

## EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

# Inequity in access to dental care services explains current socioeconomic disparities in oral health: The Swedish National Surveys of Public Health 2004–2005

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**Objective:** To analyse the effects of socioeconomic disadvantage on access to dental care services and on oral health.

**Design, setting and outcomes:** Cross-sectional data from the Swedish National Surveys of Public Health 2004 and 2005. Outcomes were poor oral health (self-rated oral health and symptoms of periodontal disease) and lack of access to dental care services. A socioeconomic disadvantage index (SDI) was developed, consisting of social welfare beneficiary, being unemployed, financial crisis and lack of cash reserves.

**Participants:** Swedish population-based sample of 17 362 men and 20 037 women.

**Results:** Every instance of increasing levels of socioeconomic disadvantage was associated with worsened oral health but, simultaneously, with decreased utilisation of dental care services. After adjusting for age, men with a mild SDI compared with those with no SDI had 2.7 (95% confidence interval (CI) 2.5 to 3.0) times the odds for self-rated poor oral health, whereas odds related to severe SDI were 6.8 (95% CI 6.2 to 7.5). The corresponding values among women were 2.3 (95% CI 2.1 to 2.5) and 6.8 (95% CI 6.3 to 7.5). Nevertheless, people with severe socioeconomic disparities were 7–9 times as likely to refrain from seeking the required dental treatment. These associations persisted even after controlling for living alone, education, occupational status and lifestyle factors. Lifestyle factors explained only 29% of the socioeconomic differences in poor oral health among men and women, whereas lack of access to dental care services explained about 60%. The results of the multilevel regression analysis indicated no additional effect of the administrative boundaries of counties or of municipalities in Sweden.

**Conclusions:** Results call for urgent public health interventions to increase equitable access to dental care services.

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Social inequalities have been well documented in relation to mortality risk and health outcomes such as cardiovascular diseases, stroke and cancer. Social inequalities in oral health have been reported in previous studies,<sup>1–4</sup> but the mechanisms linking poor oral health and low socioeconomic position are not well studied.<sup>5</sup> Oral health is not merely important because it decreases quality of life and harms social life<sup>6</sup> but also because it can exacerbate systemic conditions, such as diabetes and respiratory and cardiovascular diseases.<sup>6–10</sup>

For example, poor oral health has been associated with impaired cardiovascular risk profile (ie, high levels of fibrinogen and triglycerides and low plasma levels of high-density lipoprotein),<sup>11</sup> higher risk of coronary heart disease<sup>12–13</sup> and increased risk of all-cause, cardiovascular and cancer mortality.<sup>14</sup> Some previous studies have shown an association between measures of social class and oral health.<sup>1–12, 15–18</sup> Oral health is important for overall health, and socioeconomic inequalities in oral health could be one of the mechanisms behind the socioeconomic differentials in mortality.

We hypothesised that socioeconomic disadvantage limits access to dental services and in turn contributes to the large social inequalities in oral health. Therefore, we analysed the association between socioeconomic disadvantage and access to dental care services, and whether this association could explain socioeconomic disparities in oral health. We used a measure of socioeconomic disadvantage that captures a wide range of material standards and socioeconomic

circumstances in a large dataset of men and women in the Swedish general population.

## POPULATION AND METHODS

### Study population

In 2003, the Swedish government endorsed the national public health policy.<sup>19</sup> As a consequence, the Swedish National Surveys of Public Health started in 2004, with a repeated survey in 2005. This survey was carried out by Statistics Sweden in collaboration with healthcare regions and districts in Sweden, and was coordinated by the Swedish National Institute of Public Health. The total study population comprised a randomly selected sample of 73 330 people (33 964 men and 39 366 women) aged 16–84 years. The data analyses in this study were restricted to people aged  $\geq 21$  years. This is because fees for dental care services in Sweden are waived for children and young adults up to age 20 years. We investigated 17 362 men (mean age 52.0 ((standard deviation (SD) 16.6 years)) and 20 037 women (mean age 51.2 (SD 16.7)) years.

### Collection of data

Data were collected during a period of 3 months (from 26 March to 15 June 2004 and 2005), and were based on a self-administered questionnaire and registry data from Statistics Sweden. The questionnaire was sent by mail to participants' home addresses for completion. People were reminded three times if they did not return the questionnaire in the given time and the final response rate was 63%. The questionnaire

consisted of information on different health outcomes, health habits and socioeconomic conditions, as well as factors related to work and family.

The questionnaires were scanned and a dataset was established. Data from the completed questionnaires were further controlled for errors and inconsistencies using a well-established method developed by Statistics Sweden and compared with the official registry data.<sup>20</sup> The data inspection department permitted Statistics Sweden to conduct the survey. Respondents were informed and they gave consent for data linkage on income, educational level, and marital status. Statistics Sweden tabulated the data and provided us with the database in a form that prevented the identification of the individuals. The research ethics committee at the Swedish National Board of Health and Welfare (20031208) and the ethics committee at the Karolinska Institutet (DNR 2005/1146–31) approved the study. Both committees have conformed to the principles embodied in the Declaration of Helsinki.

### Study variables

#### Access to dental care services

Data on dental care services were based on two variables: (1) seeking required dental treatment and (2) visiting a dentist or dental hygienist.

Refraining from dental treatment was evaluated on the basis of the question: "Have you during the past 3 months considered yourself in need of dental treatment but refrained from seeking it?" Alternative answers were "yes" or "no". When participants reported refraining from seeking dental treatment, they were further asked to give the reasons. Alternative answers were "pain disappeared", "financial reasons", "afraid of dentist" or "lack of time".

Visiting the dentist or dental hygienist was evaluated on the basis of the question: "When was the last time you visited the dentist or dental hygienist?" Alternative answers were ">1 year ago", "about 1–2 years ago", "about 3–5 years ago", ">5 years ago", "have never been to the dentist/dental hygienist" and "don't know/don't remember". For the analysis, we further dichotomised data into "2 years" (the first two alternatives) and ">3 years ago or never". Information on visiting the dentist or dental hygienist was available only for 2004.

#### Oral health

Oral health was evaluated on the basis of two variables: self-rated oral health and symptoms of periodontal disease.

Evaluation of self-rated oral health was based on the question: "How do you rate your oral health?" Alternative answers were "excellent", "good", "somewhat good", "somewhat poor" and "very poor". Oral health was categorised as poor if respondents gave answers as somewhat poor and very poor.

Evaluation of symptoms of periodontal disease was on the basis of the question: "Do you have any complications with loose teeth?" We chose this symptom because loose teeth has been reported to be a more reliable measure of self-reported symptoms of periodontal disease than, for example, tooth decay (caries), bleeding gums, chewing difficulties or sensitive teeth.<sup>21</sup> In addition, the symptom of loose teeth has been validated with clinical observations and is found to be a valuable tool in epidemiological studies on symptoms of periodontal disease.<sup>21</sup>

#### Socioeconomic disadvantage

For computing the socioeconomic disadvantage index (SDI), we used four variables that encompass a broad perspective of material standards and socioeconomic circumstances. These variables were: (1) being on social welfare at the time of the

survey, (2) being currently unemployed, (3) having a financial crisis (difficulties paying ordinary bills such as food or house rent for the past 12 months), and (4) lacking cash reserves (difficulty to raise 14 000 Swedish Krona in 1 week if happened to be in an unexpected situation). All the four binary indicators were summed, resulting in a range of 0–4 points. SDI was categorised as none (sum = 0), mild (sum = 1) and severe (sum = 2–4). Although the internal consistency of the SDI was not high enough (Cronbach's  $\alpha = 0.50$ ), the four variables included in the SDI seemed to reflect material standards and socioeconomic circumstances rather than the traditional socioeconomic status. The correlations ranged from  $r = 0.12$  to  $0.44$ . Further inclusion of educational level and occupational status lowered the internal reliability of the SDI index from Cronbach's  $\alpha = 0.50$  to  $0.37$ , indicating that these two variables measured other aspects of socioeconomic position that do not directly translate into material standards. Therefore, educational level and occupational status were analysed separately. Current single measurement of socioeconomic status (eg, income, educational achievement, occupation) in social epidemiology has been criticised,<sup>22–23</sup> because single measures often lack conceptual clarity and seem to disregard established psychometric techniques. Thus, we attempted to develop an index that combined several socioeconomic indicators to broadly describe a person's underlying socioeconomic conditions that reflected material standards.

#### Confounders

The following confounders were considered.

*Age in years:* Categorised into four groups; 21–35, 35–50, 50–65 and 65–84 years.

*Living alone:* Categorised on the basis of information on family characteristics and defined as being a lone adult (with or without children) in a household.

*Low education:* Categorised on the basis of the highest formal educational level, and defined as achieving less than high school (ie, up to 9 years of schooling).

*Occupational status:* Derived from the Swedish socioeconomic classification based on occupation<sup>24</sup> and assessed by the questionnaire for both currently active and inactive people. Categorised occupational status as blue-collar (manual), white-collar (non-manual) or inactive.

*Lifestyle habits:* Included five variables. (a) Daily smoking (yes or no); (b) daily snuffing (yes or no); (c) dietary habits (diet with poor fruit and vegetables (yes (less than three times a week) or no (several times))); (d) high alcohol consumption assessed following an established method,<sup>25</sup> as the total sum equal to 8–12 for men and 6–12 for women, based on three variables: how often have you drunk alcohol in the past 12 months, how many glasses do you drink on a typical day and how often do you drink six glasses at one go; and (e) physical inactivity categorised as sedentary or non-sedentary activities during leisure time.

#### Statistical analyses

We applied multilevel logistic regression with three levels of analysis (ie, individuals, nested within municipalities, which were in turn nested within counties). Estimations were carried out using the restricted iterative generalised least squares method with second-order penalised quasi-likelihood. We used the software MLwiN<sup>26</sup> for the analyses.

After carrying out multilevel regression analysis, we observed that the variances at the county and the municipality levels were close to zero. Also, the odds ratios (ORs) for the associations between the individual variables and self-rated oral health and periodontal disease were almost identical to those obtained by single-level logistic regression that did not consider the county and municipality levels.

Therefore, the results from our study are based on analyses using single-level logistic regression.

Using Stata V.9.0,<sup>27</sup> we conducted single-level multiple logistic regression analyses to estimate the associations of socioeconomic disadvantage with refraining from seeking dental treatment and with not having visited a dentist or dental hygienist for >2 years. To assess the degree to which the associations of SDI with self-rated poor oral health and symptoms of periodontal disease were mediated by refraining from seeking dental treatment, we derived five multiple logistic regression models. In the first model we adjusted for age; in the second model we further adjusted for living alone, occupational status and education. In the third model we adjusted for age and lifestyle factors (daily smoking, daily snuffing, high alcohol consumption, dietary habits with less fruit and vegetables and physical inactivity) and in the fourth model we added refraining from seeking dental treatment to the first model. In the fifth model we adjusted for all covariates.

Using the OR obtained in the first model as reference (OR<sub>reference</sub>), we calculated the percentage of change in the magnitude of the first OR (PCOR) that was explained by including new variables in the model with more variables (OR<sub>more</sub>):

$$PCOR = ((OR_{reference} - OR_{more}) / (OR_{reference} - 1)) \times 100$$

This method of calculating the explanatory value of mediating effects of excess risk (odds) has been previously used in other studies.<sup>28, 29</sup> We used this percentage as an indicator of the magnitude of a possible mediating effect of lifestyle factors and refraining from seeking treatment in the association between socioeconomic disadvantage and poor oral health. In the logistic regression, we used the regression coefficients (standard errors) to obtain OR (95% confidence interval (CI)).

**RESULTS**

Table 1 shows the distributions of study variables by sex.

**Access to dental care services**

**Refraining from seeking dental treatment**

Younger age, low education, occupational status and living alone were associated with refraining from seeking dental treatment. Younger people (21–35 years; 28% of women and 25% of men) were more likely to refrain from seeking dental treatment than older people (65–84 years; 10% of women and 12% of men).

Financial limitations dominated as the main reason for refraining from seeking dental treatment (68% of men and 73% of women). People with severe SDI were more likely to give financial limitations as the main reason for refraining from seeking dental treatment (89% of men and 91% of women) than those with no SDI (49%). Other reasons such as disappearance of pain, fear of the dentist or lack of time were not significantly associated with refraining from seeking dental treatment in relation to SDI. We found that people with no SDI were more likely to refrain from seeking dental treatment as a result of disappearance of pain and lack of time.

Table 2 shows the absolute levels of poor oral health, symptoms of periodontal disease and lack of access to dental care services in relation to SDI.

We found a dose–response effect for the odds for refraining from seeking dental treatment in relation to increasing level of SDI after adjusting for age, low education, occupational status, living alone and lifestyle factors (table 3). Compared with no SDI, we found ORs of 2.8 (95% CI 2.5 to 3.0) among men and 2.7 (95% CI 2.5 to 2.9) among women for mild SDI

**Table 1** Distributions of study variables among men and women 21–84 years old

	Men (46%; 33 964)	Women (54%, 39 366)
Self-rated poor oral health	12 (3 960)	10 (3 686)
Symptoms of periodontal disease	7 (1 098)	7 (1 175)
Refraining from seeking dental treatment	17 (5 351)	17 (6 331)
Not visiting dentist or dental hygienist	14 (2 019)	10 (1 685)
Socioeconomic disadvantage		
Mild	15 (4 812)	19 (7 033)
Severe	10 (3 243)	14 (5 231)
Living alone	26 (8 177)	29 (10 492)
Low education (≤9 years)	54 (15 616)	51 (17 132)
Occupational status		
Manual (blue-collar)	42 (12 779)	48 (16 899)
Inactive in labour market	10 (3 164)	7 (2 409)
Age group (years)		
21–35	18 (5 881)	19 (7 221)
35–50	25 (8 161)	27 (9 933)
50–65	31 (9 877)	30 (10 964)
65–84	26 (8 179)	24 (9 034)
Lifestyle habits		
Daily smoking	14 (4 295)	17 (6 140)
Daily snuffing	22 (7 009)	3 (977)
Diet with less fruit and vegetables	34 (10 822)	17 (6 108)
High alcohol consumption	14 (4 304)	6 (2 375)
Physical inactivity	13 (4 129)	13 (4 524)

Values are % (n).

and 7.0 (95% CI 6.5 to 7.7) among men and 7.3 (95% CI 6.7 to 7.9) among women for severe SDI in relation to refraining from seeking dental treatment (table 3). Further adjustment for lifestyle factors did not affect the association with SDI observed in model 1 (table 3).

Table 1 shows that a larger number of men than women had not visited a dentist or dental hygienist for the past 2 years. Also, compared with people with no SDI, more people in the severe SDI category had not visited a dentist or dental hygienist for >2 years (table 3). A similar pattern was observed for people living alone, with low occupational status, inactive in the labour market or with low educational achievement compared with those cohabiting or with higher occupational status with high educational achievement.

Multiple logistic regression models (table 3) show significantly increased odds for lack of access to dental care services in relation to SDI.

**Self-reported oral health**

Table 1 indicates that there were no sex-specific differences in self-rated oral health. However, middle-aged men were more likely to report poorer oral health than younger men. We found living alone, low education, low occupational status or being inactive in the labour market to be associated with poor oral health in both men and women. Unhealthy lifestyle factors were associated with poor oral health, particularly daily smoking.

We found a dose–response association between increasing levels of SDI and poor oral health (table 4). After adjusting for age, men with mild SDI and those with severe SDI had 2.7-fold (95% CI 2.5 to 3.0) and 6.8-fold (95% CI 6.2 to 7.5) increased odds for self-rated poor health compared with those with no SDI, respectively. The corresponding odds among women were 2.3 (95% CI 2.1 to 2.5) and 6.8 (95% CI 6.3 to 7.5); (table 4).

**Table 2** Absolute levels for lack of access to dental care services and poor oral health in relation to socioeconomic disadvantage

Socioeconomic disadvantage	Refraining from seeking treatment, 2004 and 2005, absolute levels		Not having visited a dentist/dental hygienist for $\geq 2$ years, 2004, absolute levels	
	Men	Women	Men	Women
None	10% (2421/23225)	10% (2128/23753)	10% (1029/10646)	6% (675/11032)
Mild	27% (1268/4745)	23% (1594/6892)	20% (451/2272)	13% (419/3200)
Severe	49% (1571/3209)	48% (176/429)	33% (498/1525)	23% (550/2397)

  

Socioeconomic disadvantage	Self-rated poor oral health, 2004 and 2005		Symptoms of periodontal disease, 2004	
	Men	Women	Men	Women
None	8% (1829/23351)	6% (1424/23925)	7% (676/10312)	6% (657/10668)
Mild	17% (798/4765)	12% (826/6948)	9% (187/2156)	8% (233/1067)
Severe	32% (1011/3210)	26% (1363/5181)	15% (206/1444)	11% (254/2295)

Focusing on the group with severe SDI, lifestyle factors (daily smoking, daily snuffing, high alcohol consumption, dietary habits with less fruit and vegetables and physical inactivity) explained only 29% ( $PCOR = ((6.82 - 5.12) / (6.82 - 1)) \times 100$ , 95% CI 28% to 30%) oral health among men and similarly 29% ( $PCOR = ((6.83 - 5.16) / (6.83 - 1)) \times 100$ , 95% CI 28% to 30%) among women with socioeconomic differences (table 4). However, further inclusion of the variable refraining from seeking dental treatment explained up to 65% (95% CI 64% to 67%) oral health among men and up to 64% (95% CI 63% to 65%) among women with socioeconomic differences (table 4).

### Symptoms of periodontal disease

In all, 47% of men and 42% of women who rated their oral health as poor also had symptoms of periodontal disease. Table 2 shows that the prevalence of symptoms of periodontal disease was higher among people with severe SDI than among those with no SDI. The same was true for people living alone compared with those who were cohabitating and

those with low education or were inactive in the labour market.

Table 4 indicates, as in the case of self-rated poor oral health, a dose-response curve of the association between increasing SDI and the odds of several symptoms of periodontal disease. Adjustment for lifestyle factors explained 29% of symptoms of periodontal disease among men and 45% of those among women with socioeconomic differences, whereas further inclusion of refraining from seeking dental treatment explained up to 52% among men and 49% among women (table 4). People with severe SDI refrained from seeking dental treatment due to financial reasons.

We analysed the interaction effects between SDI and refraining from seeking dental treatment in relation to self-rated oral health and symptoms of periodontal disease. We analysed the interaction effects between SDI and refraining from seeking dental treatment in relation to self-rated oral health and symptoms of periodontal disease. A combination of any form of SDI and refraining from seeking dental treatment resulted in increased age-adjusted odds of 19.1 (95% CI 15.6 to 23.3) among men and 11.9 (95% CI 9.8 to

**Table 3** Logistic regression odds ratios (95% CI) for lack of access to dental care services

	Refraining from seeking treatment, 2004 and 2005		Not having visited a dentist/dental hygienist for $\geq 2$ years, 2004	
	Men	Women	Men	Women
Model 1				
None	Reference	Reference	Reference	Reference
Mild	2.92 (2.70 to 3.15)	2.81 (2.61 to 3.01)	2.3 (2.03 to 2.60)	2.32 (2.03 to 2.64)
Severe	7.47 (6.88 to 8.12)	8.0 (7.44 to 8.6)	4.6 (4.04 to 5.24)	4.78 (4.19 to 5.43)
Model 2				
None	Reference	Reference	Reference	Reference
Mild	2.76 (2.54 to 3.0)	2.66 (2.45 to 2.87)	2.02 (1.76 to 2.33)	2.12 (1.82 to 2.47)
Severe	7.07 (6.46 to 7.74)	7.25 (6.7 to 7.86)	3.93 (3.41 to 4.54)	3.98 (3.42 to 4.62)
Model 3				
None	Reference	Reference	Reference	Reference
Mild	2.62 (2.42 to 2.84)	2.60 (2.41 to 2.81)	2.06 (1.82 to 2.34)	2.12 (1.86 to 2.43)
Severe	6.2 (5.68 to 6.76)	6.76 (6.26 to 7.3)	3.83 (3.35 to 4.38)	4.04 (3.53 to 4.64)
Model 4				
None	Reference	Reference	Reference	Reference
Mild	2.52 (2.31 to 2.75)	2.53 (2.33 to 2.74)	1.85 (1.61 to 2.14)	1.95 (1.67 to 2.29)
Severe	6.04 (5.50 to 6.63)	6.42 (5.91 to 6.98)	3.44 (2.97 to 4.0)	3.47 (2.97 to 4.06)

Model 1, adjustment for age; model 2, adjustment for age, and in addition, low education, occupational status and living alone; model 3, adjustment for age, and in addition, lifestyle factors (daily smoking, daily snuffing, high alcohol consumption, dietary habits with less fruit and vegetables, physical inactivity); model 4, adjustment for all covariates.

**Table 4** Logistic regression odds ratios (95% CI) for self-rated poor oral health and symptoms of periodontal disease

	Self-rated poor oral health, 2004 and 2005		Symptoms of periodontal disease, 2004	
	Men	Women	Men	Women
<b>Model 1</b>				
None	Reference	Reference	Reference	Reference
Mild	2.74 (2.49 to 3.0)	2.33 (2.12 to 2.54)	1.9 (1.6 to 2.27)	1.64 (1.40 to 1.92)
Severe	6.82 (6.21 to 7.50)	6.83 (6.25 to 7.45)	4.16 (3.47 to 4.99)	3.4 (2.88 to 4.01)
<b>Model 2</b>				
None	Reference	Reference	Reference	Reference
Mild	2.59 (2.34 to 2.87)	2.21 (1.99 to 2.45)	1.78 (1.47 to 2.17)	1.57 (1.31 to 1.87)
Severe	6.12 (5.52 to 6.79)	6.52 (5.9 to 7.19)	3.84 (3.15 to 4.96)	2.86 (2.36 to 3.45)
<b>Model 3</b>				
None	Reference	Reference	Reference	Reference
Mild	2.35 (2.13 to 2.58)	2.02 (1.83 to 2.22)	1.69 (1.41 to 2.03)	1.36 (1.15 to 1.62)
Severe	5.12 (4.63 to 5.66)	5.16 (4.70 to 5.66)	3.25 (2.68 to 3.94)	2.32 (1.94 to 2.29)
<b>Model 4</b>				
None	Reference	Reference	Reference	Reference
Mild	1.8 (1.62 to 2.0)	1.6 (1.45 to 1.76)	1.52 (1.27 to 1.83)	1.38 (1.27 to 1.62)
Severe	3.02 (2.72 to 3.37)	3.08 (2.79 to 3.4)	2.52 (2.08 to 3.07)	2.23 (1.87 to 2.68)
<b>Model 5</b>				
None	Reference	Reference	Reference	Reference
Mild	1.55 (1.38 to 1.75)	1.39 (1.23 to 1.56)	1.34 (1.08 to 1.65)	1.16 (0.95 to 1.41)
Severe	2.29 (2.02 to 2.59)	2.54 (2.26 to 2.85)	2.02 (1.61 to 2.54)	1.48 (1.19 to 1.84)

Model 1, adjustment for age; model 2, adjustment for age, and in addition, low education, occupational status and living alone; model 3, adjustment for age, and in addition, lifestyle factors (daily smoking, daily snuffing, high alcohol consumption, dietary habits with less fruits and vegetables, physical inactivity); model 4, adjustment for age and refraining from seeking dental treatment; model 5, adjustment for all covariates.

14.4) among women for poor oral health. Refraining from seeking dental treatment itself, in the absence of any form of SDI, was associated with OR = 10.6 (95% CI 9.0 to 12.5) among men and 8.2 (95% CI 6.9 to 9.9) among women. ORs for poor oral health in relation to any form of SDI in the absence of refraining from seeking dental treatment were 1.8 (95% CI 1.4 to 2.3) among men and 1.8 (95% CI 1.4 to 2.1) among women.

**Results from multilevel analyses**

The crude point estimates of prevalence for poor oral health by the six regions in Sweden ranged from 10.1% to 13.2% among men and from 9.4% to 11.4% among women, whereas symptoms of periodontal disease ranged from 5.2% to 8.8% among men and from 5.7% to 9.2% among women. According to the results from the multilevel logistic regression, the between-counties and between-municipalities variance in self-rated oral health and periodontal disease were non-significant and close to zero in all three models (the results of the multilevel analysis will be available on request). These results suggest that the outcomes were not clustered in any specific areas but rather homogeneously distributed all over the country.

**DISCUSSION**

Using an index of socioeconomic disadvantage that covers a wide range of socioeconomic circumstances, we found that increased levels of SDI decreased the opportunity of using dental care services and worsened oral health among adult men and women in Sweden. Severe SDI compared with no SDI was associated with 4.2-fold and 3.4-fold increased odds among men and women, respectively, for symptoms of periodontal disease. Similarly, severe SDI compared with no SDI was associated with 6.8-fold odds for self-rated poor oral health among men and women. Despite increased prevalence of poor oral health among people with severe SDI, the same people were more likely to refrain from seeking the required

dental treatment than those with no SDI. People with severe SDI were 7–9 times as likely to refrain from seeking dental treatment as those with no SDI. Financial limitations were often given as reasons for refraining from seeking dental treatment. The results of the multilevel regression analyses indicated that the administrative boundaries of the counties and of the municipalities in Sweden seem to have a non-significant role in relation to individual oral health. Our results therefore suggest that any public health strategy directed towards improving oral health should be implemented all over the country rather than in any specific counties or municipalities.

This is the first study in Sweden to show socioeconomic differentials in both oral health and access to dental treatment using a nationally representative dataset that includes a large number of men and women. Unlike in previous studies, we used a broad measure of socioeconomic circumstances and took into account other factors that are related to material standards and socioeconomic resources that may promote general health and facilitate access to health-promoting services.

Our results should be interpreted in the light of limitations that include a cross-sectional design and the use of self-reported measures of oral health and symptoms of periodontal disease.<sup>8</sup> The non-responders in the Swedish Surveys of Public Health included a larger proportion of men with social disadvantage, immigrants and inhabitants in metropolitan areas. Therefore, this implies an underestimation of the magnitude of true effects between SDI and poor oral health observed in this study. The SDI used in this study includes economic hardships, position in the labour market and being unable to economically support oneself, which reflects both material standards and a broad understanding of socioeconomic circumstances. The internal reliability of 0.50 was lower than the usually recommended value of 0.60, which suggests that variables used in the index may not be measuring a similar underlying concept.<sup>30</sup> Nevertheless, it

### What is already known on this topic

- Social inequalities have been well documented in relation to risk for death and other health outcomes,
- Social inequalities in oral health have attracted only occasional attention.

### What this study adds

- This is the first national study in Sweden to explain how socioeconomic differentials affect both oral health and access to dental care services, using a broad measure of socioeconomic circumstances.
- Insufficient access to dental care services was a stronger explanation than lifestyle factors for the impaired oral health among socially disadvantaged adults in Sweden.

has substantial policy implications and reflects a broader understanding of a person's socioeconomic circumstances than using single measures of socioeconomic position, which have recently been criticised in health research.<sup>22–23</sup> We additionally evaluated education and occupational status and as single measures of socioeconomic status.

Differentials in sampling procedures of municipalities may have resulted in response rates not being uniformly distributed among counties. This may have affected results from the multilevel analyses. However, the variances in oral health were small (close to zero), both at the county and municipality levels; and, an unequal participation rate would increase rather than decrease the geographical variance in oral health.

In Sweden, since 1999, dental care charges have been fluctuating but with no modifications in state interventions related to dental care public insurance. Currently, the public insurance finances 5–30% of the dental treatment costs, and this has been constant despite the increase in dental care costs.<sup>31</sup> A larger compensation is given to the younger (21–25 years old) and older (aged  $\geq 65$  years) people. The fee for dental services is waived for children and young adults aged  $\leq 20$  years. Thus, this is reflected by the results of this study, in which people aged 21 years up to middle age were more likely to refrain from seeking dental treatment as a result of financial limitations. The public health implications of having a large growing group of younger people, which refrains from seeking the dental treatment required, are serious.

Oral health is often associated with individual-level determinants such as dental hygiene and dietary habits.<sup>32–33</sup> However, results in this study indicate that refraining from seeking dental treatment explained  $>60\%$  of the socioeconomic differences in poor oral health, whereas lifestyle factors explained only 29%. Our results confirm the fact that access to dental care services and oral health may be one of the most obvious reflections of socioeconomic conditions.<sup>34–36</sup> Our results do not support the fact that individual lifestyle factors may largely explain why socially disadvantaged people have poor oral health.<sup>16–37–38</sup> Rather, we found support for a neomaterialistic explanation in which a political system may condition access to healthcare services by imposing economic barriers.<sup>39</sup> Actually, we found that people with SDI had the need, were not afraid of the dentist and had the time to access dental treatment, but refrained from seeking

### Policy implications

- Financial limitations limit access to healthcare services and contribute to health inequalities.
- Healthcare systems, including dental care services, have a major role in creating health inequalities; healthcare policies should contribute to their elimination.
- Urgent public health interventions are needed at the national level to increase equitable access to dental care services.

treatment as a result of financial limitations. These results indicate that there is a need to move away from an individual-blaming attitude and look into wider structural determinants beyond individual characteristics. Arguably, refraining from seeking dental treatment may be a proxy measure for SDI. However, the correlation coefficient between these two factors was not high ( $r = 0.30$ ). In addition, we found that refraining from seeking dental treatment itself, in the absence of SDI, was associated with a much larger magnitude ( $>8$  times as large) of increased odds for poor oral health than the presence of SDI in the absence of refraining from seeking dental treatment. This implies that lack of access to dental care services in itself has more negative consequences on oral health than socioeconomic disadvantage.

Our results provide evidence that insufficient access to dental care services seems to be a major explanation of the impaired oral health among socially disadvantaged adult people, and call for urgent public health interventions at the national level to increase access to dental care services. Equitable access to dental care services may be one effective way of reducing overall socioeconomic differences in health.

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