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ORIGINAL ARTICLE

Do self-assessed oral health and treatment need associate with clinical findings? Results from the Finnish Nationwide Health 2000 Survey

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Abstract

Objective. To associate self-assessed oral health and treatment need with clinically determined findings. ***Materials and methods.*** As part of the Finnish nationwide comprehensive Health 2000 Survey, the present cross-sectional study included dentate participants aged 30–64 years who self-assessed their oral health and treatment need in an interview and who underwent a clinical oral health examination ($n = 4385$). Self-assessed oral health and treatment need were used as subjective indicators. Clinically determined dental and periodontal status described objective dental and periodontal health and treatment need. The evaluation of relationships between subjective and objective findings was based on two-by-two tables and multivariate analyses. ***Results.*** The better the self-assessed oral health, the better the objective dental and periodontal health. Those reporting need for treatment more often had the objective need in terms of dental or periodontal treatment, also when controlling for background factors. Of the subjective indicators, good self-assessed oral health best reflected the absence of clinically determined dental or periodontal treatment need. Those who reported a need for treatment were mainly adults with an objective dental and periodontal treatment need. ***Conclusions.*** Self-assessed good oral health is a fairly good estimate for the absence of clinically determined dental and periodontal treatment need. As implication for practice, self-assessed data could be used for screening purposes for oral health service planning and for priority allocation in large adult populations.

Key Words: *adults, clinically-determined treatment need, self-assessed oral health, self-assessed treatment need*

Introduction

Self-assessment is commonly used in social epidemiology [1] and public health [2] in the screening of many general health conditions, such as cancer, cardiovascular diseases [3] and rheumatoid arthritis [4], as well as health-related risk behaviours [3,5,6]. Self-assessment of oral health has been shown to be of possible value for adult communities [7], providing reasonably valid estimates for the numbers of remaining teeth, for fillings and for root canal therapy experiences and for the presence of fixed and removable prostheses [8,9] and for screening of urgent dental care [10]. In larger populations, usefulness of self-assessment data is recommended in management and evaluation of oral health promotion intervention, as well as in surveillance of health conditions, determining population health needs and identifying target groups, especially when clinical assessment is unattainable [11]. In individuals, self-assessment seems to complement clinically-determined clinical conditions [12,13], reflecting the overall impacts of health conditions on a person's well-being [14].

Existing studies on self-assessment of oral health and treatment need in adults have involved mainly elderly [15], especially those who are community-dwelling or institutionalized [16,17], but have seldom involved representative adult populations [11,18]. Various

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studies have shown that self-assessed oral health and treatment need seem to vary by age cohort, population [19] and socio-cultural setting [20,21], although some studies have found no such differences [22,23].

Within limited resources, the dental profession is continuously facing growing expectations and demands due to the demographic diversity of patients and new trends in disease patterns, as well as technological and scientific advances. Because of growing demands, public health systems require new approaches such as prioritization of services. Concerning population studies, the knowledge about how well subjective oral health estimates objective dental and periodontal health conditions is limited. Therefore, our aim was to investigate congruence and discrepancy of self-assessed and clinically determined oral health and treatment need among the Finnish population aged 30–64 years. Our working hypothesis was that self-assessed oral health and treatment need are associated with clinically determined dental and periodontal treatment need.

Materials and methods

Study design

This cross-sectional study is part of the nationwide comprehensive Health 2000 Survey in Finland, which used a stratified two-stage cluster sample of a total of 8028 citizens aged 30 years and older [24–26]. The sampling frame was regionally stratified according to Finland's five university hospital regions. Data collection was carried out by means of structured health interviews and clinical oral health examinations.

Study subjects

This study comprised adults aged 30–64 years (sample $n = 5871$). Altogether, 82% ($n = 4814$) participated in the clinical oral health examination: 94% ($n = 4587$) were dentate. The study population was further restricted to those dentate adults who assessed their oral health and treatment need in an interview and for whom complete clinical data on their dental status was available. This reduced the final study population to a total of 4385 (96% of the dentate subjects aged 30–64 years). Since a periodontal examination was not carried out for subjects who required antibiotic protection in connection with dental care ($n = 71$), complete clinical data on periodontal status were collected for 4314 subjects. Non-response was accounted for by calibrating the original design weights using post-stratification with gender, age and geographical region [25].

Ethical approval

Permission for the study was given by the ethics committees of the University Hospital Region of Helsinki and Surroundings and the National Public Health Institute. Informed consent was obtained from each survey participant.

Interview

The study subjects were interviewed at home by trained interviewers. The question 'How do you rate the condition of your teeth and oral health?' was to be answered on a 5-point scale: good, fairly good, average, fairly poor and poor. First, the categories of fairly poor and poor were merged and, for further analyses, the scale was dichotomized into poor (consisting of average, fairly poor and poor) and good (comprising good and fairly good). A question related to self-assessed oral healthcare need was 'Do you think you are currently in need of oral health care?' and the answer alternatives to the question were: 'Yes, I do' or 'No, I don't'. After the interview, subjects received an invitation to a health examination, which took place ~1 month later at field examination sites, usually at local health centres. Oral health examination was part of the comprehensive health examination.

Professionally determined clinical oral health

Clinical oral health examinations were conducted by five calibrated dentists assisted by a dental nurse or hygienist using a portable dental treatment unit (Dentronic Mini-Dent®, Planmeca Oy, Helsinki, Finland) including a built-in compressor, saliva suction and a high-powered suction motor. In addition, the team had the use of a portable patient chair, fibre-optic light (Novar, Helsinki, Finland), fibre-optic head lamp (Tekmala Oy, Vantaa, Finland) and a letter scale. The examinations, which were conducted using a dental mirror, fibre-optics and a WHO periodontal probe [26], were based on the methodology of the Mini-Finland Survey [27] and on WHO guidelines [28]. Each tooth was recorded as sound, filled, decayed (caries lesion clearly extending to dentin) or fractured. The number of all teeth and the number of sound teeth, filled teeth and decayed/fractured teeth served as indicators for the subjects' objective dental health. The presence of any decayed/fractured teeth indicated objective dental treatment need. Probing depth (PD) was measured at four points of each tooth, excluding wisdom teeth, and the deepest measurement was recorded by tooth. Bleeding on probing (BOP) was recorded immediately after pocket measurements and recorded by sextant. The number of teeth with and without deepened pockets and the number of sextants with BOP served as indicators of objective periodontal health. The presence of any deepened pockets, shallow (PD = 4–5 mm) or deep (PD ≥6 mm) or of BOP, indicated clinically determined need for periodontal treatment.

Background information

The subjects' background details such as age, gender and educational level were collected in the health interview. Age was further sub-divided into the following age groups: 30–34, 35–44, 45–54 and 55–64 years. The level of education was determined on the basis of basic, vocational and advanced qualifications and was grouped into three levels: basic, intermediate and higher [24]. Clinical data (objective dental health) of the participants according to their background characteristics (gender, age and education) have been reported earlier in 'Oral Health in the Finnish Adult Population' [26] (www.terveys2000.fi/julkaisut/oral_health.pdf).

Statistical evaluation

Statistical analyses were carried out using SPSS 16.0 and PASW 18 and SAS Callable Sudaan software. Statistical significances of differences between the groups were evaluated using Kruskal-Wallis and Mann-Whitney and Wilcoxon Two-Sample tests for mean values because of the skewed distributions of dental and periodontal health indices and by chi-square test for frequencies; statistical significance was set at $p \leq 0.05$ level. Weights were used for handling correlated data with unequal sampling probabilities and for correcting for the effects of non-response.

Multivariate analyses were carried out to identify associations of self-assessed oral health and treatment need with clinically determined dental and periodontal treatment need when controlling background characteristics (age and educational level), as well as numbers of teeth, separately, by gender. In the analyses, age and numbers of teeth were treated as continuous variables, whereas education and subjective oral health and treatment need were regarded as categorical ones. For the latter, 'good' oral health and 'no treatment need' were designated as reference groups. The relative effect of the explanatory variables on the outcome was expressed as beta (β) and as the standard deviation of the sampling distribution as standard error of means (SEM).

The evaluation of objective vs subjective assessment of dental and periodontal health and treatment need was based on two-by-two tables and included calculation of Sensitivity (SN), Specificity (SP), Positive predictive value (PPV) and Negative predictive value (NPV)—this was carried out separately by gender. They were calculated by defining self-assessment as the 'test' and clinically determined dental or periodontal treatment need as the 'disease'. Poor self-assessed oral health or reported need for treatment served as positive results for the 'test' (T+) and the presence of objective dental or periodontal treatment need as positive results for the 'disease' (D+). Correspondingly, good self-assessed oral health or no reported need for treatment served as negative results for 'test' (T) and the absence of objective dental or periodontal treatment need as negative results for the 'disease' (D). Further, the true positive rate (SN) against the false positive rate (1-SP) was plotted as Receiver Operating Characteristic (ROC) curves together with the area under the curve (AUC), to illustrate the predictive power of the tests.

Results

Of the total, 38% reported having good, 29% fairly good, 22% average and 11% fairly poor or poor oral health; 52% reported a need for treatment at present. Self-assessed oral health varied by age, gender and education (Table I); the youngest adults (30–44 years) as well as women and highly educated were the more likely to rate their oral health as good. Self-assessed treatment need varied by education, so that those with a higher level of education were more inclined to report no need for treatment.

A clinically determined need for dental treatment was found in 38% of all subjects (in 45% of men and 32% of women). The clinical findings showed that on average the adults had 24.2 teeth, of these 10.2 were sound (ST), 13.0 were filled (FT) and 1.0 decayed/fractured. The better the self-assessed oral health, the greater were the mean numbers of all teeth, of ST and of FT and the smaller the mean numbers of teeth with clinically determined need for treatment, for both men and women (Table II) and in each age group (Figure 1). Those reporting no present treatment need had a better objective dental health and fewer teeth with clinically determined treatment need, both for men and women (Table II).

In terms of periodontal findings, a clinically determined treatment need was found in 83% of the subjects (87% of men and 79% of women). Of all, 63% (71% of the men and 55% of the women) had deepened pockets and 73% had BOP. Of the periodontally examined teeth (mean = 23.3), 19.1 had no deepened pocket, 3.6 had a shallow pocket and 0.6 a deep pocket. BOP was found in 2.4 sextants on average.

The better the self-assessed oral health, the greater were the mean numbers of teeth without deepened pockets and the smaller were the mean numbers of teeth with shallow or deep pockets or of sextants with BOP. These associations were found for both genders (Table III) and in each age group (Figure 2). The present need for treatment was associated with greater numbers of teeth with deepened pockets for both men and women and with greater numbers of sextants with BOP for women only (Table III).

In multivariate analyses, when controlled for background characteristics (age and educational level) as well as numbers of teeth, self-assessed oral health and

Table I. Self-assessed oral health and treatment need for oral care according to background characteristics among Finnish dentate population aged 30–64 years (n = 4385).

		Self-assessed oral health					Self-assessed treatment need for oral care		
	All, n	Good, %	Fairly good, %	Average, %	Fairly poor or poor, %	p-value	No need, %	In need, %	p-value
All	4385	38	29	22	11		48	52	
Age									
30–34	668	41	34	18	7	< 0.001	46	54	0.055
35–44	1373	41	29	21	9		46	54	
45–54	1459	37	27	22	14		48	52	
55–64	885	33	29	24	14		52	48	
Gender									
Men	2095	34	29	23	14	< 0.001	47	53	0.201
Women	2290	42	30	20	8		49	51	
Education									
Higher	1549	47	30	17	6	< 0.001	53	47	< 0.001
Intermediate	1638	36	29	24	11		46	54	
Basic	1198	30	28	25	17		46	54	

treatment need were associated with clinically determined dental treatment need, but not with the periodontal one, in both genders (Table IV).

Good self-assessed oral health best reflected the absence of a clinically determined need for treatment, as shown by the specificity values of 0.78–0.80 for dental treatment and of 0.70–0.78 for periodontal treatment (Table V). Poor self-assessed oral health provided positive predictive values of 0.84–0.89 for the presence of a clinically determined need of periodontal treatment.

Self-assessed present need for treatment identified 69% of those with a clinically determined need for dental treatment and 52–53% of those in need of periodontal treatment; for the latter, the positive predictive values were 0.81–0.88 (Table V). Reporting no present treatment need reflected fairly well the absence of a clinically determined need for dental treatment, with the negative predictive values being 0.70–0.80.

Figure 3 shows Receiver Operating Characteristic (ROC) curves together with the area under the curve

Table II. Clinically determined dental findings according to self-assessed oral health and treatment need among Finnish dentate population aged 30–64 years, separately for men (n = 2095) and women (n = 2290).

	No. of teeth Mean (SEM)		No. of sound teeth Mean (SEM)		No. of filled teeth Mean (SEM)		No. of teeth in need of treatment (Decayed + Fractured) Mean (SEM)	
	Men	Women	Men	Women	Men	Women	Men	Women
All	24.3 (0.16)	24.2 (0.15)	10.8 (0.15)	9.6 (0.15)	12.1 (0.15)	13.8 (0.15)	1.4 (0.07)	0.7 (0.04)
Self-assessed oral health								
Good	25.8 (0.24)	25.6 (0.16)	12.3 (0.25)	10.9 (0.22)	13.1 (0.23)	14.5 (0.21)	0.5 (0.04)	0.3 (0.03)
Fairly good	25.1 (0.25)	24.3 (0.26)	11.1 (0.24)	9.9 (0.26)	13.1 (0.22)	13.8 (0.20)	0.9 (0.07)	0.6 (0.03)
Average	23.5 (0.30)	22.9 (0.35)	9.8 (0.26)	8.0 (0.25)	12.2 (0.26)	13.8 (0.33)	1.5 (0.10)	1.0 (0.08)
Fairly poor or poor	19.9 (0.55)	19.4 (0.55)	7.7 (0.37)	6.3 (0.39)	7.8 (0.43)	10.8 (0.49)	4.3 (0.31)	2.3 (0.22)
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Self-assessed treatment need								
No need	24.5 (0.20)	24.7 (0.19)	10.9 (0.21)	10.1 (0.20)	13.0 (0.18)	14.3 (0.20)	0.6 (0.05)	0.3 (0.03)
Needed	24.0 (0.23)	23.6 (0.21)	10.6 (0.20)	9.2 (0.18)	11.4 (0.20)	13.4 (0.19)	2.0 (0.10)	1.0 (0.06)
p-value	0.189	< 0.001	0.256	< 0.001	< 0.001	0.001	< 0.001	< 0.001

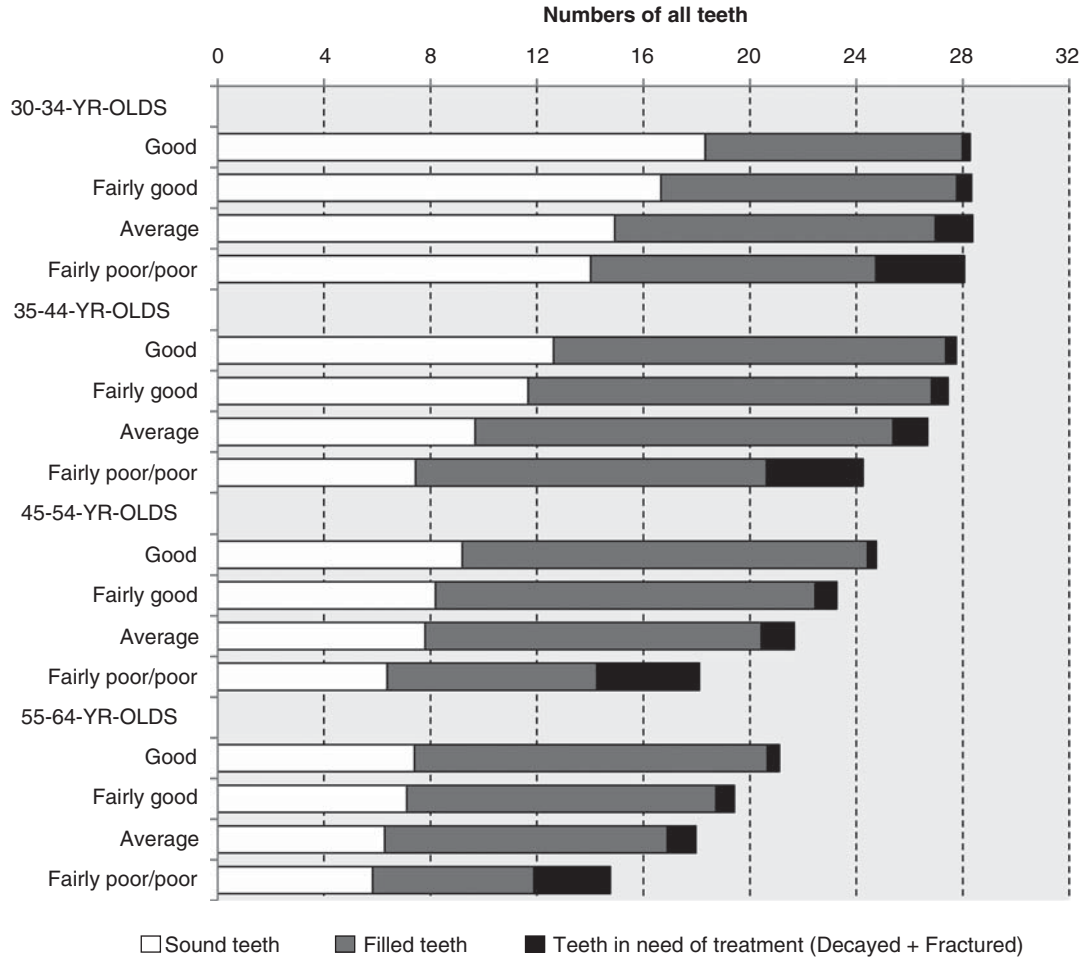

Figure 1. Clinically determined dental health indicators according to self-assessed oral health among Finnish dentate population ($n = 4385$), by age.

(AUC) of self-assessed oral health (SOH) and treatment need (STN) as tests for clinically determined dental (CDN) or periodontal (CPN) need for treatment. The tests in general were not powerful predictors of clinically determined dental or periodontal treatment need.

Discussion

As part of the Finnish nationwide comprehensive Health 2000 Survey, this study included a representative sample of dentate adults aged 30–64 years. Study participants self-assessed their oral health and treatment need in an interview and underwent a clinical oral health examination. This study showed that, among the study participants, self-assessed good oral health is a fairly good estimate for the absence of clinically determined dental and periodontal treatment need. In contrast, self-assessed poor oral health is a weak estimate for the presence of clinically determined dental and particularly periodontal treatment. Overall, subjective oral health was not a powerful predictor of objective treatment need.

One of the strengths of the present study is that evaluation of the relationships of self-assessed and clinically determined oral health and treatment need was based on nationwide representative survey data. Our study participants represent the dentate adult population aged 30–64 years in Finland well, and the results can be generalized nationwide as a result of the weightings, study sample and design and the high response rates at all stages of the survey [24–26]. Except for one recently published paper on a representative sample of adults aged 30 years and older in the US [11], previous studies on this subject have mainly involved selected groups, mainly of older participants and especially community-dwelling or institutionalized ones.

A limitation of this study was that, in the Health 2000 study interview, subjective oral health was rated by asking ‘condition of teeth and oral health’ and treatment need by asking ‘current need of oral healthcare’. These questions may be understood by respondents in a narrow context, i.e. as ‘only dental health’, or in a wider context, i.e. as ‘in addition to dental and periodontal status, the orthodontic,

Table III. Clinically determined periodontal findings according to self-assessed oral health and treatment need among Finnish dentate population, aged 30–64 years, separately for men (n = 2061) and women (n = 2253).

	No. of teeth Mean (SEM)		No. of teeth without deepened pockets: PD < 4 mm, Mean (SEM)		No. of teeth with shallow pockets: PD = 4–5 mm Mean (SEM)		No. of teeth with deep pockets: PD ≥6 mm Mean (SEM)		Number of sextants with bleeding on probing, Mean (SEM)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
All	23.1 (0.16)	23.5 (0.14)	17.8 (0.24)	20.4 (0.18)	4.4 (0.17)	2.8 (0.12)	0.9 (0.06)	0.4 (0.03)	2.7 (0.09)	2.2 (0.08)
Self-assessed oral health										
Good	24.7 (0.22)	25.1 (0.15)	20.2 (0.30)	22.4 (0.21)	3.8 (0.20)	2.4 (0.13)	0.6 (0.08)	0.3 (0.03)	2.5 (0.10)	2.0 (0.10)
Fairly good	24.1 (0.23)	23.6 (0.24)	19.1 (0.36)	20.5 (0.29)	4.4 (0.26)	2.8 (0.17)	0.6 (0.07)	0.4 (0.06)	2.8 (0.12)	2.2 (0.10)
Average	22.4 (0.30)	22.1 (0.34)	16.6 (0.43)	18.7 (0.42)	4.8 (0.28)	3.1 (0.23)	1.1 (0.13)	0.4 (0.06)	2.8 (0.12)	2.4 (0.12)
Fairly poor or poor	17.9 (0.49)	18.6 (0.54)	10.9 (0.52)	14.1 (0.61)	5.4 (0.32)	3.5 (0.35)	1.6 (0.22)	1.0 (0.17)	2.9 (0.15)	2.3 (0.18)
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.016	0.003
Self-assessed treatment need										
No need	23.5 (0.19)	24.1 (0.17)	18.8 (0.30)	21.3 (0.21)	4.0 (0.21)	2.5 (0.13)	0.7 (0.07)	0.3 (0.04)	2.6 (0.10)	2.1 (0.10)
Needed	22.7 (0.22)	22.9 (0.21)	16.9 (0.31)	19.5 (0.25)	4.8 (0.20)	2.9 (0.15)	1.0 (0.08)	0.4 (0.04)	2.8 (0.10)	2.3 (0.09)
p-value	0.012	< 0.001	< 0.001	< 0.001	0.001	0.012	< 0.001	0.003	0.061	0.014

prosthetic, aesthetic and mucosal health conditions of the oral cavity'. Regardless of possible variability of responses, a single global question for self-assessment could possibly be generalized across all different extents concerning oral health. Thus, such a global question is, at the same time, cheap, concise and feasible, especially for large populations, being therefore one of the strengths of the self-assessment measure in this study. Concerning indicators we used to determine objective periodontal treatment need, pocket measuring was recorded at tooth level, but gum bleeding by sextants. This disallowed differentiation between those pockets without and with inflammation, over-estimating periodontal treatment need.

Our finding of a weak association of poor self-assessed oral health and clinically determined need for dental and particularly periodontal treatment is in line with previous studies that have shown a poor congruence between objective and subjective oral health and treatment need for caries and periodontitis [9,29,30]. As regards the most common oral diseases, caries and periodontitis, the physical and pathological changes occur long before the pain, discomfort and functional disability set in. Hence, people often under-estimate the presence, severity and treatment need of these diseases [21,29]. Weaker associations of objective periodontal health and treatment need with subjective oral health and treatment need, compared to associations seen in dental health and treatment need, in both multivariate analyses and cross-tabulation analyses, may partly be explained by the silent character of periodontal diseases. Our result of a weak association of subjective and objective periodontal health is in line with a reported association between poor perceived oral health and presence of periodontal treatment need when comparing periodontal patients who had deep pockets in more than eight teeth with those patients who had fewer than three teeth with such pockets [31]. In contrast, a recent study on the performance of self-assessment in predicting periodontitis among US adults [11] showed that all self-assessed measures were associated with clinical findings. This could be due to the fact that their self-assessment questions were designed more specifically for periodontal diseases, whereas we used more global questions.

Self-assessed present need for treatment identified two thirds (69%) of those with objective dental treatment need, thus supporting findings among adults in East London whose self-assessment of treatment need identified 76% of those with clinically determined treatment need for oral care [7]. Our finding on the association between greater numbers of decayed teeth and reported treatment need is in agreement with previous studies among 21–63-year-old Greeks [23] and in a national sample of 20–25 year-old Swedes [18]. A surprising finding was that

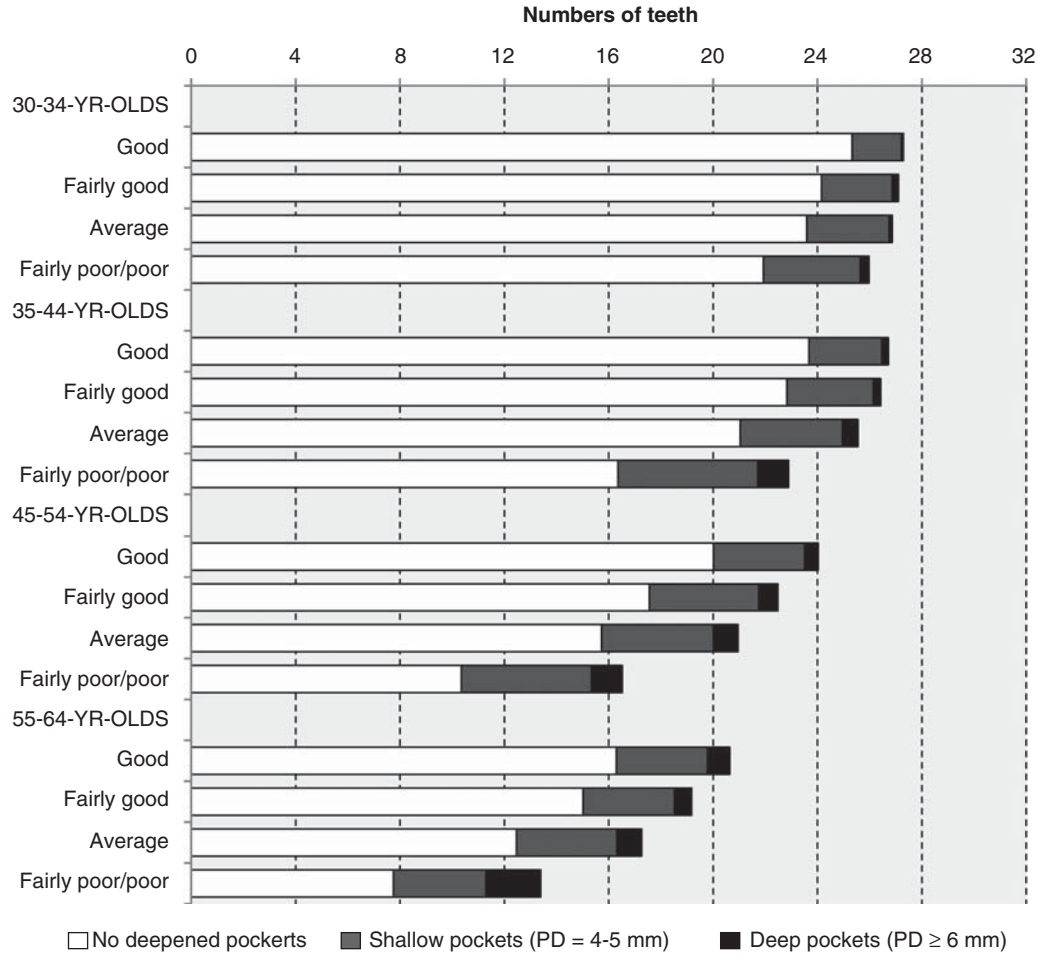

Figure 2. Clinically determined periodontal health indicators according to self-assessed oral health among Finnish dentate population (n = 4314), by age.

Table IV. Association of self-assessed oral health and treatment need with clinically determined dental and periodontal treatment need among Finnish dentate population aged 30–64 years.

	Presence of clinically determined need for							
	dental treatment: yes				periodontal treatment: yes			
Subjective oral health	β	SEM	p	OR (95% CI)	β	SEM	p	OR (95% CI)
Men		(n = 2095)				(n = 2061)		
Subjective oral health:								
Poor/fairly poor vs good	2.00	0.18	< 0.001	7.4 (5.2–10.5)	0.43	0.24	0.069	1.5 (1.0–2.5)
Average vs good	0.94	0.13	< 0.001	2.6 (2.0–3.3)	0.35	0.19	0.070	1.4 (1.0–2.1)
Fairly good vs good	0.38	0.12	0.002	1.4 (1.2–1.9)	0.22	0.16	0.183	1.2 (0.9–1.7)
Treatment need: need vs no need	0.79	0.10	< 0.001	2.2 (1.8–2.7)	0.80	1.04	0.798	1.0 (0.8–1.4)
Model goodness-of-fit		0.833					0.706	
Women		(n = 2290)				(n = 2253)		
Subjective oral health:								
Poor/fairly poor vs good	1.68	0.18	< 0.001	5.4 (3.8–7.7)	0.28	0.22	0.194	1.3 (0.9–2.0)
Average vs good	1.06	0.13	< 0.001	2.9 (2.2–3.8)	0.51	0.16	0.001	1.7 (1.2–2.3)
Fairly good vs good	0.55	0.12	< 0.001	1.7 (1.3–2.2)	0.12	0.13	0.351	1.1 (0.9–1.4)
Treatment need: need vs no need	0.62	0.11	< 0.001	1.9 (1.5–2.3)	0.05	0.12	0.643	1.1 (0.8–1.3)
Model goodness-of-fit		0.900				0.844		

Table V. Self-assessed oral health and treatment need vs clinically determined dental and periodontal treatment need among Finnish dentate population aged 30–64 years, separately for men and women.

	Presence of clinically determined need for							
	dental treatment: yes, no (n = 4385)				periodontal treatment: yes, no (n = 4314)			
Self-assessments by gender	SN	SP	PPV	NPV	SN	SP	PPV	NPV
Oral health: poor, good								
Men	0.54	0.78	0.67	0.67	0.37	0.70	0.89	0.14
Women	0.46	0.80	0.51	0.76	0.30	0.78	0.84	0.23
Treatment need: yes, no								
Men	0.69	0.61	0.60	0.70	0.53	0.51	0.88	0.14
Women	0.69	0.57	0.43	0.80	0.52	0.53	0.81	0.23

SN, Sensitivity; SP, Specificity; PPV, Positive predictive value; NPV, Negative predictive value.

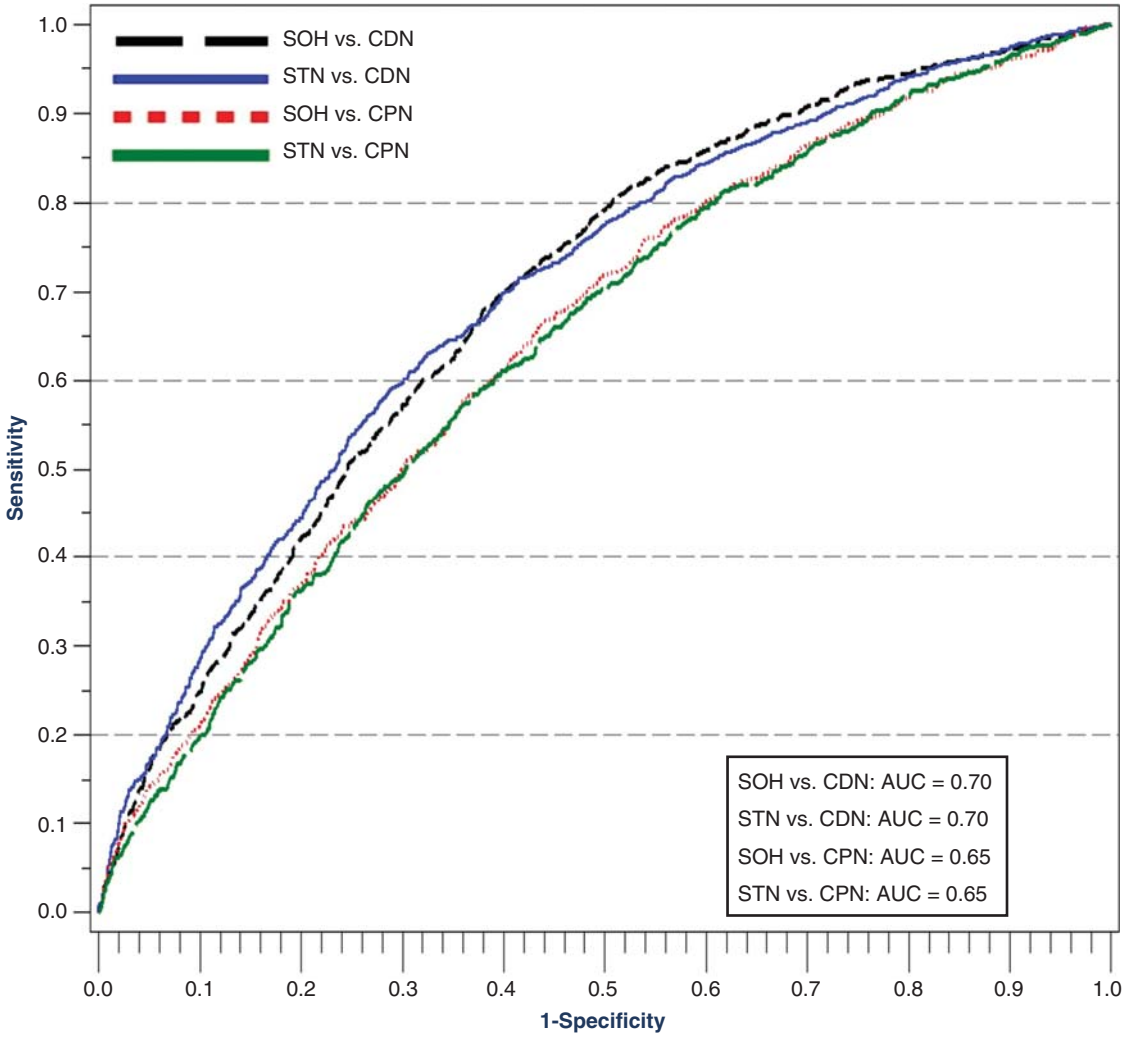

Figure 3. Receiver operating characteristic (ROC) curves together with the area under the curve values (AUC) (SOH, self-assessed oral health; STN, self-assessed treatment need; CDN, clinically determined dental treatment need; CPN, clinically determined periodontal treatment need).

self-assessed need for treatment was weakly associated with the presence of gum bleeding, although it should be easy to recognize by the participants themselves. This result goes against our expectation based on a Swedish report showing a clear congruence of subjective need and objective observations for those conditions that are relatively easy for the individual to observe [13].

It is known that self-assessment is a subjective measure largely affected by individuals' socio-economic and cultural backgrounds, as well as perceptions. In our study, socio-demographic backgrounds such as age, gender and educational level showed a statistically significant association with subjective oral health and treatment need, thus supporting findings that a higher educational level relates to better self-rated dental health [30]. Similarly, among Finnish adults poor subjective oral health was more frequently reported by men, older adults and those with higher education compared women, younger adults and those with basic or intermediate level of education, respectively [32]. The study among Greek adults, instead, found no such associations [23].

In order to minimize some of these confounding factors, in this study, associations of subjective and oral health with objective ones were determined controlling some of the possible background variables (age, gender, educational level) as well as numbers of teeth, by means of logistic models.

For periodontal treatment need, positive and negative predictive values emerged at the extreme ends, PPV with a high value and NPV with a low one. This is a natural consequence since PPV and NPV are affected by disease prevalence, which for the periodontal treatment need among adults in this study was as high as 83%. Based on the high specificity values of oral health assessments from two-by-two table tests (Table V), T results estimate well the D ones. This supports potential use of self-assessment of oral health in screening of adult population groups. Conversely, based on low sensitivity values of oral health assessments in diagnostic tests, T+ results do not estimate well the D+ ones. This may be due to cases with oro-facial functioning and/or psychosocial concerns not identified by the clinical indicators we used.

In this type of large adult population, with relatively low dental caries treatment need and high prevalence of periodontal disease, since good subjective oral health is associated with being objective-treatment need-free, self-assessment of oral health seems to be a good screening tool. Thus, in practice, for example, self-assessment could be used in discriminating healthy ones (D+) from the rest (D) when clinical assessment is unattainable due to limited resources. In this way, self-assessment data could be useful to prioritize health services and manage health needs with the purpose of responding to increasing demands in large populations with similar disease distributions. In conclusion, in Finland self-assessed good oral health provides a fairly good estimate for the absence of clinically determined dental or periodontal treatment need. In contrast, self-assessed poor oral health is a weak one for the presence of such need in this population. Overall, subjective oral health and treatment need were not powerful in estimating objective treatment need. Thus, at the population level, self-assessed data could be used for screening purposes for oral health service planning and for priority allocation in large adult populations with dental and periodontal disease prevalence and distributions similar to Finland.

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References

[1] Burström B, Fredlund P. Self-rated health: is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? J Epidemiol Community Health 2001;55:836–40.

[2] Emmelin M. Self-rated health in public health evaluation. Doctoral thesis. Sweden: Umeå University Medical Dissertation; Series 2004. p 46–80.

[3] Newell DE, Girgis A, Sanson-Fisher RW, Savolainen NJ. The accuracy of self-reported health behaviors and risk factors relating to cancer and cardiovascular disease in the general population: a critical review. Am J Prev Med 1999;17:211–29.

[4] Wright FV, Law M, Crombie V, Goldsmith CH, Dent P. Development of a self-report functional status index for juvenile rheumatoid arthritis. J Rheumatol 1994;21:536–44.

[5] Rimm EB, Giovannucci EL, Stampfer MJ, Colditz GA, Litin LB, Willett WC. Reproducibility and validity of an expanded self-administered semiquantitative food frequency questionnaire among male health professionals. Am J Epidemiol 1992;135:1114–26.

[6] Wolf AM, Hunter DJ, Colditz GA, Manson JE, Stampfer MJ, Corsano KA, et al. Reproducibilty and validity of a self-administered physical activity questionnaire. Int J Epidemiol 1994;23:991–9.

[7] Robinson PG, Nadanoysky P, Sheiham A. Can questionnaires replace clinical surveys to assess dental treatment needs of adults? J Public Health Dent 1998;58:250–3.

[8] Axelsson G, Helgadóttir S. Comparison of oral health data from self-administered questionnaire and clinical examination. Community Dent Oral Epidemiol 1995;23: 365–8.
[9] Pitiphat W, Garcia RI, Douglass CW, Joshipura KJ. Validation of self-reported oral health measures. J Public Health Dent 2002;62:122–8.
[10] Luzzi L, Jones K, Spencer AJ, Roberts-Thomson KF. Association of urgent dental care with subjective oral health indicators and psychosocial impact. Community Dent Health 2009;26:77–83.
[11] Eke PI, Dye BA, Wei L, Slade GD, Thornton-Evans GO, Beck JD, et al. Self-reported measures for surveillance of periodontitis. J Dent Res 2013;92:1041–7.
[12] Jakobsen JR, Hunt RJ. Validation of oral status indicators. Community Dent Health 1990;7:279–84.
[13] Unell L, Söderfeldt B, Halling A, Birkhed D. Explanatory models for oral health expressed as number of remaining teeth in an adult population. Community Dent Health 1998;15: 155–61.
[14] Undén A-L, Elofsson S. Health from the patient́s point of view. How does it relate to the physiciańs judgment? Fam Pract 2001;18:174–80.
[15] Ekbäck G, Åstrøm AN, Klock K, Ordell S, Unell L. Variations in subjective oral health indicators of 65-year-olds in Norway and Sweden. Acta Odontol Scand 2009;67:222–32.
[16] Locker D, Jokovic A. Using subjective oral health status indicators to screen for dental care needs in older adults. Community Dent Oral Epidemiol 1996;24:398–402.
[17] Tickle M, Worthington HV. Factors influencing perceived treatment need and the dental attendance patterns of older adults. Br Dent J 1997;182:96–100.
[18] Lundegren N, Axtelius B, Håkansson J, Åkerman S. Dental treatment need among 20 to 25-year-old Swedes: discrepancy between subjective and objective need. Acta Odontol Scand 2004;62:91–6.
[19] Blicher B, Joshipura K, Eke P. Validation of self-reported periodontal disease: a systematic review. J Dent Res 2005;84: 881–90.
[20] Bardage C, Pluijm SMF, Pedersen NL, Deeg DJ, Jylhä M, Noale M, et al. Self-rated health among older adults: a cross-national comparison. Eur J Ageing 2005;2:149–58.
[21] Nagarajan S, Pushpanjali K. Self-assessed and clinically diagnosed periodontal health status among patients visiting the outpatient department of a dental school in Bangalore, India. Indian J Dent Res 2008;19:243–6.
[22] Östberg A-L, Eriksson B, Lindblad U, Halling A. Epidemiological dental indices and self-perceived oral health in adolescents: ecological aspects. Acta Odontol Scand 2003; 61:19–24.
[23] Seremidi K, Koletsi-Kounari H, Kandilorou H. Self-reported and clinically-diagnosed dental needs: determining the factors that affect subjective assessment. Oral Health Prev Dent 2009; 7:183–90.
[24] Aromaa A, Koskinen S. editors. Health and functional capacity in Finland. Baseline results of the Health 2000 health examination survey. Publication B12/2004 Helsinki: National Public Health Institute; 2004. p 11–23. Available online at www.terveys2000.fi/julkaisut/baseline.pdf.accessed .
[25] Heistaro S. Methodology report. Health 2000 Survey. Publication B26/2008 Helsinki: National Public Health Institute; 2008. p 182–9. Available online at http://www.terveys2000.fi/doc/methodologyrep.pdf.accessed.
[26] Suominen-Taipale L, Nordblad A, Vehkalahti M, Aromaa A. editors. Oral health in the Finnish adult population. Health 2000 Survey. Publication B25/2008 Helsinki: National Public Health Institute; 2008. p 9–26. Available online at www.terveys2000.fi/julkaisut/oral_health.pdf.accessed.
[27] Vehkalahti M, Paunio I, Nyyssönen V, Aromaa A. editors. Suomalaisten aikuisten suunterveys ja siihen vaikuttavat tekijät (Oral health in the adult Finnish population and associated factors. In Finnish, abstract in English). Kansaneläkelaitoksen julkaisuja AL:34. Helsinki ja Turku: Vammalan kirjapaino; 1991. p 129–60.
[28] Oral Health Surveys. Basic methods. 4th ed. Geneva: World Health Organization; 1997. p 39–44.
[29] Tervonen T, Knuuttila M. Awareness of dental disorders and discrepancy between ”objective” and ”subjective” dental treatment needs. Community Dent Oral Epidemiol 1988; 16:345–8.
[30] Gilbert AD, Nuttall NM. Self-reporting of periodontal health status. Br Dent J 1999;186:241–4.
[31] Cunha-Cruz J, Hujoel PP, Kressin NR. Oral health-related quality of life of periodontal patients. J Periodontal Res 2007; 42:169–76.
[32] Kaprio H, Suominen AL, Lahti S. Association between subjective oral health and regularity of service use. Eur J Oral Sci 2010;120:212–17.