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Original Article

# Relationship between self-reported oral hygiene and clinical plaque index among adolescents in Isfahan

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## Abstract

**Introduction:** Although though the best way to assess individual's oral hygiene is to measure plaque and calculus indices, various studies have evaluated an individual's self-report of oral-hygiene behaviors. The aim of this study was to investigate diagnostic values of self-reporting tool and relationship between current oral self-care behaviors and plaque index (PI).

**Materials & Methods:** This cross-sectional study was conducted on 260 13-15-year-old students from girls' schools in Isfahan using two-stage randomized sampling. Data collection tools on oral-hygiene habits were extracted based on available studies and presented in two versions for student and parent. Then, students' PI was measured by a trained and calibrated examiner using Silness and Loe PI. The frequency of oral-hygiene behaviors reported by parents and students with PI was measured by McNemar, Kappa and Mann Whitney tests with significance level of 0.05. Sensitivity and specificity of the tools were calculated based on the standard PI.

**Results:** The PI mean (SD) was 1.07 ±0.5. There was a significant relationship between PI and self-reported toothbrushing status (p=0.017). The PI was higher in students with bad toothbrushing habits based on the reports of themselves and their parents as well as with bad flossing habits based on their parents' reports (p= 0.017, 0.001, 0.005). Diagnostic value of children's self-report and parental report about toothbrushing status indicated low sensitivity (about 35%) and high specificity (about 83%). Positive predictive value was approximately good (about 71%) and negative predictive value was low (about 52%). Diagnostic value of parental report about flossing status represented high sensitivity (85%) and low specificity (26%).

**Conclusion:** Findings of this study suggested that among such population, students with bad toothbrushing habits based on parental and self-reports are more likely to have undesirable (moderate/poor) PI.

**Keywords:** Toothbrushing, Sensitivity and specificity, Oral hygiene, Dental plaque index, Self-report

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# ارتباط خود گزارشی وضعیت بهداشت دهان و شاخص پلاک دندانی در نوجوانان اصفهان

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## چکیده

**مقدمه:** اگرچه بهترین روش برای ارزیابی بهداشت دهان فرد، اندازه گیری بالینی شاخص های پلاک و جرم دندانی است، در بسیاری از ارزیابی ها به گزارش فردی از رفتار بهداشتی دهان اکتفا می شود. طی مطالعه حاضر ارتباط رفتارهای رایج مراقبت فردی دهان با شاخص پلاک ارزیابی شده و ارزش تشخیصی ابزار خودگزارشی مورد بررسی قرار گرفت.

**مواد و روش ها:** مطالعه حاضر به صورت مقطعی تحلیلی در ۲۶۰ نفر از دانش آموزان ۱۳ تا ۱۵ ساله مدارس دولتی دخترانه شهر اصفهان با انتخاب به روش نمونه گیری تصادفی دو مرحله ای اجرا شد. ابزار جمع آوری اطلاعات راجع به عادات بهداشتی دهان بر اساس مطالعات موجود استخراج و به دو صورت نسخه ی دانش آموز و والدین در اختیار هر یک قرار گرفت. سپس میزان پلاک دانش آموزان توسط یک معاینه گر آموزش دیده و کالیبره بر اساس شاخص پلاک سیلنس و لو اندازه گیری شد. ارتباط فراوانی رفتار بهداشتی گزارش شده توسط فرد و والدین با درجه شاخص پلاک با آزمون های مک نمار، کاپا و مان ویتنی با سطح معنی داری ۰/۰۵ سنجیده شد و حساسیت و ویژگی ابزار پرسشنامه فردی بر اساس شاخص استاندارد پلاک محاسبه شد.

**یافته ها:** میانگین (انحراف معیار) شاخص پلاک در این جمعیت۰/۵±۱/۰۷ بود. شاخص پلاک در خودگزارشی دانش آموزان با گزارش وضعیت مسواک زدن ارتباط معنی دار ($p=0.017$) داشت. همچنین دانش آموزانی که بر اساس گزارش خود یا والدینشان عادت نامطلوب مسواک داشته و یا بر اساس گزارش والدین وضعیت نامطلوب نخ دندان داشتند دارای شاخص پلاک بالاتری بودند ($p=0.017$ ،0.001، 0.005). ارزش تشخیصی خودگزارشی و گزارش والدین از وضعیت مسواک با حساسیت پایین (حدود ۳۵٪) و ویژگی بالا (حدود ۸۳٪) و ارزش اخباری مثبت تقریبا خوب(حدود ۷۱٪) و ارزش اخباری منفی کم(حدود ۵۲٪) به دست آمد. ارزش تشخیصی گزارش والدین از وضعیت نخ دندان با حساسیت بالا(۸۵٪) و ویژگی پایین(۲۶٪) به دست آمد.

**نتیجه گیری:** بر اساس این مطالعه در صورتیکه در چنین جمعیتی گزارشی نامطلوب در زمینه مسواک زدن توسط دانش آموز یا والدین او ارائه شود به احتمال قوی شاخص پلاک او نامطلوب (متوسط یا ضعیف) بوده است.

**واژگان کلیدی:** مسواک زدن، حساسیت و ویژگی، بهداشت دهان، شاخص پلاک دندانی ، خود گزارشی

## Introduction

Assessment of the oral health-related behaviors is one of the most common outcomes in oral health studies. There are a large amount of studies in which oral health behaviors are asked as one of the risk factors or associated factors with dental caries or other oral diseases. As well, oral health behaviors are frequently used as expected outcome after health promotion programs. [1-5] In "patient-centered health care approaches", trusting in statements of patients is inevitable. Although the reports of health care clients, the provider's expertise and available best evidences for a good practice are worthwhile, their credibility and reliability should be investigated. [6] A group of epidemiological studies focuses on evaluating the patient-related tools and recognizing the professional value of the patient-centered tool based on the clinical index. In the study of Cascaes et al., the sensitivity and specificity of the mothers' reports on oral health pattern of their 5-year-old children were evaluated by clinical examination OHI-S (Oral Hygiene Index-Simplified). [7] In the study by Tahani et al. who assessed the oral health habits and status of children with hearing



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impairment in Isfahan, it was shown that there was a significant correlation between OHI-S index and their daily toothbrushing habits. [8]

To assess the efficacy of oral health-related behaviors of individuals, measurement of dental plaque and calculus is considered as the standard diagnosis. [9,10] Among the various oral-hygiene indicators, the plaque index (PI) defined by Soben is known as an indicator with validity and reliability. In addition, this index is suitable to register the severity of plaque and it is acceptable and usable in the outreach setting as well as dental unit. [11]

In summary, though self-reporting toothbrushing habits or the use of additional oral-hygiene tools have been accepted as indicators of individual's oral-hygiene status, there is a few literatures on the validity of such self-reports. Moreover, it seems that the value and reliability of self-reported hygiene behavior would be highly age-specific. In the present study on Iranian adolescents, self-reported oral health behaviors are compared with the clinical PI (Silness and Loe) as a standard as well as the sensitivity, specificity and positive and negative predictive values of them were evaluated.

## Materials & Methods

**Study Population:** This cross-sectional analytical study was approved by Ethics Committee of Isfahan University of Medical sciences with code of IR.MUI.REC.1395.3.431. The target population was 13-15-year-old students of public girls' high schools in Isfahan city of Iran. This limitation was according to the same-gender examining rules of the country. The sample size was calculated 250 persons based on the prevalence of toothbrushing of 50% (main variable), confidence level of 95% and confidence interval (CI) of 0.06. Through two-stage sampling method, 4 girls' schools of different regions were randomly selected from the high-school list of the Bureau of Education in Isfahan province, and 65 students in the seventh and ninth grades were randomly included in the study from each school. After the explanation of the aim and process of the present study, the students without consent and interest in participating or with any special medical condition were excluded from the project.

**Assessment tools:** Data gathering tool used for oral-hygiene habits was the selected questions of the World Health Organization form for the assessment of patient's risk factors. The frequency of toothbrushing during the past month was as following: "Never: 0, several times a week irregularly: 1, once a day: 2, twice daily, or more: 3". Using toothpaste containing fluoride was scaled as below: "Yes: 1 and No: 0"; using of sweet snacks as "More than three times a day: 0, three times a day or less: 1, rarely or never: 2"; and the regular use of dental floss as "Yes: 1 and No: 0". [12]

For dichotomizing the variables, in the first item, once a day/ twice daily or more toothbrushing (scores 2 or 3); in the second and fourth items, dental flossing and toothpaste usage (scores 1); and in the third item, sweet snack consumption three times a day or less (scores 1 and 2) were defined as "favorable behavior" and the other values were defined as "unfavorable behavior" status. The status of dental visit was not introduced into the tool due to the lack of relevance to the aim.

The questionnaires were provided in both student and parent versions and delivered on the examination day. The students' questionnaires were completed at site and the parents' questionnaires were collected by the school authorities during three days.

**Clinical Examination:** A standard method was used to record the clinical PI. The examiner was theoretically and practically trained by a professor of the Periodontology Department before beginning the project and calibrated by examination on 10 patients. The Kappa coefficient was calculated for the pilot test, and the main study was started after achievement the agreement over 90%. The clinical examination was done on the class chair by natural light and head light. Disposable mirror and explorer were applied to detect the plaque or debris. The examiner tried to carry out the most recordings in the early morning before their first break without any toothbrushing at their school time.

To record the index, 4 parts of teeth including distobuccal, buccal, mesiobuccal and lingual were examined. Based on the criteria, the scoring was as following "0: No plaque", "1: A film of plaque adhering to the free gingival margin and adjacent area of the tooth; the plaque may be seen in situ only after using the probe on the tooth surface", "2: Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which can be seen with the naked eye" and "3: Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin". The mean of the area indices determined the tooth PI. The sum of the recorded scores of index teeth

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was divided by the total number of examined teeth and the individual PI was calculated (Fig 1).

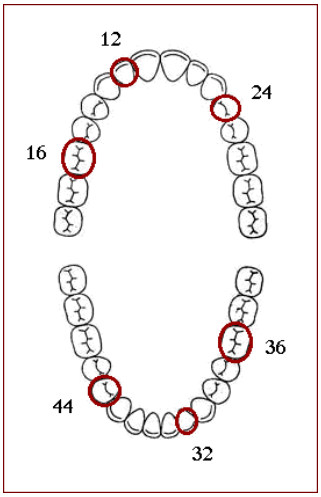



**Fig1. Index teeth for PI (Loe and Silness) calculation in high schoolchildren**

The nominal scale for assessing the patient was as below: excellent (0), good (0.1-0.9), moderate (1-1.9) and poor (2-3). This scale was recoded for sensitivity and specificity as 'desirable' (excellent and good) and 'undesirable' (moderate and poor). [11]

**Statistical Analysis:** In descriptive statistics, the score and frequency of oral health behaviors based on using the toothbrush, dental floss, toothpaste and sweet consumption habits in adolescents were reported based on parental and self-reports. Moreover, the average PI of the population was calculated. In the analytical statistics, the relationship between the status of each individual health behaviors and PI status was evaluated using McNamara test (comparing the ratio in two dependent groups) and Kappa test. Furthermore, the difference between PI mean of behaviors was evaluated in two desirable and undesirable groups with Mann-Whitney U test. Sensitivity and specificity parameters as well as positive and negative predictive values were calculated to assess the diagnostic value of the oral-hygiene tool based on PI level. For these estimations, the dichotomized values were applicable.

## Results

According to the students' reports, 22.8% (n=59) had twice a day toothbrushing habit. Almost half (51.7%, n=135) of them brushed once a day, but 25.5% cases never or rarely brushed their teeth (n=66). About 85% (n=219) of them used toothpaste containing fluoride and nearly 13% (n=35) of them had more than three sugary snacks a day. About 74.1% (n=192) of students did not use dental floss at all (Table 1).

**Table 1. The frequency of oral health-related behaviors and its relationship with PI mean based on the student's reports (n=260)**

| oral health-related behaviors | | N(%) | PI (mean±SD) | P-value |
|---|---|---|---|---|
| Tooth brushing habits | twice & more in a day | 50(19.2) | 0.9±0.4 | 0.02 |
| | once a day | 135(51.9) | 1.1±0.5 | |
| | irregular in week | 66(25.4) | 1.2±0.5 | |
| | never | 9(3.5) | 1.3±0.7 | |
| Toothpaste | using | 226(86.9) | 1.05±0.5 | 0.15 |
| | Not-using | 34(13.1) | 1.16±0.6 | |
| Cariogenic diet | More than 3 times | 42(16.1) | 1.04±0.5 | 0.79 |
| | less 3 time | 98(37.7) | 1.05±0.4 | |
| | never | 120(46.2) | 1.1±0.5 | |
| Dental flossing | using | 54(21) | 1±0.5 | 0.36 |
| | Not-using | 206(79) | 1.1±0.5 | |

To assess the agreement of proxy reports of the students and parents about the oral health behaviors, the responses were evaluated based on the criteria mentioned in the method as a dichotomous variable (favorable and unfavorable). About 94% of students who toothbrushed at least once a day had also good toothbrushing habits in their parents' point of view. There was no significant difference between the responses of students and their parents (P>0.05) regarding to toothbrushing habit. The agreement was obtained 0.86 based on Kappa coefficient (P<0.001). About 98% of the students who used toothpaste had similar opinions with their parents. The Kappa agreement was 0.89 (P <0.001) about using toothpaste.

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Approximately 94% of the students who ate sweet snacks less than three times a day had acceptable habits in parents' ideas, too. The difference was not significant (P =0.28) in this case; however, the agreement rate based on the Kappa test was 0.66 (P <0.001). About 39% of the students who reported dental flossing habits had negative reports from their parents. Using McNemar test revealed a significant difference between the student and parent responses regarding to flossing, indicating more unfavorable condition (P = 0.02) from the parents' point of view. The agreement of responses was significant based on Kappa test with a coefficient of 0.6 (P <0.001).

Among the examined students, the PI range varied from 0.1 to 2.6. The PI mean (±standard deviation) was 1.07±0.5 in the total population. After recoding the variable of plaque status to a binary variable, 120 (46.2%) cases had a desirable PI and 140 (53.8%) had an undesirable PI. The relationship between PI and oral-hygiene behaviors is illustrated in table 2 based on the reports of student and par ent. It could be seen that the PI was significantly correlated just with the self-reports on the status of toothbrushing (P=0.017) and parental reports on the child's toothbrush (P = 0.001) as well as using dental floss (P= 0.005); thus, the diagnostic value was only calculated for these factors. Regarding the evaluation of diagnostic value of reports on oral-hygiene behaviors, the statistically significant associations were considered true positive defined as persons who had undesirable PI with unfavorable oral-hygiene report. True negative was the students with desirable PI and favorable reports on oral hygiene. The results of sensitivity, specificity in addition to positive and negative predictive values are presented in table 3.

**Table 2. The relationship between oral health-related behaviors and PI based on parental and self- reports (n=260)**

| | | Parents' reports | | | | Student's self- reports | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Number | Mean ±SD* Plaque Index | | P-Value | Number | Mean ±SD* Plaque Index | | P-Value |
| **Toothbrush** | favorable | 184 | 1 | ± 0.50 | 0.001 | 193 | 1.03 | ± 0.51 | 0.017 |
| | unfavorable | 75 | 1.24 | ± 0.52 | | 66 | 1.2 | ± 0.52 | |
| **Toothpaste** | favorable | 226 | 1.06 | ± 0.50 | 0.25 | 218 | 1.05 | ± 0.50 | 0.22 |
| | unfavorable | 32 | 1.19 | ± 0.60 | | 39 | 1.15 | ± 0.60 | |
| **Diet** | favorable | 218 | 1.09 | ± 0.53 | 0.66 | 225 | 1.08 | ± 0.52 | 0.63 |
| | unfavorable | 41 | 1.02 | ± 0.46 | | 35 | 1.04 | ± 0.54 | |
| **Dental floss** | favorable | 52 | 0.89 | ± 0.45 | 0.005 | 67 | 1.01 | ± 0.48 | 0.36 |
| | unfavorable | 206 | 1.12 | ± 0.52 | | 192 | 1.09 | ± 0.53 | |

*Standard Deviation, # Mann- Whitney U test

**Table 3. Diagnostic value of reports on dental-hygiene behavior based on PI (95% CI)**

| Tool | Sensitivity | Specificity | PPV † | NPV |
|---|---|---|---|---|
| **Self-reported Toothbrushing** | 34(26-42) | 84(76-90) | 70(60-79) | 52( 48-55) |
| **Parent reports Tooth brushing** | 39.5(31-48) | 83(76-90) | 73(64-81) | 54(50-58) |
| **Parent reports Dental flossing** | 85(78-90) | 26(18-35) | 57(54-61) | 60(47-71) |

† Positive Predictive Value ‡ Negative Predictive Value

## Discussion

The results of the current study demonstrated that PI in 13-15-year-old students with a good toothbrushing habits was significantly better than that in others. The diagnostic value of self-reported toothbrushing, calculated based on the PI showed low sensitivity (the power in determining the correct patients) and relatively high specificity. The average of PI in this population was nearly good to moderate. Frequently, describing the prevalence of health outcomes is based on self-reported

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assessments, as a result of their simplicity, speed, and low cost in obtaining information. [13] However, the validity of such questions is scientifically controversial. A review on the validity of self-reported periodontal disease indicates that some measures are assured, but the results depend on population's characteristics and types of measures. [14] This study evaluated self-reported oral hygiene through clinical dental plaque examinations. In this regard, based on the known rule (high specificity+positive test=patient), if an individual presents an undesirable self-reported toothbrushing habit, he/she will be ill and his/her PI is undesirable (moderate and poor).[15] A few studies were done on testing the diagnostic value with similar methodology. In the study of Gilbert et al. on self-reported periodontal problems in periodontal patients, the high specificity of 88% and low sensitivity of 32% were obtained, representing that many patients who had a periodontal disease were unaware of their condition.[16]

In addition, in the present study based on calculated positive and negative predictive value, it was found that 70% of students who reported their toothbrushing habits as 'undesirable' really had undesirable PI. Nevertheless, if a person's self-reported toothbrushing was desirable, the likelihood of a good index of its plaque was 52% (almost equivalent to chance). In a study on periodontal disease, some oral health professionals believed that the self-reported validity was 76% and 74% for positive and negative predictive values, while these values were 83% and 69% among other health professionals, respectively. [17] Our finding suggested that the PI was significantly higher in the students whose parents reported unsuitable toothbrushing and dental flossing.

According to the results of the current study, the parents' reports on their children's toothbrushing status were very similar to the children's reports with low sensitivity (39%) and high specificity (83%), partly good positive predictive value (74%) and low negative predictive value (54%). Nevertheless, the parents' reports regarding to the condition of children's flossing were obtained with high sensitivity (85%) and low specificity (26%). Hence, this tool is a good criterion to reject a person's disease based on his/her self-report. In such a condition, based on the rule (high sensitivity+ negative test = non-patient), if a student uses dental floss according to the parent's report, it can be estimated that his/her PI is desirable (good). [15] As a result of the predictive value, if the student's report regarding to the flossing is negative with the probability of 58%, his/her PI is undesirable, and if the parents declare the use of dental floss with the probability of 60%, the PI will be desirable.[8] In the study of Cascaes et al. in Brazil in 2010, it was found that false positive rates were 72-52% and concluded that the maternal reports on the oral health of 5-year-old children were not a good alternative to oral clinical examination by PI. Therefore, the presence of dental plaque should be directly evaluated. [7] Gil et al. in Brazil in 2015 assessed the reliability of a short self-administered questionnaire on oral behaviors including toothbrushing frequency and sugar intake via microbiological test of saliva, clinical oral-hygiene index and visible PI. Like the present study, they declared that adolescents who brushed their teeth less than twice a day had visible plaque and unsatisfactory OHI-S scores. [18]

This study demonstrated that the plaque accumulation status of female students in a good representative sample in Isfahan was not too bad. A study on 18-year-old Lithuanian adolescents indicated that the oral-hygiene status was only satisfactory in 40.0% of subjects which were fewer than those (54%) in the current study. [19] However, it should be noticed that the demographic characteristics including age and gender made some limitations to generalize the findings. Moreover, the family structure and supervising the teens' behaviors would be varied among different communities and cultures and it would be changed over time. Generally, the findings of this study confirmed that the students whose parents reported unsuitable toothbrushing and dental flossing status and those who self-reported bad toothbrushing habits had higher PI. In this regard, with an acceptable validity, we can trust on these individual reporting about oral self-care behaviors, but the estimated errors should be considered for some outcome measurements.

## Conclusion

The finding supported the significant relationship between the self-reported and parent-reported toothbrushing habits and students' dental PI. The diagnostic value of self-reported/parent-reported toothbrushing based on PI showed relatively low sensitivity and high specificity. So, the reported value of "bad toothbrushing habit" is acceptable for clinical plaque index. On the other hand, good clinical index will be acceptable if the student uses dental floss according to the parent's report.

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**Conflict of interest disclosure**: The authors state that they have no conflict of interest.

## Author Contribution

Asgari developed the study concept and design as well as performed the study supervision, analysis, interpretation of data and manuscript drafting. Amiri collected data, recorded clinical indices and provided draft of study report.

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