

# Oral Hygiene Pattern observed in Primary School Children as Reported by Their Mother: A Longitudinal Study

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## ABSTRACT

**Objective:** The study was conducted to determine the oral hygiene pattern in primary school children as reported by their mother through questionnaire used in epidemiological studies.

**Materials and methods:** The study was conducted by Department of Pedodontic and Preventive Children Dentistry, Institute of Dental Sciences, Bareilly, Uttar Pradesh, India. The children received dental examinations, and their mothers were interviewed at home. The gold standard for oral hygiene was the simplified oral hygiene index. The mothers answered questions related to their child's oral hygiene, including daily tooth brushing, tooth brushing before sleeping and the combination of the two (oral hygiene). These responses were dichotomized into regular and irregular. The validity was determined by calculating the percentages and respective 95% confidence intervals for sensitivity, specificity, positive predictive value and negative predictive value.

**Results:** The overall prevalence of dental plaque was 38.3%. Just over half (54.6%) of the children were boys. Approximately, 80% of the mothers reported that their children brushed their teeth twice or more per day; however, 42.7% of the children presented oral hygiene pattern considered irregular. Plaque was higher among those with an irregular daily brushing pattern (49.8%, 95% CI 43.5; 56.1) and irregular oral hygiene (42.2%, 95% CI 37.7; 46.6) than among those in the regular categories.

**Conclusion:** Oral hygiene questions answered by mothers of primary school going children are not an appropriate substitute for direct oral hygiene assessment by the clinical examination of dental plaque.

**Keywords:** Children, Mother, Dental plaque, Tooth brushing.

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## INTRODUCTION

As evidenced by the US National Health and Nutrition Examination Survey,<sup>1</sup> incorporation of oral health questionnaires into epidemiologic studies has become more common. However, such strategies will only be useful if the questions are valid, i.e. if the individual self-assessment actually matches the epidemiological diagnose in most of the cases.

In the oral health field, some studies have also focused on this subject. Evidence from the literature has indicated

that the validity of some self-reported measures of gingivitis and periodontal disease,<sup>2</sup> the presence of dental caries,<sup>3</sup> restorative needs<sup>4</sup> and orthodontic needs<sup>5</sup> are undesirably low, whereas tooth counts and the use of partial dentures<sup>6</sup> show acceptable validities. All of the oral health studies mentioned above were performed in adolescent, adult and elderly population in developed countries. The validity of self-reported oral health measures in children has been poorly addressed,<sup>7</sup> and studies of this nature have not been performed in developing countries.

Bacterial plaque control is recognized as a key factor for preventing dental caries, gingivitis and periodontitis, and it can be used to assess oral hygiene standards. Furthermore, such an assessment may aid in planning preventative and health-promotion educational programs, which commonly target schoolchildren. In addition, it has been shown that oral hygiene standards in children are influenced by their socioeconomic factors and parents' attitudes toward oral health.<sup>8</sup>

Clinicoepidemiological indicators, such as the simplified oral hygiene index (OHI-S) proposed by Greene and Vermillion (1964),<sup>9</sup> have traditionally been used to assess the oral hygiene levels of individuals or communities. Classic oral hygiene questions, such as the frequency of daily tooth brushing, have been extensively used in research and population surveys to assess oral hygiene levels and, in some instances, as substitutes for clinical examinations.<sup>7</sup> However, the validity of such questions is not currently known, which makes them weak from a scientific point of view and compromises their use.

The aim of this study was to determine the validity of questions commonly used in epidemiological studies of children's oral hygiene to predict the presence of dental plaque, comparing overall validity with the results obtained by subgroups of education level of mother.

## MATERIALS AND METHODS

The study was conducted on 1,125 children from different areas of Bareilly, Uttar Pradesh, India by the Department of Pedodontics, Institute of Dental Sciences, Bareilly, Uttar Pradesh.

The oral health study commenced in October 2011. The parents/guardians of all the study group members born

between July and October of 2008 who had been followed up to the age of 4 years ( $n = 1,429$ ) were invited to participate in the study. The children were aged 5 (plus or minus a few weeks) and were in the deciduous stage of dentition.

A team of four pedodontists and 10 interviewers performed the fieldwork, which consisted of oral examinations for dental caries, occlusal problems, soft tissue lesions, and the eruption patterns of first permanent molars and the presence of dental plaque. The tested questions were presented in a structured interview with the mother in Hindi which was later translated into English, involved questions related to the child's oral hygiene pattern. Both the intraoral examination of the child and the interview with the mother was performed in a single home visit. The children were examined while seated on chair and under a sunlight. The interview preceded the intraoral examination, so that the questionnaire responses would not be influenced by the outcome of the examination. Out of 1,429 children, finally 1,125 children became the subject of the study.

The children's oral hygiene status was assessed using a version of the OHI-S9 that had been modified to address deciduous dentition.

The OHI-S (modified for deciduous dentition) was used as the gold standard for oral hygiene assessment in this validation study. The presence of plaque was varied on the buccal surface of 6 index teeth: The upper right second deciduous molar (tooth 55), the upper right central deciduous incisor (tooth 51), the upper left second deciduous molar (tooth 65), the lower right second deciduous molar (tooth 85), the lower left central deciduous incisor (tooth 71) and the lower left second deciduous molar (tooth 75). According to the OHI-S, dental plaque is defined as a soft organic material loosely adhering to the tooth surface. The tooth surface covered by plaque was estimated by visual examination according to the following criteria: 0 = no plaque present; 1 = plaque covering no more than one-third of the surface in question; 2 = plaque covering more than one-third, but no more than two-third of the surface; 3 = plaque covering more than two-third of the surface; 9 = tooth excluded, no information. This last category was considered as missing data. The total OHI-S score was calculated and later dichotomized into plaque absent (total score = 0) or plaque present (total score  $\geq$ ).

The variables on the child's oral hygiene were answered by the mothers and included: (i) Daily brushing frequency, by the question 'In general, how many times a day does child brush his/her teeth?' The answer choices were never/not every day, once, twice and three times or more. These were later grouped into irregular (never or once) or regular (twice or more). (ii) Brushing before sleeping, by the

question 'Before bed, does child brush his/her teeth?' The possible answers were never, sometimes and always, which were later grouped into irregular (never or once) or regular (always). Oral hygiene was defined by the combined frequencies of daily brushing and brushing before bed. This was categorized as good (regular brushing frequency and regular bedtime brushing), fair (irregular brushing frequency and regular bedtime brushing or *vice versa*) or poor (irregular brushing frequency and irregular bedtime brushing). These categories were later narrowed into irregular (poor and fair) and regular (good). The categorization of oral hygiene into regular and irregular patterns followed guidelines from the literature.<sup>10</sup>

The analyses were performed according to the education level of the mother based on completed school years and categorized as 0 to 4, 5 to 8, 9 to 11 and 12 or more years.

The validity was determined by comparing the mother's report of the child's oral hygiene with the clinical examination findings by the dentists and calculating the percentage values and respective 95% CI for sensitivity (SE), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV). The SE consisted of the fraction of children with dental plaque (according to the gold standard) whose mothers reported an irregular oral hygiene pattern. The SP was obtained from the proportion of plaque-free children whose mothers reported a regular oral hygiene pattern. The PPV was obtained from the proportion of children with plaque (the true positives) whose mothers reported an irregular oral hygiene pattern. The NPV was obtained from the proportion of plaque-free children (true negatives) whose mothers reported a regular oral hygiene pattern.

The results obtained were subjected to statistical analysis.

Dental plaque prevalence was studied in the 5-year-old, according to socioeconomic factors and oral hygiene habits ( $n = 1,125$ ).

## RESULTS

The questionnaire response rate for this study was 88.8% ( $n = 1,132$ ). The final sample included only those subjects who also underwent the clinical examination for dental plaque ( $n = 1,125$ ).

The prevalence of dental plaque was 38.3%. The distribution of the studied variables, the prevalence of dental plaque according to sex, and the child's oral hygiene pattern (as reported by their mothers), and the mothers' education levels are shown in Table 1. Just over half (54.6%) of the children were boys. Approximately, 80% of the mothers reported that their children brushed their teeth twice or more

**Table 1:** Dental plaque prevalence in the studied primary school going children, according to mother's education level and oral hygiene habits

Variables	Distribution		Prevalence of dental plaque (n)	(95% CI)
	n	%		
Presence of dental plaque <sup>a</sup>			423	38.3 (34.1-39.9)
Sex				
Male	615	54.6	238	40.1 (35.7-43.7)
Female	510	45.3	189	34.1 (30.0-38.0)
Frequency of daily tooth brushing				
Regular	845	75.1	271	31.3 (30.2-36.5)
Irregular	280	24.8	145	52.3 (43.5-56.1)
Brushing before bed <sup>c,d</sup>				
Regular	419	37.2	168	34.5 (31.0-38.1)
Irregular	706	62.4	248	40.9 (36.2-45)
Oral hygiene <sup>b</sup>				
Regular	642	57.0	212	32.0 (29.4-36.7)
Irregular	483	43.0	202	42.2 (37.7-46.6)
Mother's education in school years <sup>b</sup>				
12 or more	124	11.2	27	22.0 (14.0-29.4)
9 to 11	394	35.7	132	33.7 (29.0-38.4)
5 to 8	442	40.0	183	41.6 (37.1-46.3)
0 to 4	147	13.0	68	47.2 (93.0-55.5)

<sup>a</sup>: Dental plaque prevalence as measured by the OHI-S; <sup>b</sup>: Variables with missing information. The highest number of missing observations was 23; <sup>c</sup>: Never brushes, does not brush everyday or brushes only once daily; <sup>d</sup>: Never or sometimes brushes before bed

**Table 2:** The validity of oral hygiene patterns in relation to dental plaque (OHI-S) in 5-year-old children

Validity	Irregular daily brushing <sup>a</sup>	Test irregular bedtime brushing <sup>b</sup>	Irregular oral hygiene <sup>c</sup>
SE (95%CI)	29.6 (25.3-34.3)	41.8 (37.0-46.7)	48.8 (43.9-53.7)
SP (95%CI)	82.5 (79.5-85.2)	64.6 (61.0-68.2)	60.8 (57.1-64.4)
PPV (95%CI)	49.8 (43.4-56.2)	40.9 (36.2-45.8)	42.2 (37.7-46.7)
NPV (95%CI)	66.6 (63.4-69.7)	65.5 (61.8-69.0)	67.0 (63.2-70.6)

SE: Sensitivity; SP: Specificity; PPV: Positive predictive value; NPV: Negative predictive value; <sup>a</sup>: Never brushes, does not brush everyday or brushes only once daily; <sup>b</sup>: Never or sometimes brushes before bed; <sup>c</sup>: Combination of irregular daily tooth brushing frequency and irregular bedtime brushing

per day; however, 43% of the children presented oral hygiene pattern considered irregular. Plaque was higher among those with an irregular daily brushing pattern (52.3%, 95% CI 43.5; 56.1) and irregular oral hygiene (42.2%, 95% CI 37.7; 46.6) than among those in the regular categories.

The validity in relation to the OHI-S of the maternal reporting of the children's oral hygiene patterns is presented in Table 2. A low SE was observed for irregular daily brushing (29.6%, 95% CI 25.3; 34.3); but when bedtime brushing was also considered (the variable denominated oral hygiene), the sensitivity increased to 48.8% (95% CI 43.9; 53.7). The opposite occurred with the SP values, which showed higher values in the irregular daily brushing group (82.5%, 95% CI 79.5; 85.2) and lower values for the oral hygiene variable (60.8%, 95% CI 57.1; 64.4). The brushing frequency variable had the highest PPV (49.8%, 95% CI 43.4; 56.2), while the NPV for all three variables showed similar values, ranging from 65.0 to 67.0%.

The validity results were grouped by the mother's education level (Table 3), i.e. higher SE for oral hygiene and higher SP for the frequency of daily brushing in all the education categories. The increase in the SE for the questions was inversely proportional to the number of years that the mother attended school, while the opposite effect was observed for the SP values. The PPV was higher among the children of less educated mothers, and the contrary was observed for the NPV.

## DISCUSSION

The questionnaire on oral hygiene patterns, as answered by the mothers of 5-year-old children, showed an unsatisfactory performance in assessing actual oral hygiene; therefore, its validity as a substitute for the intraoral examination of dental plaque is questionable. Although no universally accepted criteria for an accurate test exists, some authors have defined a test to be accurate if the sum of its SE and SP values is

**Table 3:** The validity of oral hygiene pattern in relation to dental plaque (OHI-S) in primary school going children family income quartiles

Test validity	Mother's education (in school year completed)			
	0-4	5-8	9-11	12 or more
Irregular daily tooth brushing				
SE (95% CI)	32.2 (23.8-41.5)	28.4 (20.5-37.6)	36.1 (27.5-45.4)	15.4 (7.63-26.5)
SP (95% CI)	77.2 (70.1-83.4)	81.7 (75.0-87.02)	81.7 (75.6-86.9)	89.1 (83.5-93.3)
PPV (95% CI)	49.3 (37.6-61.1)	51.6 (38.7-64.2)	54.4 (42.8-65.7)	34.5 (17.9-54.3)
NPV (95% CI)	62.3 (55.03-68.9)	62.4 (55.7-68.8)	67.99 (61.6-73.8)	73.8 (67.3-79.6)
Irregular bedtime brushing				
SE (95% CI)	48.7 (39.3-58.2)	43.5 (34.3-53.0)	42.9 (33.8-52.3)	24.6 (14.8-36.9)
SP (95% CI)	57.5 (49.6-65.1)	61.5 (53.8-68.9)	65.5 (58.4-72.1)	73.6 (66.4-79.9)
PPV (95% CI)	44.1 (35.3-53.2)	43.5 (34.3-53.0)	42.9 (33.8-52.3)	25.8 (15.5-38.5)
NPV (95% CI)	61.9 (53.8-69.6)	61.5 (53.8-68.9)	65.5 (58.4-72.1)	72.3 (65.1-78.8)
Irregular oral hygiene				
SE (95% CI)	54.8 (45.2-64.1)	47.8 (34.4-57.3)	52.9 (43.6-62.2)	32.3 (21.2-45.1)
SP (95% CI)	54.5 (46.6-62.2)	58.6 (50.8-66.1)	60.9 (53.7-67.8)	69.0 (61.5-75.7)
PPV (95% CI)	45.3 (36.9-54.0)	44.0 (35.1-53.2)	45.0 (36.06-53.6)	28.0 (18.2-39.6)
NPV (95% CI)	63.6 (55.2-71.5)	62.3 (54.2-69.8)	68.2 (60.8-75.0)	73.2 (65.7-79.8)

SE: Sensitivity; SP: Specificity; PPV: Positive predictive value; NPV: Negative predictive value

higher than 120%.<sup>2</sup> In the present study, despite using the lowest summation, a desirable level of accuracy was not obtained.

The results of the present study must be interpreted with caution because limitations on the data collection for the gold standard may have occurred. The OHI-S advocates a visual examination with the aid of a dental probe to determine the extent of plaque. The use of a plaque-disclosing solution, although not recommended for epidemiological surveys, could facilitate visualizing the extent of plaque; this method would thus provide a more accurate diagnosis, with a higher number of true positives observed. Another relevant point is that the OHI-S originally assessed the smooth surfaces of the teeth (buccal, palatal or lingual) in up to 12 readings. The OHI-S was modified in the present study, and only the buccal surfaces were examined in a total of six readings. Once again, the evaluation of a lower number of dental surfaces may have reduced the number of true positives and caused a lower prevalence estimate. Such factors may have reduced the actual prevalence of dental plaque as identified by the gold standard, which could consequently have led to a decrease in the PPV for the test questions.

Children with less educated mothers<sup>8</sup> and irregular oral hygiene habits<sup>11</sup> have been found to have higher prevalence of dental plaque, consistent with findings of this study.

According to this study, the probability of identifying individuals with dental plaque in children whose mothers have reported an irregular oral hygiene pattern was, in general, lower than 50%. The prevalence differences between the income and education groups could explain the variations in performance of the tests used. The twice-daily minimum tooth brushing frequency is the most

accepted evidence of adequate levels of oral hygiene. Additional factors, such as brushing time,<sup>12</sup> the use of toothpaste, features of the toothbrush bristles, the use of dental floss, brushing technique and manual dexterity, can interfere with the efficacy of good oral hygiene.<sup>13</sup> In the case of children younger than 6 years, it is recommended that the brushing be performed by an adult until the child has developed sufficient manual dexterity and cognitive skills to perform their tooth brushing independently.<sup>14</sup> Therefore, children's oral hygiene is also influenced by their mother's attitudes toward this practice.

Investigating the validity of self-reported oral health assessments in population surveys is highly relevant given the high costs of applying more accurate methods of clinical epidemiological diagnosis, such as intraoral examination. This study showed a high rate of false positives (52-70% overall), which suggests that reports from mothers on the oral hygiene of their 5-year-old children are not good substitutes for clinical intraoral examination; therefore, the presence of dental plaque should be directly assessed. More precise questions should be formulated and tested in future validation studies.

## CONCLUSION

Oral hygiene questions answered by mothers of primary school going children are not an appropriate substitute for direct oral hygiene assessment by the clinical examination of dental plaque.

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