Epidemiological dental indices and self-perceived oral health in adolescents: ecological aspects

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The aim of this study was to investigate the correlations between epidemiological indices (objective) and self-perceived oral health (subjective) in adolescents at school level, and to study gender differences in epidemiological indices and in self-perceived oral health. The study comprised two sets of data from Skaraborg County, Sweden: 1. Self-reported questionnaires answered by adolescents at all senior level schools (n = 9,559, 13–15 years). 2. Epidemiological indices based on clinical registrations of oral health in 13–15-year-old adolescents were collected in all 17 municipalities (n = 7,899). Simple and partial Pearson correlation coefficients were used to study correlations between subjective and objective oral health in the adolescents at school level. Gender differences in adolescents' subjective and objective oral health were estimated using a logistic regression model. The correlations between epidemiological index registrations and self-perceived oral health were weak. The strongest correlations were found between epidemiological indices and self-perceived gingival bleeding: 0.416 between the DS (decayed surfaces) index and self-perceived bleeding. Girls were less likely to be satisfied with the appearance of their teeth than boys were in municipalities with clinical good oral health OR 0.76 (95% CI 0.59–0.98) and with poor clinical oral health OR 0.74 (CI 0.57–0.94). No gender differences were found in the epidemiological index registrations. The currently used epidemiological indices did not reflect adolescents' own perceptions of their oral health at school level and they could not recognize or identify gender differences. Surveillance of oral health in young people should include information on self-perceived oral health. □ *Adolescence; epidemiology; outcome assessment; public health dentistry; self-perceived oral health*

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A person's oral health can be measured in two fundamentally different ways: in a clinical examination by a dental professional, or by the person himself (self-perceived oral health). These two methods of assessment have also been described as objective and subjective, respectively (1). In Sweden, clinical measures—the DMF (decayed, missing, filled) indices (2)—have been the basis for systematic epidemiological registrations of oral health among children and adolescents since the beginning of the 1980s. These registrations have been widely used in the monitoring of oral health, and for planning purposes on clinic, county, and national levels in the Nordic countries (3).

In later years, the predominant professional aspects used in evaluating oral health have been questioned as being too narrow, and a need to include the patients' self-perceived oral health has been emphasized by several authors (4, 5). The usefulness of subjective oral health indicators for monitoring outcome measures and for planning purposes has recently been recognized (6, 7). A number of patient-rated oral health indicators that focus mainly on adult and older people have been developed (8, 9), while corresponding issues in children and adolescents have been less frequently investigated.

The agreement between objective and subjective assessments has been a focus of interest for decades. In 1975, Brunswick & Nikias (10) found a congruence between dentists' ratings and adolescents' perceptions of oral health. The agreement between dentists' clinical examination and patients' self-perception of dental status has in recent years been investigated on an individual level in adult and older populations using measures such as remaining teeth and the presence of dentures (11–16). In an interview study, adolescents' perceptions of oral health were explored (17). The most profound foundations used by the informants in that study for rating their own oral health were the presence or absence of manifest carious lesions and dental appearance, for instance whiteness of teeth.

The epidemiological registrations of oral health among children and adolescents are clinical records of individuals that have been reviewed and reported aggregated on the clinic level, or a higher level. However, little is known about the congruence between these registrations and self-perceptions of oral health in local settings such as schools.

The gender perspective in health issues has been recognized in several studies (18). In Sweden, epidemiological registrations of oral health included information on gender for the first time in the year 2000. For the year 2001, only small differences between boys and girls could be demonstrated (19). However, in a comprehensive school survey in Skaraborg County, associations between

oral health attitudes, behaviors, and self-perceived oral health differed widely between boys and girls (20).

The aim of the present study was to examine the correlations between epidemiological indices (objective) and self-perceived oral health (subjective) in adolescents at the school level, and to study gender differences in epidemiological indices and in self-perceived oral health.

Materials and methods

The study comprised two sets of data on adolescents aged 13–15 years from Skaraborg County, Sweden. Skaraborg is a rural area with approximately 300,000 inhabitants, small municipalities, and a few medium-sized towns. Income and educational levels are below the Swedish national average and unemployment rates above.

Adolescents in epidemiological index registrations (data set I)

The first data set consisted of epidemiological index registrations of all 13–15-year-old individuals in the 17 municipalities surveyed by the Skaraborg PDS (Public Dental Services) in 1996. The data-processing center at the county council supplied data files with all epidemiological index registrations. A clinical dental status was determined for the subjects and registered ($n = 7,899$, coverage 83%). When the present study was planned, it was decided to use the epidemiological reports from the four extreme municipalities in the county—the two reporting the best dental health ($n = 995$) and the two reporting the poorest dental health ($n = 950$)—among young people in the ages under study. Later, the decision was taken to study a larger sample, and epidemiological reports from all 17 municipalities in the county were collected. At that time, however, information on gender had been removed from the registers and hence reports from only the four original municipalities were used to study gender differences. All information that could enable identification of individuals was removed before data processing.

Adolescents' survey (data set II)

A survey among all 13–15-year-old adolescents at the senior level of all schools in the 17 municipalities in Skaraborg County, performed in November 1996, comprised 9,559 adolescents (a participation rate of 91%). Self-reported questionnaires were answered anonymously in a standardized manner in classrooms and were then sent to a coordinating center for data processing. Several health-related and lifestyle-related topics besides dental issues were inquired about. All variables in the inquiry concerning dental matters have been presented, re-tested, and commented on elsewhere (21).

The Medical Faculty Ethics Committee of Göteborg University approved the study.

Variables and data management

In the epidemiological index registrations of 13–15-year-old adolescents (data set I), dental health was expressed using the following indices: the DFT index (decayed filled teeth), the DS index (decayed surfaces), the DSa index (decayed surfaces approximally), and the DFSa index (decayed filled surfaces approximally). Dichotomizations for logistic regressions were performed as follows: scores equaling zero were given the value 1; scores exceeding zero were given the value 0.

In the questionnaires completed by the adolescents participating in the survey (data set II), self-perceived oral health was represented by a single-item rating, and questions about self-perceived gingival bleeding and satisfaction with the appearance of the teeth. The single-item rating was expressed as the statement *'My oral health is good'* which had the following four options: 'corresponds precisely', 'corresponds roughly', 'corresponds poorly', and 'corresponds not at all'. This variable was dichotomized when used as an outcome measure: 'corresponds precisely' and 'corresponds roughly' were given the value 1; 'corresponds poorly' and 'corresponds not at all' were given the value 0. The questions concerning the occurrence of gingival bleeding and the appearance of the teeth were binary with the possible answers 'yes' or 'no'.

Information in data set I and data set II, respectively, was aggregated to the school level for the analysis. In cases when school and dental clinic catchment areas did not correspond ($n = 5$), further aggregations were made. After the final aggregations were completed, the two data sets were merged to a data set comprising 24 school areas with variables with information on epidemiological index registrations and variables with information on self-perceived oral health, all at the school level.

Statistical analysis

Associations between epidemiological index registrations made by the PDS and adolescents' self-perceived oral health at the school level were estimated using simple and partial Pearson correlation coefficients. Rank correlation versions were also used. Coverage in the epidemiological index registrations, rate of participation in the questionnaire study, and failure to complete school certificate (percentage of adolescents finishing the final class in each school (22)) were used as potential confounding variables in the partial correlations.

Gender differences in epidemiological index registrations of oral health and adolescents' self-perceived oral health were estimated using logistic regressions and expressed as odds ratios (ORs) for girls with boys as a reference, using reports from the four municipalities with information on gender. Statistical significance was assumed when the 95% confidence interval (CI) excluded 1.0.

Table 1. Dental health in adolescents 13–15 years ($n = 7,899$). Epidemiological indices as estimated by dental professionals

	Subjects with index value = 0		
	No. of adolescents (%)	Range*	Index mean†
DFT (decayed filled teeth)	3,045 (38.5)	22.9–51.6	1.88
DS (decayed surfaces)	5,682 (71.9)	55.9–89.1	0.50
DSa (decayed surfaces approximally)	7,131 (90.3)	80.8–95.7	0.14
DFSa (decayed filled surfaces approximally)	6,422 (81.3)	73.4–90.7	0.38

* By clinical catchment area corresponding schools ($n = 24$). Number of adolescents in areas: range 105–625.
† Weighted by school size.

Table 2. Self-perceived oral health in adolescents 13–15 years ($n = 9,559$) assessed by questionnaires distributed in all schools

	Participants	
	No. of adolescents (%)	Range*
'My oral health is good' *(Corresponds precisely or roughly)*	8,256 (89.7)	86.6–94.0
Bleeding gums when toothbrushing *(No)*	7,117 (78.6)	72.2–83.6
Satisfied with appearance of the teeth *(Yes)*	5,686 (63.0)	57.9–68.5

* By school ($n = 24$). Number of adolescents in schools: range 163–788. *Missing cases 2–4%.*

SPSS (Statistical Package for the Social Sciences) version 10.1 was used for data analyses (23).

Results

Correlations between epidemiological index registrations of clinical dental health and adolescents' self-perceived oral health

Epidemiological indices in registered subjects are given in Table 1. Information on self-perceived oral health in adolescents participating in the questionnaire study is given in Table 2.

In general, no strong correlations between epidemiological indices and self-perceived oral health could be identified at the school level (Table 3). The overall pattern revealed small positive correlations between the single-item rating of self-perceived oral health and each of the indices DFT and DS. The correlation between the DS index and self-perceived appearance of the teeth was negative in bivariate correlations (Spearman correlation −0.106) but became weakly positive (0.159) in partial correlations when adjustments for confounders (rate of participation in the questionnaire study, coverage in the epidemiological index registrations, and failure to complete school certificate) were made. Low scores in epidemiological indices were consistently correlated with no self-perceived gingival bleeding, the strongest of the correlations being 0.416 (between the DS index and self-perceived gingival bleeding). All other correlations between epidemiological indices of clinical dental health and self-perceptions of oral health were negative.

Adjustments for potential confounders—coverage in the epidemiological index registrations (69–98%), rate of participation in the questionnaire study (75–97%), and failure to complete a school certificate (0–11%)—had only little impact on the correlations.

One area with high scores in epidemiological indices, though with average scores in self-perceived oral health, was found to influence some correlations specifically. If this catchment area is considered an outlier and is omitted, correlations between low scores in all epidemiological indices and no self-perceived gingival bleeding to some extent increased (DFT 0.397 → 0.512; DS 0.416 → 0.535; DSa 0.330 → 0.436; DFSa 0.316 → 0.423). Influence on other correlations between epidemiological indices and self-perceived oral health was weak.

Gender differences in epidemiological index registrations of clinical dental health and adolescents' self-perceived oral health

Epidemiological indices and self-perceived oral health measures by gender in the four municipalities with extreme scores in epidemiological index registrations are given in Tables 4 and 5. Differences between boys and girls in low-scoring and high-scoring municipalities, respectively, are also presented in the tables. Analyses

Table 3. Correlations at the school level (13–15 years) between epidemiological indices of clinical dental health and self-perceived oral health in all 17 municipalities

	DFT*	DS†	DSa‡	DFSa§
Self-perceived oral health: single-item rating	0.239	0.224	−0.133	−0.170
Self-perceived gingival bleeding	0.397	0.416	0.330	0.316
Self-perceived satisfaction with appearance of the teeth	0.038	−0.106	−0.334	−0.404

Spearman's correlation coefficients.
* Decayed filled teeth.
† Decayed surfaces.
‡ Decayed surfaces approximally.
§ Decayed filled surfaces approximally.

Table 4. Gender differences in epidemiological dental indices in four municipalities reporting good and poor clinical dental health, respectively

	Municipalities reporting the best dental health				Municipalities reporting the poorest dental health			
	Boys *n* (%)	Girls *n* (%)	OR	CI	Boys *n* (%)	Girls *n* (%)	OR	CI
DFT = 0	255 (50)	219 (46)	0.85	0.66–1.09	116 (30)	111 (28)	0.89	0.66–1.22
DS = 0	418 (81)	381 (79)	0.88	0.64–1.20	254 (67)	267 (67)	1.04	0.77–1.41
DSa = 0	473 (92)	450 (94)	1.26	0.78–2.04	340 (89)	350 (88)	0.94	0.60–1.47
DFSa = 0	433 (84)	398 (83)	0.90	0.64–1.25	303 (79)	305 (77)	0.87	0.62–1.23

OR (odds ratios) and CI (confidence intervals) for girls with boys as reference.
Number of subjects in two municipalities with good dental health: 995.
Number of subjects in two municipalities with poor dental health: 950.

were performed at the individual level, not in an aggregated format.

In both municipalities with good clinical oral health OR 0.76 (CI 0.59–0.98) and those with poor OR 0.74 (CI 0.57–0.94), girls were less likely than boys to be pleased with the appearance of their teeth (Table 5). No gender differences in epidemiological index registrations were found.

Discussion

Correlations between epidemiological index registrations and self-perceived oral health among adolescents were weak. Gender differences were found in self-perceived oral health among adolescents, but not in the epidemiological index registrations.

High participation rates were achieved in the two substudies. The design of the survey among adolescents in school settings entailed a high participation rate (21). Coverage in the epidemiological index registrations was ruled by the PDS. The participation rate was lower than in the questionnaire (83%). The routinely reported epidemiological data were supplied from the county council and the administration was out of control of the authors. In the analyses, efforts were made to reduce bias and confounding by controlling for some potential confounders and exploring the data for areas with extreme scores. However, the general conclusions remained the same.

Ecological studies utilizing aggregated data are often used to estimate contextual or group-level effects (24–26). The major problem is the so-called ecological fallacy, which arises when associations between two variables at the group level (or ecological level) differ from associations between analogous variables measured at the individual level (27). Individual-level within-group and ecological between-group correlation coefficients may differ. However, regardless of individual characteristics, specific variables such as the average economic status of an area can be an important factor. Health education programs are typically implemented on the clinical catchment level, for instance in schools, and thus affect groups of individuals. However, it is important not to make the assumption that the findings in such studies can be used to make inferences on an individual level (27).

Locker & Slade (13) found low correlations between clinical and subjective indicators of oral health in older adults, even though their study was performed on an individual level. Studies on an aggregated level generally produce lower correlation values, which was in accordance with our study where the strongest correlation was 0.416 (between the DS index and self-perceived gingival bleeding). However, the overall correlation pattern should be considered. The correlations between the different epidemiological indices and the single-item rating of self-perceived oral health were weak and inconsistent. This indicates that this global assessment of self-perceived oral health might be explained by other mechanisms than the clinical dental status, for instance attitudes (20). It might also not have been sensitive enough to correlate with

Table 5. Gender differences in self-perceived oral health in four municipalities reporting good and poor clinical dental health, respectively

	Municipalities reporting the best dental health				Municipalities reporting the poorest dental health			
	Boys *n* (%)	Girls *n* (%)	OR	CI	Boys *n* (%)	Girls *n* (%)	OR	CI
'My oral health is good' *(Corresponds precisely/roughly)*	489 (90)	467 (93)	1.33	0.86–2.06	477 (88)	502 (90)	1.24	0.85–1.81
Bleeding gums when toothbrushing *(No)*	420 (79)	412 (83)	1.29	0.94–1.76	415 (79)	434 (78)	0.95	0.71–1.27
Satisfied with appearance of the teeth *(Yes)*	360 (68)	309 (62)	0.76	0.59–0.98	358 (68)	334 (60)	0.74	0.57–0.94

OR (odds ratios) and CI (confidence intervals) for girls with boys as reference.
Number of subjects in two municipalities with good dental health: 1069.
Number of subjects in two municipalities with poor dental health: 1121.

clinical dental health in a population with low scores in clinical caries. Another aspect of self-perceived oral health that might have been of relevance to consider is pain, still relatively common despite improving oral health in adolescents (28). The general pattern of inverse correlations between the epidemiological indices and self-perceived satisfaction with appearance might be explained by socio-cultural factors. In schools where the clinical oral health of the adolescents is good, the demand for good-looking teeth might be high (29).

Agreement between dentists' assessments and adolescents' self-perceptions of oral health has been investigated previously. In 1975, Brunswick & Nikias (10) found good agreement at the individual level for dental conditions but low agreement for gingival conditions. Kallio (30) found weak positive correlations between dentists' assessments and self-reported bleeding gums ($r = 0.26$ between bleeding on probing [BOP] and self-reported bleeding gums) on an individual level and suggested that self-reporting of bleeding gums could be a useful method for monitoring the gingival health of populations. This is supported by the consistent positive correlations between the epidemiological indices—even if these measure caries and not gingival status—and self-perceived gingival bleeding in the present study. Although this investigation was on an aggregated level and one school had deviating scores in the epidemiological indices, the correlations were stronger than those in Kallio's study.

In 1996, when the present study was conducted, gender was not reported in the compilations of dental epidemiological indices. However, in the four extreme municipalities (the best and the poorest clinical dental health, with big differences in absolute figures) which originally were selected for the study, information on gender was retained, which enabled analyses of gender differences in clinical oral health in these municipalities. Although no such differences could be verified, questionnaire results showed that girls were less satisfied than boys with the appearance of their teeth in both municipalities with good and those with poor clinical dental health. Appearance has been found to be one of the greatest concerns of adolescent girls (31). Social and individual expectations for girls and boys are different and girls tend to exhibit more self-evaluative concerns than boys (32–34).

The predominating DMF indices for the epidemiological index registrations within dentistry have been questioned in later years (35, 36). The major criticism has been that the DMF indices measure disease and have shortcomings in measuring health. This study found weak correlations between the adolescents' self-perceived oral health and the epidemiological index registrations on an aggregated level. Other indicators of clinical dental health, aiming to reflect health rather than disease, have been proposed by, for instance, Sheiham et al. (37). Besides the limitations of the presently used indices, the supposed objective clinical assessments (38) solely reflect the provider's aspect, leaving the patients' view aside. In the present study, the epidemiological indices were only weakly correlated with adolescents' own perceptions of their oral health on an aggregated level and they could not catch gender differences in these perceptions. Adding patient and gender perspectives to professional clinical assessments would probably provide a more comprehensive basis for the monitoring of oral health, the allocation of health resources, and research (6).

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