Oral disease, impairment, and illness: congruence between clinical and questionnaire findings

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In 1992 a questionnaire was sent to 50-year-olds in two Swedish counties. These self-report data were compared with clinical observations with regard to number of teeth, removable dentures, caries, and periodontitis. Complete information from both data sources was obtained for 1041 persons. The relevant questionnaire item explained 71% of the missing tooth variance. An agreement of 0.91 (Cohen's κ) was obtained for removable dentures. A question about problems in opening the mouth differentiated clearly with regard to measured mouth opening ability. Toothache and tooth sensitivity were reported with 95% probability when having 22 decayed teeth and with 46% when there were no decayed teeth (58% correctly predicted). Two teeth with pockets $\geq$6 mm gave 5% probability and 22 such teeth gave 39% probability of reporting migration of front teeth. The main conclusion from this study is that there is good correspondence between subjective self-reports and clinical findings, especially for those conditions that are relatively easy for the patient to observe, such as the number of teeth and the presence of dentures. Thus questionnaire data can be used for information and screening about some well-defined oral conditions.

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During the past decades a new conceptual system has been developed with regard to health and illness under the auspices of the World Health Organization (1). Health is conceived as fundamentally different from disease and not as merely the absence of pathologic conditions. Ill health is regarded from three aspects: as *disease* (the physical pathologic condition), as *impairment* (the functional disabilities), and as *illness* (the subjective sense of lacking well-being). This system has found applications in public dental health research (2, 3). The idea behind this is that there is a process going on from disease via impairment to illness. The three aspects (disease, impairment, and illness) are thus closely related, although the relation by no means fully determines the aspects. Especially with regard to oral health, there can be signs of disease long before there is impairment, and even longer before there is illness. It is also conceivable that there is impairment without any diagnosable disease, and that there can be illness without any observable impairment.

The relations between disease, impairment, and illness vary greatly for different conditions. For example, periodontal disease can be rather advanced before it results in impairment, like increased mobility, migration of teeth, or tooth loss. The same argument can be applied to caries, although there might be illness present earlier in the caries process than in periodontitis.

Illness contains a social component, and there is usually a complex social and cultural process involved. For instance, edentulousness is today regarded as an illness, a negative subjective well-being, by most people in Sweden. This was hardly the case earlier, when lack of teeth was regarded as a natural part of aging. This means that one can expect a socially related difference between disease and illness and that this may vary from time to time (1, 4).

In clinical observation the goal is primarily to find signs of disease—that is, observable biologic changes. In, for example, questionnaire surveys and anamneses, the goal is usually to find indicators of illness. The most prevalent situation is, however, that the disease causes malfunctions and symptoms of various kinds, which are experienced as illness. There are reasons for the frequent statements of the relative independence of disease and illness, but there are also arguments for a certain amount of congruence between them. The general objective of this study was therefore to assess this congruence for an adult population with regard to four oral conditions: missing teeth, presence of removable dentures, caries (as indicated by toothache and tooth sensitivity), and periodontitis. In one case, we also studied the congruence between impairment, functional limitation, and illness—namely, the ability to open the mouth.

Materials and methods

Study base

In 1992, a mail questionnaire was sent to all 50-year-old persons in two counties in Sweden, Örebro and Östergötland—altogether 8888 persons (3633 in Örebro and 5255 in Östergötland). Their names and addresses were obtained from public records (Statistics, Sweden), available as a data file. If a questionnaire was returned with unknown address, that person was excluded from the population. Individuals not responding within 2 weeks were sent a letter of reminder. For those still not answering after an additional 2 weeks, a new questionnaire was sent. After that, no further contacts were made. The final response rate was 71% (6343 persons), the same in both counties. The only variable for which the representativeness of the respondents could be controlled was gender; there was no significant difference in gender composition of the respondents as compared with the original population. A fuller description of the questionnaire has been published elsewhere (5).

In addition to the questionnaire, clinical examinations were offered to 20% of the whole population—that is, 1780 persons. This was carried out at a clinic in the vicinity of their residence, at altogether 31 different locations. The patients were offered a free clinical examination by telephone. Those who were not reached, received a letter with the same offer. Altogether 1041 persons (58% of the subsample) were examined. Those attending who had not completed the questionnaire were given a new copy and requested to mail it after the examination. The examining dentist was not aware of the patient's questionnaire responses at the examination. Before examination, patients were briefly interviewed about diseases of relevance to the situation, in accordance with Swedish legal regulations.

Calibration

Before the clinical study 11 experienced general practitioners were calibrated. They were trained for 3 days by two of the authors (L. Unell and A. Halling), who were used as standards. The training contained detailed registration instructions and comparative clinical investigations with result assessments. The examinations included six patients with six dentists from Östergötland County and four patients with six dentists from Örebro County. The conditions during training were the same as for the actual study—that is, well-equipped dental clinics. For each patient, four bitewing radiographs were available. The calibration was done on the following variables: number of teeth, number of coronal caries lesions and fillings, number of root surface caries lesions, gingival recession, and community periodontal index (CPI). There were few caries lesions in the studied group, so the calibration had to be done including fillings. For measuring of ability to open the mouth, no calibration study was done; only oral and written instructions were given.

The following calibration results were obtained, on the basis of intraclass correlation, Cronbach's α (6). For Örebro County: number of teeth, $\alpha = 1.00$; number of coronal caries lesions and fillings (at the tooth surface level), $\alpha = 0.99$; number of root surface caries lesions, $\alpha = 0.73$; gingival recession, $\alpha = 0.92$; and CPI, $\alpha = 0.73$. For Östergötland County: number of teeth, $\alpha = 1.00$; number of coronal caries lesions and fillings (on the tooth surface level), $\alpha = 0.99$; number of root surface caries lesions, $\alpha = 0.78$; gingival recession, $\alpha = 0.89$; and CPI, $\alpha = 0.88$. On the basis of these figures, we considered the reliability of the dentists' registrations as satisfactory, and, thus, the data from the two counties were treated together.

Non-participation

Analysis of non-attendance in the clinical study group was done on the basis of the questionnaire data. Additionally, at the telephone contact, non-attenders were asked about reason for refusal and about a few oral conditions; there were 182 responses to this. Stated reasons for non-attendance were as follows: no suitable time found (31%), refusal without reason (27%), language problems (24%), sick or disabled patient (5%), wearing removable dentures (4%), long distance to examination site (3%), fear of dental treatment (2%), and other reasons (4%). There were also questions about the number of remaining teeth, time of last visit for dental care, and frequency of visits; the differences between the non-attenders and attenders were in no case significant. It was concluded that non-attendance was approximately random in this respect.

Dependent variables

The following five dependent variables were used:

1) Number of teeth. The remaining teeth (maximum, 28) also included teeth with artificial crowns, and partially erupted teeth.

2) Ability to open the mouth. The patient was asked to open his/her mouth as widely as possible. The distance (in millimeters) was registered with a ruler, between the edges of upper and lower incisors, compensating for overbite or open bite.

3) Toothache and sensitive teeth. In the questionnaire there was a question regarding the latest experience of toothache with the following response alternatives: 'during past 3 months', 'during past year', 'more than 1 year ago', 'have never had toothache', and 'do not remember'. Another question in the questionnaire reported problems with sensitive teeth, with the response alternatives: 'no problems', 'some problems', 'rather many problems', and 'great problems'. A binary variable was constructed combining those who had

experience of 'toothache more than 1 year ago', 'no toothache ever', and those 'not remembering' with those reporting 'no problems with sensitive teeth' into a category of 'no problems'. The rest were categorized as the other group, 'some problem'.

4) Migrating front teeth. In the questionnaire there was a question as to whether the respondent had noticed any changed position of his/her front teeth during the past year. The response was binary, 'yes' or 'no'.

5) Trouble with bleeding gingiva. In the questionnaire there was a question about possible trouble with bleeding gums. The following response alternatives were used: 'no problems', 'some problems', 'rather many problems', and 'great problems'. A binary variable was constructed combining the first two alternatives into one alternative, and the last two alternatives into another alternative.

Independent variables

The following five variables were used as independent variables:

1) Remaining teeth. In the questionnaire there was a question about the number of remaining teeth, with the following response alternatives: 'all teeth remaining', 'missing a few teeth', 'missing rather many teeth', 'have almost no teeth left', and 'edentulous'. The variable was transformed into four dummy variables, with the indicated response alternative set as 1 and all other set to 0. 'Edentulous' was chosen as reference category.

2) Number of decayed teeth. All tooth surfaces were examined, and the number of decayed (D), missing (M), and filled (F) tooth surfaces (DMFS) and teeth (DMFT) recorded in accordance with the criteria stated by the National Board of Health and Welfare (7, 8). Root caries was scored in accordance with Ravald (9).

3) Number of teeth with CPI = 4. Probing pocket depth was measured with a WHO probe (10). The probing was done around the whole tooth, and CPI = 4 was registered if the pocket was $\geq$6 mm anywhere (11).

4) Number of teeth with recession. Recessions were measured buccally (using the probe) from the cementoenamel junction to the gingival margin, categorized into two categories: no recession ($\leq$0.5 mm) and recession (>0.5 mm). If there was a filling extending to or over the cementoenamel junction, the distance from the edge of the filling to the gingival margin was measured.

5) Problems in opening the mouth. Response alternatives for problems in opening the mouth widely were 'no problems', 'some problems', 'rather many problems', and 'great problems'. The variable was transformed into three dummy variables with the indicated response alternative set as 1 and all other set to 0, where the two middle alternatives were combined into one dummy variable. 'No problems' was set as reference category.

Methods of analysis

The data were analyzed in contingency tables and by regression analysis. In bivariate regression the choice of dependent variable is arbitrary, and the variable with the most favorable metric properties was chosen as dependent. For determination of correspondence between the two data sources, Cohen's κ was used in one case. With κ, the probability for random correspondence in the assessment of interrater reliability is considered (12). For those models in which the response variable was binary, logistic regression models were used with logit-transformed probabilities calculated for best, average, and worst possible person from a clinical point of view (13). For categoric independent variables, dummy variables were calculated (14). All data analysis was done in SPSS (Statistical Package for the Social Sciences).

Results

The responses to the question about remaining teeth were related to the number of teeth in the clinical examination by using dummy variable regression (Table 1). The model was highly significant and the variance explanation, as measured by adjusted R^2, was high,

Table 1. Dummy variable regression analysis of reports of missing teeth in relation to clinical examination results. Dependent variable: number of teeth in clinical examination

Independent variable	Regression coefficient	$s_{\bar{x}}$
All teeth remaining	27.0	0.71
Missing a few teeth	25.3	0.69
Missing rather many teeth	20.1	0.72
Have almost no teeth left	7.8	1.00
Edentulous (intercept)	0.0	0.68

Adj. R^2 = 0.71. Model significance: F = 591.2, 967 df, P = 0.0000.

Table 2. Presence of removable dentures, including combinations of fixed and removable dentures, from subjective reports and clinical examination in 71 subjects. Values are given as percentages (and absolute numbers within parentheses)

	Subjective report		
Clinical examination	Removable partial denture	Full upper or lower denture	Full dentures in both jaws
Removable partial denture	90 (28)	7 (2)	3 (1)
Full upper or lower denture	6 (1)	94 (15)	–
Full dentures in both jaws	–	–	100 (24)

Cohen's κ = 0.91 ± 0.08 (0.93 ± 0.08 excluding patients with combinations of fixed and removable dentures).

Table 3. Dummy variable regression analysis of the relation between ability to open the mouth by subjective reports of problems in opening the mouth. Dependent variable: ability to open mouth, in millimeters

Independent variable	Regression coefficient	$s_{\bar{x}}$
No problems (intercept)	50	0.2
Some problems	−5	0.7
Great problems	−10	1.9

R^2 = 0.07. Model significance: F = 34.9, 972 df, P = 0.0000.

Table 4. Logistic regression with reports of any problem with toothache and sensitive teeth as dependent variable and remaining teeth, decayed teeth, and teeth with gingival recession as independent variables

Independent variable	Regression coefficient	Odds ratio	P
No. of remaining teeth	0.03	1.03	0.0258
No. of decayed teeth	0.12	1.13	0.0002
No. of teeth with recessions	0.01	1.01	0.1756
Intercept	−1.01		0.0018

Correctly predicted cases = 57.5%. −2LL = 1311.3, 969 df, P = 0.0000. Model chi-square = 21.5, 3 df, P = 0.0001. Goodness of fit = 971.9, 969 df, P = 0.4674.
Probability for average person (1.4 decayed teeth, 23.9 teeth, 11.8 without recession), 50.0%. Probability for best possible person (0 decay, 28 teeth, 0 recession), 45.8%. Probability worst possible person (22 decay, 27 recession, 28 teeth) 95.0%.

71%. In Table 2 the presence of removable dentures is compared between the two data sources. By Cohen's κ, the correspondence was high between dentists' and patients' observations.

The clinical observations of the ability to open the mouth was set as a dependent variable in a bivariate dummy variable regression model. The model was significant, but the variance explanation low. The gradient between the three dummy categories was in the expected direction, with 10 mm less mouth opening

Table 5. Bivariate logistic regression analysis of the relation between share of remaining teeth with community periodontal index (CPI) = 4 by subjective reports of front teeth with changed position last year (dependent variable: reports of changing positions of front teeth last year or not)

Independent variable	Regression coefficient	Odds ratio	P
Share of teeth with CPI = 4	0.12	1.12	0.0001
Intercept	−3.1		0.0000

−2LL = 408.6, 964 df, P = 1.0000. Model chi-square = 13.4, P = 0.0002. Goodness of fit = 971.3, P = 0.4285. Correctly predicted cases = 94.3%.
Probability for average person (2 teeth with CPI = 4): 5.4%. Probability for best possible person (no teeth with CPI = 4): 4.3%. Probability worst possible person (22 teeth with CPI = 4): 38.7%.

Table 6. Bivariate logistic regression analysis of the relation between share of remaining teeth with community periodontal index (CPI) = 4 by subjective reports of many troubles with bleeding gingiva. (Dependent variable: reports of many troubles with bleeding gingiva or not)

Independent variable	Regression coefficient	Odds ratio	P
Share of teeth with CPI = 4	0.14	1.15	0.0004
Intercept	−4.26		0.0000

−2LL = 185.2, 962 df, P = 1.0000. Model chi-square = 9.4, P = 0.0021. Goodness of fit = 979.9, P = 0.3369. Correctly predicted cases = 97.9%.
Probability for average person (2 teeth with CPI = 4): 1.7%. Probability for best possible person (no teeth with CPI = 4): 1.4%. Probability worst possible person (22 teeth with CPI = 4): 23.5%.

ability for those patients reporting 'problems' and 5 mm less for those reporting 'some problems'. According to the standard errors, the coefficients were significant and the associations clear (Table 3).

Problems with toothache or tooth sensitivity was related to the number of decayed teeth, the number of teeth with gingival recessions, and to the number of remaining teeth in a logistic regression model (Table 4). Two of the independent variables were significantly related to the dependent variable. Gingival recessions had no effect on reports of problems with toothache or tooth sensitivity. Logit probabilities were calculated for the best, the average, and the worst possible cases. The differences between the probabilities were large. Goodness of fit was satisfactory, and the model improved prediction by 7.5%.

Periodontitis was indicated by a question about changing position of front teeth and another about problems with bleeding gingiva. The responses were related to the share of remaining teeth, with CPI = 4 in logistic regression models (Tables 5 and 6). In both cases the models were significant, with more than adequate goodness of fit. Logit probabilities were calculated with large differences between stereotypic cases. The averages were close to the best possible cases, indicating rather low prevalence of problems in the studied population.

Discussion

The main result of the present study was a good congruence between subjective reports and clinical observations. This holds true primarily for those conditions that are relatively easy for the patient to observe—that is, the number of teeth and the presence of dentures. The possible indicators for caries, ability to open the mouth, and periodontitis showed less congruence with clinical findings, but, as shown by the probability calculations, the models had good (at least 20% improvement of probability) predictive ability for extreme cases. Two conclusions can therefore be drawn

from the results: 1) there seems to be an association between clinical conditions and subjective perceptions—that is, between disease and illness; and 2) data of good validity for disease conditions could be collected from subjective data sources, such as by questionnaire.

The observation of good correspondence between reports of the number of teeth and presence of teeth examined by a dentist agrees rather well with previous results (for example, Ref. 15). There are studies showing overreporting as well as underreporting of the number of teeth (16, 17). For a representative sample of the general population the present observation of good correspondence has been confirmed (18, 19). For the presence of dentures, there was good correspondence, which is in agreement with other reports (20). We consider the deviations from perfect correspondence to be due to possible misunderstanding of the questionnaire. Full dentures in one jaw are certainly removable and might well be interpreted by some respondents as meaning removable dentures. Questionnaires should be made absolutely clear on this point, to improve correspondence.

With regard to the ability to open the mouth, the results cannot be said to imply a comparison between disease and illness, but rather between impairment and illness. Of course, on this point there is a natural anatomic variation among people. The results show, however, that those persons reporting problems did indeed have less ability to open the mouth. The result of an average mouth opening ability of 40 mm among those reporting 'great problems' corresponds well with the traditional clinical standard.

Toothache and tooth sensitivity are relatively late symptoms in the development of caries. The dentist can discover signs of caries much earlier than the patient becomes conscious of symptoms. However, the models showed good fit and good predictive ability for the more extreme cases. Thus one may conclude that questionnaires could be considered possible screening instruments for severe caries patients but not for other patients. Essentially the same reasoning is applicable to periodontal disease, perhaps even to a greater extent. Periodontal disease is indeed in an advanced stage when the patient can perceive migration of front teeth. Despite the low prevalence of that perception, the model showed good predictive ability for those reporting such migration. Our result is in accordance with other studies, in which CPI is regarded as a reliable assessment of periodontal disease (21).

Although high-risk groups are an important concern in many contexts, clinical as well as preventive, there are arguments that low-risk groups are more rewarding targets for prevention, because of their often much greater numbers (22). Survey methods seem to be at a disadvantage in this respect, according to our results. Surveys are less suitable as evaluative instruments of low-risk preventive strategies. In dentistry, disease indicators can be discovered so much earlier than illness that the professional judgement cannot be replaced by subjective reports. Caries and periodontitis prevalence should thus always be measured by professionals. However, questionnaires could be used for finding those conditions that are directly connected to the individual's experiences, such as the number of teeth or the experience of toothache. If that is the objective, survey methods would be valid and reliable.

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