)	
Technique of brushing	Circular scrub	7 (10.4)	60 (89.6)	0.023*
	Horizontal scrub	30 (26.1)	85 (73.9)	
	Combination (Vertical+Horizontal)	44 (27.2)	118 (72.8)	
	Vertical scrub	6 (15.4)	33 (84.6)	
Dental visit	Yes	27 (24.3)	84 (75.7)	0.687
	No	60 (22.1)	212 (77.9)	
Type of diet	Vegetarian	48 (28.7)	119 (71.3)	0.014*
	Mixed	39 (18.1)	177 (81.9)	
Frequency of yoghurt consumption	Several times a day	1 (11.1)	8 (88.9)	0.711
	Everyday	9 (20.9)	34 (79.1)	
	Several times a week	13 (18.3)	58 (81.7)	
	Every week	30 (25.2)	89 (74.8)	
	Seldom /Never	34 (24.1)	107 (75.9)	
Frequency of fruit consumption	Several times a day	1 (14.3)	6 (85.7)	0.476
	Everyday	10 (20.8)	38 (79.2)	
	Several times a week	11 (16.9)	54 (83.1)	
	Every week	34 (27.9)	88 (72.1)	
	Seldom /Never	31 (22.0)	110 (78.0)	
Frequency of soft drink consumption	Several times a day	7 (36.8)	12 (63.2)	<0.001*
	Everyday	23 (37.7)	38 (62.3)	
	Several times a week	26 (29.2)	63 (70.8)	
	Every week	17 (17.2)	82 (82.8)	
	Seldom /Never	14 (12.2)	101 (87.8)	
Frequency of lemon consumption	Several times a day	7 (33.3)	14 (66.7)	<001*
	Everyday	25 (40.3)	37 (59.7)	
	Several times a week	29 (33.0)	59 (67.0)	
	Every week	19 (17.1)	92 (82.9)	
	Seldom /Never	7 (6.9)	94 (93.1)	
Method of consumption	Straw	33 (19.4)	137 (80.6)	0.179
	Direct swallow	54 (25.4)	159 (74.6)	
Type of soft drink	Carbonated	42 (23.5)	137 (76.5)	0.807
	Non-carbonated	45 (22.1)	159 (77.9)	

**P* < 0.05: statistically significant difference

Table 5 Results of logistic regression analysis

Factors	Categories	Adjusted odds ratio	95% confidence interval	P value
Material used	Toothpaste	1		0.014*
	Toothpowder	1.63	0.55-4.82	
	Other	1.75	0.65-4.76	
Brush used	Soft	1		0.044*
	Medium	1.74	0.79-3.80	
	Hard	3.80	1.33-10.87	
Brushing technique	Circular method	0.40	0.11-1.46	0.006*
	Horizontal scrub	2.05	0.70-6.02	
	Combination (vertical+horizontal)	1.80	0.64-5.07	
	Vertical scrub	1		
Diet	Vegetarian	1.86	1.08-3.21	0.027*
	Mixed	1		
Soft drink consumption	Several times a day	1.77	0.44-7.22	0.822
	Everyday	1.30	0.44-3.83	
	Several times a week	1.59	0.62-4.05	
	Every week	1.06	0.43-2.59	
	Seldom /Never	1		
Lemon consumption	Several times a day	7.28	1.62-32.70	0.016*
	Everyday	6.83	1.95-23.87	
	Several times a week	3.56	1.10-11.46	
	Every week	2.44	0.87-6.82	
	Seldom /Never	1		

* $P < 0.05$: statistically significant difference

0.016) to develop NCCLs than did children who seldom/never consumed lemon. However, frequency of soft drink consumption, which was significant in bivariate analysis, was not significantly associated ($P = 0.822$) with NCCL development in logistic regression analysis (Table 5).

Discussion

We used a standardized questionnaire to assess the prevalence and risk factors for NCCL development in children attending special needs schools in Indore city, India. NCCLs were assessed using the tooth wear index proposed by Smith and Knight (21). All cervical areas of the buccal and palatal/lingual surfaces of all permanent teeth were examined using a CPI probe. Assessment of all teeth is appropriate in children aged 12-15 years because the teeth have already been exposed in the mouth for a considerable period of time at this age. Hence, the effects of oral hygiene behavior and dietary risk factors on NCCL development can be better assessed.

The prevalence of NCCLs was 22.7% in the present study. This value is slightly higher than the range of 15-20% reported in previous studies (22-24). The higher prevalence in our study may be due to the fact that the participants included children at special needs schools, who may lack manual dexterity and have inadequate knowledge of oral hygiene practices. However, the

present prevalence is much lower than values reported by Smith et al. (1) and Tomasik (25), possibly because of cross-cultural variation and differences in dietary patterns among populations. The prevalence of NCCLs was higher among girls than among boys in our study, but the difference was not significant.

Among the 87 children with NCCLs, nearly 60% had minimal loss of contour. The prevalence of lesions that had progressed to pulp exposure was low (5.7%). Similar findings were reported by Borcic et al. (26), who found that most NCCLs were lower-grade lesions. The prevalence of severe lesions progressing to pulp exposure was very low. The authors suggested that NCCL progression causes sensitivity and discomfort, which prompts children to seek dental care and treatment of lesions. The prevalence of severe NCCLs is thus rare.

Bivariate analysis was used to identify indicators of NCCLs, which were then entered into logistic regression analysis to identify predictors of NCCL development. NCCL prevalence was significantly higher in participants who regularly consumed soft drinks than in those who seldom/never consumed soft drinks, which confirmed earlier findings (1,25). Because of the acidity and high sugar content of cola drinks, their corrosive potential is probably related to volume and frequency of intake (13). Consumption of soft drinks lowers pH in the oral cavity,

which causes dissolution of tooth enamel. However, logistic regression analysis showed no significant association between frequency of soft drink consumption and NCCL development.

NCCL development was significantly associated with the material used for oral hygiene maintenance. As compared with children using toothpaste, those who used toothpowder or other such materials for oral hygiene maintenance were more likely to develop NCCLs. Similar findings were reported by Yadav et al. (27) and Münch (28). We hypothesize that coarse particles in toothpowder exert greater pressure on tooth surfaces, thereby increasing mechanical wear of the tooth and hastening NCCL development.

NCCL development was significantly associated with the type of toothbrush used for oral hygiene maintenance. Children who used a medium or hard toothbrush for oral hygiene maintenance were more likely to develop cervical lesions than were children using softer toothbrushes. Smith et al. (1) and Piotrowski et al. (29) reported similar findings and suggested that toothbrush abrasion was likely to have contributed to the formation of most wedge-shaped lesions in their subjects.

NCCL development was significantly associated with toothbrushing technique. Participants who used a horizontal scrub technique had a significantly greater tendency to develop NCCLs than did children using a circular method. Similar findings were reported in previous studies (23,30,31). Horizontal scrubbing exerts force in a direction against the that of enamel rods, which causes early mechanical wearing and progression of cervical lesions.

Dietary factors are important in the development of NCCLs. Children consuming a vegetarian diet had a significantly greater tendency to develop NCCLs than did those who consumed a mixed diet. Smith et al. reported similar findings (1). Consumption of a vegetarian diet may expose individuals to greater erosive challenges, which could lead to NCCL development.

NCCLs were significantly associated with lemon consumption. Participants who regularly consumed lemon drinks had a greater tendency to develop NCCLs than did children who seldom/never consumed lemon drinks. Similar findings were reported in previous studies (1,32). Lemons contain citric acid, which lowers saliva pH, thereby facilitating dissolution of exposed enamel.

Results of logistic regression analysis showed that the material used for toothbrushing, type of toothbrush used, toothbrushing technique, type of diet consumed, and frequency of lemon consumption were the strongest predictors of NCCL development.

The limitations of the study include its cross-sectional design and the fact that only dietary and oral hygiene practices were considered; the effects of other risk factors were not evaluated. Parents/guardians were interviewed when a child was unable to report his/her behavior, due to severity disability. This might have affected our results. Hence, further longitudinal studies, with larger samples, are necessary before results can be generalized.

The present findings indicate that an effective policy needs to be drafted in order to improve oral hygiene status in this population. Governments and not-for-profit organizations should provide funds to provide regular dental check-ups that restore and improve awareness of oral health.

Lack of manual dexterity is a factor in NCCL development among children attending special needs schools. NCCL prevalence was 22.7%, which was slightly higher than values reported in other studies of school children in India and abroad. Most children had only minimal loss of contour or a defect of <1 mm in depth. The material used for toothbrushing, type of toothbrush used, toothbrushing technique, type of diet consumed, and frequency of lemon consumption were the strongest predictors of NCCL development. Hence, to prevent further progression of these oral lesions, appropriate steps should be taken early. To prevent development of NCCLs, parents/guardians and schoolchildren should be offered health education focusing on suitable diet and correct oral hygiene practices.

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