# Oral Prostheses and Oral Health–Related Quality of Life: A Survey Study of an Adult Swedish Population

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***Purpose:*** The purpose of the study was to investigate whether oral health–related quality of life (OHRQOL) in an adult Swedish population could be explained by social attributes; individual attributes; dental status, with a special focus on the role of prosthodontics; and dental care attitudes. ***Materials and Methods:*** The study was based on responses to a questionnaire sent in 1998 to a random sample of 1,974 persons aged 50 to 75 years (66% response rate). Three factors representing various aspects of OHRQOL were set as dependent variables in multiple-regression models: *oral health impact on everyday activities, oral health impact on the psychologic dimension,* and *oral health impact on oral function.* Independent variables in the models were *social attributes, individual attributes, number of teeth, denture* (ie, type of denture, if present), and *dental care attitudes*. ***Results:*** *General health in relation to age peers* had the strongest association with all 3 dependent variables, followed by *number of teeth* and *need care—cost barrier.* When *number of teeth* was excluded, *removable denture* was found to covary with the dependent variables in each of the 3 regression models. ***Conclusion:*** The number of remaining teeth is more important than the type of denture in explaining OHRQOL. It is less important that a denture is fixed for those with few remaining teeth, in contrast to all others. Explanations are also found in general health and various aspects of dental care costs. *Int J Prosthodont 2007;20:132–142.*

Oral health-related quality of life (OHRQOL) has been an increasingly popular subject of research in the last 10 years. Several instruments have been developed to assess OHRQOL, and they are suitable for use in, for example, public health strategies or the evaluation of different treatment outcomes on individuals or groups. Most Western youth and adults have good oral health, but for those who do not, the impact of their oral health problems on their everyday activities can be significant. For example, decayed teeth, periodontal disease, poorly functioning teeth, tooth pain, lost teeth, wearing a removable denture, infrequent dental visits, problem-based dental visits, lack of dental insurance, low income, low levels of education, low social class, and poor general health can all result in poor OHRQOL.[1] Furthermore, the position and number of teeth affect QOL.[2,3] One aspect of oral health is the role of prosthodontics, especially for middle-aged and elderly patients. It has been suggested that prosthodontic therapies might improve oral comfort and QOL.[4] According to several studies, implant-retained dentures in general improve oral function and QOL.[5]

A study in southern Sweden revealed that 90% of the adult population considers it extremely important to have natural teeth, fixed partial dentures (FPDs), or a combination of the two.[6] This attitude may have been fostered by decades of subsidized dental care in the National Dental Insurance Program, which provided extensive oral health care for most people at a relatively low cost. Twenty years earlier, in a nationwide Swedish study, 83% of the population "definitely wanted to preserve their natural teeth."[7]

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Several studies using various instruments to assess OHRQOL have defined or examined different dimensions of OHRQOL, such as chewing, conversation, appearance, worry, self-consciousness, pain, function, social contacts, physical disability, and psychologic disability.[1] One study[8] defined 3 factors that represented various dimensions of OHRQOL in a population of Swedish adults: *(1)* physical and social disability, *(2)* psychologic discomfort and disability, and *(3)* functional limitation and physical pain. These factors are similar to those found in other studies, although neither the concept nor the content of OHRQOL has been defined unequivocally. An important part of research in this field is to understand causal patterns behind aspects of OHRQOL, with the goal of deepening the understanding of the formative mechanisms behind the various factors.

Therefore, the aim of the present study was to investigate whether OHRQOL in an adult Swedish population could be explained by *(1)* social attributes; *(2)* individual attributes; *(3)* dental status, with a special focus on the role of prosthodontics; and/or *(4)* dental care attitudes.

## Materials and Methods

### *Study Population*

In 1998, a questionnaire was sent to a random sample of 1,974 persons, aged 50 to 75 years and residing in Skåne County—the southernmost county in Sweden, which includes Malmö, the third largest city in Sweden. The response rate was 66% after 2 reminders. In addition to studies of associations between dental conditions, social situations,[6] and dental care utilization,[9] the questionnaire material has been used for studies concerning attitudes toward dental status, dental care,[6] and costs of dental care.[6,9] As mentioned earlier, the material has also been used for defining factors that represent various dimensions of OHRQOL,[8] of which the present study is a continuation. The material and study design were presented in detail previously.[6] Ethical clearance concerning the questionnaire was approved by the Research Ethics Committee, Lund University, Lund 1998-02-11.

### *Nonresponse*

The study population consisted of 47% men and 53% women. Nonresponse was analyzed with 3 variables from the sampling frame: gender, age, and place of residence. The nonresponse rate was 37% for men and 32% for women ($P < .05$). The proportion of nonresponse was significantly higher in Malmö (41%; $P < .01$) than in the rest of the county (33%). No significant differences concerning age were found. A previous analysis[6] concluded that the nonresponse was biased, with an overrepresentation of edentulous individuals according to a special study of the nonrespondents.

### *Questionnaire and Variables*

The questionnaire included 63 questions, divided into 4 main sections:

1. Subjects' opinions of their oral status and its impact on the social situation and QOL (17 questions).
2. Subjects' oral health over the last 12 months and its possible consequences for physical or mental health (12 questions).
3. Subjects' oral health status and choice of and attitudes toward dental care (25 questions).
4. Subjects' social situation and general health (9 questions).

**Dependent variables.** A principal components analysis (PCA) of the responses to 12 questions from the first section and 10 questions from the second section revealed 3 factors that represented various aspects of OHRQOL.[8]

The factors were interpreted as:

- Factor 1: *Physical and social disability*, which included variables concerning the impact of oral health on physical pain, trouble with speaking or maintaining oral hygiene, ability to work, contacts with other people, irritability, and sleeping difficulties.
- Factor 2: *Psychologic discomfort and disability*, which included variables concerning the impact of oral health on concerns about appearance, on self-esteem, on behavior when smiling and laughing, and on social disability in terms of avoiding people.
- Factor 3: *Functional limitation and physical pain,* which included only variables concerning functional limitations, that is, inability to chew or physical pain in the mouth or teeth.

Factor 1 explained almost half (44.4%) of the variance, whereas factors 2 and 3 explained 9.1% and 5.8% of the variance, respectively.

The constituent variables of these factors were summed into index variables, which were set as dependent variables in regression models. These new index variables were named *oral health impact on everyday activities (OHI EA), oral health impact on the psychologic dimension (OHI PSYCH),* and *oral health impact on oral function (OHI FUNC).*

**Independent variables.** Explanatory variables were obtained from a series of items in the questionnaire and grouped under the headings *social attributes, individ-*

*ual attributes, dentures, number of teeth,* and *dental care attitudes*.

*Social attributes* included the following variables, constructed as follows:

- Social network
- Place of residence
- Education
- Occupation
- Ethnic background
- Marital status

*Social network w*as constructed from 2 questions: "Do you feel a strong affinity to your place of residence?" and "Do you feel a strong affinity to your housing area?"[10] The 4 possible responses—*yes, very much; to a certain extent; not especially;* and *not at all*—were assigned values between 1 and 4. The values of the responses to each question were summed into an index that ranged from 2 to 8. *Place of residence* was given in the sampling frame. Since there is no official classification of residence, the postal codes were categorized into 5 groups according to number of inhabitants and common knowledge of the social characteristics of the area: *Malmö*, *Malmö suburb, other city, small town,* and *rural area*. *Education* was constructed from 5 possible responses, and 3 categories were formed: Primary education was labeled as *low education* (≤ 9 years), secondary education as *medium education* (10–12 years), and college or university as *high education* (> 12 years). *Occupation* was dichotomized from 4 possible responses into 2 categories: *working* and *not working. Ethnic background* was dichotomized from 3 possible responses into 2 categories: *always lived in Sweden* and *has not always lived in Sweden*. *Marital status* was constructed from 3 possible responses into 2 categories: *married or cohabiting* and *unmarried or living alone.*

*Individual attributes* included the following variables, constructed as follows:

- Gender
- Age
- General health in relation to age peers
- Importance of oral health and regular dental care
- Importance of income and social activities

*Gender* was given in the sampling frame, as well as *age,* which ranged between *50 years* and *75 years*. *General health in relation to age peers* had 5 possible responses: *much better than age peers, better than age peers, equal to age peers, worse than age peers,* and *much worse than age peers;* these were coded between 1 and 5.

Nine items concerning attitudes toward oral health, dental care, income, and social activity opportunities were subjected to a varimax rotated factor analysis[11] in which a 2-factor solution was obtained with a variance explanation of 43% and all communalities > 0.30.

The items loading to factor 1 were:

- How important is it to have your natural teeth or fixed partial dentures?
- How important is it to be able to chew all kinds of food?
- How important is it to not have noticeable missing teeth?
- How important is your oral health in relation to your general health?
- How important is it to be able to have regular dental care?

This factor was interpreted as *importance of oral health and regular dental care.*

The items loading to factor 2 were:

- How important is it to have a safe and secure income?
- How important is it to have the opportunity to attend entertainments and be able to travel?
- How important is it to have a comfortable place of living?
- How important is it to be able to attend the hairdresser regularly?

This factor was interpreted as *importance of income and social activities.*

Responses to the items were made on 5-point scales ranging from *not at all important* to *very important.* The 2 factors were constructed as variables by adding the values of the constituent items (see "Statistical Methods").

*Number of teeth* included the following variables, constructed as follows:

- No or a few missing teeth (reference category)
- Many missing teeth
- Few or no remaining teeth

The original question, literally translated, was: "How many of your natural teeth do you have left?" and the instruction for answering that particular question was: *Do not count eventual replacements or wisdom teeth. If you, for example, have one complete denture, you should answer "No teeth in one jaw." If you, for example, have a fixed denture replacing a couple of teeth you should answer "A few teeth missing."*

Three categories were formed from 6 possible responses: *No or a few missing teeth, many missing teeth,* and *few remaining teeth or edentulous*. The 3 categories were dichotomized into 2 variables—*many missing teeth* and *few or no remaining teeth*—and used as dummy variables, with *no or a few missing teeth* as the

**Table 1** No. of Teeth, Frequencies of Questionnaire Responses, and the Categories, Dummy Variables, and Re-coded Variables for Each Possible Response Alternative

| Questionnaire response frequencies (%) | Dummy variables (DV) and reference categories (RC) | Re-coded variables |
|---|---|---|
| All teeth left (18.0) | No or few missing teeth (RC) | All others |
| A few teeth missing (53.8) | No or few missing teeth (RC) | All others |
| Missing many teeth (15.9) | Missing many teeth (DV) | Few or no remaining teeth |
| Almost no teeth left (2.0) | Few or no remaining teeth (DV) | Few or no remaining teeth |
| No teeth in one jaw (5.6) | Few or no remaining teeth (DV) | Few or no remaining teeth |
| Edentulous (4.7) | Few or no remaining teeth (DV) | Few or no remaining teeth |

reference category. To make it possible to run interaction models, the variables were finally re-coded into *few or no remaining teeth* and *all others.* The formation of the different variables from the possible responses is summarized in Table 1.

*Dentures* included the following variables, constructed as follows:

- Natural teeth only (reference category)
- FPD
- Removable denture

The original question, literally translated, was: "You can have different materials and constructions in fillings and replacements. How is the situation in your mouth?" The instruction for answering that particular question was: *Give all the alternatives that are valid for your mouth! If you, for example, have a fixed partial denture made of gold, you should mark both "gold" and "fixed partial denture."*

The variable was constructed from 22 dummy variables concerning dental materials and appliances into 3 categories: *natural teeth only, fixed partial denture,* and *removable denture*. The category *fixed partial denture* included subjects with tooth-retained and/or implant-retained FPDs. The category *removable denture* included subjects with either a complete denture (CD) or a removable partial denture (RPD) or with both FPDs and RPDs. Each of these groups was too small to be kept in separate categories, but they were relevant to be combined, since they all represented a situation that included an artificial removable prosthesis. The 3 categories were dichotomized into 2 variables: *fixed partial denture* and *removable denture,* with *natural teeth only* as the reference category.

*Dental care attitudes* included the following variables, constructed as follows:

- Importance of convenient dental care
- Importance of cost for dental care
- Too high cost
- Refrained from dental visits because of the cost
- Need care–cost barrier

Five items concerning attitudes toward factors of importance for the choice of dental care and toward costs for dental care were subjected to a varimax rotated factor analysis, and a 1-factor solution was obtained. One item—the cost question—had a low communality, and excluding it gave a variance explanation of 47% for the single factor.

The 5 items were:

- How important is it to be able to easily get an appointment for dental care?
- How important is it that consideration is shown toward your dental fear?
- How important is the cost of dental care?
- How important is it to be able to always be treated by the same dentist and the same dental care personnel?
- How important is it that the dental treatment is done in a short time?

Responses were made on 5-point scales ranging from *not at all important* to *very important*. The factor was interpreted as *importance of convenient dental care* and constructed as a variable by adding the values of the constituent items (see "Statistical Methods"). The cost item was retained as an explanatory variable in its own right and named *importance of cost for dental care*.

There were 3 other questions concerning cost. The first question was:

- How did you feel about your costs at your last dental visit in relation to what was performed?

Four possible responses were dichotomized into *reasonable price* and *too high cost,* and the variable was named *too high cost.*

The second question was:

- Have you ever refrained from a dental visit because of the cost?

Four possible responses were dichotomized into *never* and *once or more,* and the variable was named *refrained from dental visits because of the cost*.

**Table 2** Multiple-Regression Coefficients and Significance of All Models and Maximum Contrast in Model A for *OHI EA* (n = 1,089)

| Independent variable (range) | Model A | Model B | Model C | Maximum % unit change, model A |
|---|---|---|---|---|
| Social attributes | | | | |
| Social network (2–8) | 0.1 | 0.1 | 0.1 | 0.7 |
| Place of residence (1–5) | −0.2 | −0.2 | −0.2 | −1.0 |
| Education (1–3) | 0.7* | 0.6(*) | 0.5 | 2.1 |
| Not working (0–1) | 1.3 | 1.2(*) | 1.9* | 1.3 |
| Has not always lived in Sweden (0–1) | 0.1 | 0.4 | 1.0 | 0.1 |
| Unmarried or living alone (0–1) | 0.5 | 0.6 | 1.5* | 0.5 |
| Individual attributes | | | | |
| Female (0–1) | −0.6 | −0.4 | −0.5 | −0.6 |
| Age (50–75 y) | −0.2*** | −0.2** | −0.2*** | −5.2 |
| General health in relation to age peers (1–5) | 2.8*** | 2.9*** | 2.9*** | 14.0 |
| Importance of oral health and regular dental care (5–25) | 0.4** | 0.4* | 0.3(*) | 8.4 |
| Importance of income and social activities (6–20) | −0.2 | −0.2 | −0.2 | 3.0 |
| Denture | | | | |
| Natural teeth only (RC) | – | – | – | – |
| Fixed partial denture (0–1) | −0.2 | 0.9 | 1.1 | −0.2 |
| Removable denture (0–1) | 0.4 | 2.8*** | 4.0*** | 0.4 |
| Dental care attitudes | | | | |
| Importance of convenient dental care (4–21) | −0.1 | −0.1 | −0.2(*) | −1.8 |
| Importance of cost for dental care (1–5) | 0.2 | 0.2 | 0.6* | 1.0 |
| Too high cost (0–1) | 0.8 | 0.9 | 1.7** | 0.8 |
| Refrained from dental visits because of the cost (0–1) | 2.6** | 2.8*** | – | 2.6 |
| Need care–cost barrier (0–1) | 5.8*** | 6.1*** | – | 5.8 |
| No. of teeth | | | | |
| No or few missing teeth (RC) | – | – | – | – |
| Many missing teeth (0–1) | 3.3*** | – | – | 3.3 |
| Few or no remaining teeth (0–1) | 4.7*** | – | – | 4.7 |
| Adjusted $R^2$ | 0.18 | 0.17 | 0.12 | |
| Model significance (*P*) | .000 | .000 | .000 | |
| F | 12.77 | 13.02 | 9.83 | |
| *df*1/*df*2 | 20/1,068 | 18/1,070 | 16/1,072 | |

The regression coefficient gives the percentage units by which the dependent variable changes when an independent variable changes by 1 unit.
(*)$P \le .10$; *$P \le .05$; **$P \le .01$; ***$P \le .001$.
*OHI EA* = oral health impact on everyday activities; RC = reference category; *df* = degrees of freedom.

The third question was:

- Do you at present feel a need for dental care without the opportunity to get it?

Four possible responses were dichotomized into *no cost barrier* and *need care–cost barrier* and the variable was named *need care–cost barrier.*

### *Statistical Methods*

The data were first analyzed in frequency tables, where ranges, mean values, and standard deviations were calculated. Selected items were subjected to factor analysis using PCA (see "Questionnaire and Variables"). The number of factors was determined by inspection of scree plots and by the Kaiser criterion. Items with low communality (< 0.20) were excluded from the final factor analysis. The communality (ranging between 0 and 1) indicates the extent to which the factor analysis as a whole exhausts the variation of each item. Varimax rotation was used, defining the factors as uncorrelated. The factors were then constructed as variables by adding the values of the constituent items. For the dependent variables, the new variables were transformed additively to range between 0 and 100, which allowed the regression coefficients to be interpreted as changes in percentage units, thus rendering these comparable between models.

To study the explanatory patterns in detail, for example, to reveal possible interaction between *number of teeth* and *denture*, 3 multiple-regression models—A, B, and C—were run in 3 steps for each dependent variable (*OHI EA, OHI PSYCH,* and *OHI FUNC*). In model A, all variables were included; in model B, the variables *many missing teeth* and *few or no remaining teeth* were excluded; and in model C, the following variables were excluded: *refrained from dental visits because of the cost, need care–cost barrier, many missing teeth,* and *few or no remaining teeth.*

The regression coefficient of the transformed variables gives the percentage units by which the dependent variables change when an independent variable changes by 1 unit. A maximum contrast between the lowest and highest value for each variable was calculated in the A models. The models were run with inspection of residual plots for determination of het-

**Table 3** Multiple-Regression Coefficients and Significance of All Models and Maximum Contrast in Model A for *OHI PSYCH* (n = 1,123)

| Independent variable (range) | Model A | Model B | Model C | Maximum % unit change, model A |
|---|---|---|---|---|
| Social attributes | | | | |
| Social network (2–8) | 0.5(*) | 0.6(*) | 0.7* | 3.5 |
| Place of residence (1–5) | −0.5(*) | −0.4 | 0.5 | −2.5 |
| Education (1–3) | 0.7 | 0.3 | 0.1 | 2.1 |
| Not working (0–1) | 0.6 | 0.8 | 2.4* | 0.6 |
| Has not always lived in Sweden (0–1) | −2.1(*) | −1.3 | 0.0 | −2.1 |
| Unmarried or living alone (0–1) | 0.4 | 0.6 | 2.7* | 0.4 |
| Individual attributes | | | | |
| Female (0–1) | −0.5 | −0.1 | −0.2 | −0.5 |
| Age (50–75 y) | −0.3*** | −0.3*** | −0.4*** | −7.8 |
| General health in relation to age peers (1–5) | 2.6*** | 2.8*** | 3.0*** | 13.0 |
| Importance of oral health and regular dental care (5–25) | 0.5* | 0.4(*) | 0.2 | 10.5 |
| Importance of income and social activities (6–20) | −0.2 | −0.3 | −0.4(*) | −3.0 |
| Denture | | | | |
| Natural teeth only (RC) | – | – | – | – |
| Fixed partial denture (0–1) | −1.7 | 1.3 | 1.9 | −1.7 |
| Removable denture (0–1) | 0.6 | 6.5*** | 9.2*** | 0.6 |
| Dental care attitudes | | | | |
| Importance of convenient dental care (4–21) | −0.2(*) | −0.3* | −0.5** | −3.6 |
| Importance of cost for dental care (1–5) | 0.7* | 0.7* | 1.5*** | 3.5 |
| Too high cost (0–1) | 1.1 | 1.2 | 3.0** | 1.1 |
| Refrained from dental visits because of the cost (0–1) | 5.9*** | 6.4*** | – | 5.9 |
| Need care—cost barrier (0–1) | 12.6*** | 13.4*** | – | 12.6 |
| No. of teeth | | | | |
| No or few missing teeth (RC) | – | – | – | – |
| Many missing teeth (0–1) | 10.0*** | – | – | 10.0 |
| Few or no remaining teeth (0–1) | 11.3*** | – | – | 11.3 |
| Adjusted $R^2$ | 0.28 | 0.24 | 0.14 | |
| Model significance (*P*) | .000 | .000 | .000 | |
| F | 22.55 | 20.51 | 12.05 | |
| *df*1/*df*2 | 20/1,102 | 18/1,104 | 16/1,106 | |

The regression coefficient gives the percentage units by which the dependent variable changes when an independent variable changes by 1 unit.
(*)$P \le .10$; *$P \le .05$; **$P \le .01$; ***$P \le .001$.
*OHI PSYCH* = oral health impact on the psychologic dimension; RC = reference category; *df* = degrees of freedom.

eroscedasticity (unequal distribution of the residuals along the regression line). Interaction models were also run to investigate a possible interaction between measures of dental status, including multiplicative interaction variables in the models.[12] The categories *few or no remaining teeth, many missing teeth,* and *no or few missing teeth,* were re-coded and labeled *few or no remaining teeth* and *all others*. Using this re-coded variable, the models were rerun and an interaction factor was included: the simplified dental status category was multiplied by the *denture* variable. The new models gave the same results as the original models, and the interaction variables were not significant. However, the coefficient for *removable denture* was changed—a sign of interaction. The interaction models are not presented here. Instead, the interaction effect was handled by splitting the population into subgroups, according to the re-coded variable. For each subgroup, separate multiple-regression models were run with *OHI EA, OHI PSYCH,* and *OHI FUNC* as dependent variables. Statistical significance was set at $P \le .05$. All data analyses were made using SPSS software (Statistical Package for the Social Sciences, version 10.0).

## Results

In the multiple-regression models, the adjusted $R^2$ was high for all 3 models, and model significance was ≤ .001.

*General health in relation to age peers* had the strongest association with all 3 dependent variables. *Number of teeth* and *need care—cost barrier* also had strong associations with all 3 dependent variables.

The variables that were significantly associated with *OHI EA* in model A are shown in Table 2. In models B and C, the variable *removable denture* was also significantly associated with *OHI EA,* as were the variables *too high cost* and *importance of cost for dental care* in model C.

The variables that were significantly associated with *OHI PSYCH* in model A are shown in Table 3. In models B and C, the variables *removable denture, importance of cost for dental care,* and *importance of convenient dental care* were also significantly associated with *OHI PSYCH*, as was the variable *too high cost* in model C.

The variables that were significantly associated with *OHI FUNC* in model A are shown in Table 4. In models B and C, the variables *fixed partial denture, removable denture,* and *importance of convenient dental care* were

**Table 4** Multiple-Regression Coefficients and Significance for All Models and Maximum Contrast in Model A for *OHI FUNC* (n = 1,121)

| Independent variable (range) | Model A | Model B | Model C | Maximum % unit change, model A |
|---|---|---|---|---|
| Social attributes | | | | |
| Social network (2–8) | 0.5 | 0.6(*) | 0.7(*) | 3.5 |
| Place of residence (1–5) | −1.0** | −0.9** | −1.0** | −5.0 |
| Education (1–3) | 1.0 | 0.5 | 0.3 | 3.0 |
| Not working (0–1) | 2.6* | 3.0* | 4.2*** | 2.8 |
| Has not always lived in Sweden (0–1) | −1.8 | −0.8 | 0.3 | −1.6 |
| Unmarried or living alone (0–1) | −0.2 | −0.0 | 1.7 | −0.3 |
| Individual attributes | | | | |
| Female (0–1) | −2.5** | −2.1* | −2.2* | −2.5 |
| Age (50–75 y) | −0.2* | −0.2* | −0.3*** | −5.2 |
| General health in relation to age peers (1–5) | 4.2*** | 4.5*** | 4.6*** | 21.0 |
| Importance of oral health and regular dental care (5–25) | 0.6* | 0.5(*) | 0.3 | 12.6 |
| Importance of income and social activities (6–20) | −0.4(*) | −0.5* | −0.5* | −6.0 |
| Denture | | | | |
| Natural teeth only (RC) | – | – | – | – |
| Fixed partial denture 0–1) | 0.2 | 4.0** | 4.4*** | 0.2 |
| Removable denture (0–1) | 2.6 | 9.4*** | 11.6*** | 2.6 |
| Dental care attitudes | | | | |
| Importance of convenient dental care (4–21) | −0.3(*) | −0.4* | −0.5** | 5.4 |
| Importance of cost for dental care (1–5) | 0.6 | 0.6 | 1.2** | 3.0 |
| Too high cost (0–1) | 3.1*** | 3.1** | 4.5*** | 3.1 |
| Refrained from dental visits because of the cost (0–1) | 4.4** | 11.0*** | – | 4.4 |
| Need care–cost barrier (0–1) | 10.0*** | 5.0*** | – | 10.0 |
| No. of teeth | | | | |
| No or few missing teeth (RC) | – | – | – | – |
| Many missing teeth (0–1) | 12.3*** | – | – | 12.3 |
| Few or no remaining teeth (0–1) | 13.1*** | – | – | 13.1 |
| Adjusted $R^2$ | 0.29 | 0.23 | 0.17 | |
| Model significance (*P*) | .000 | .000 | .000 | |
| F | 22.16 | 19.29 | 15.71 | |
| *df*1/*df*2 | 20/1,100 | 18/1,102 | 16/1,104 | |

The regression coefficient gives the percentage units by which the dependent variable changes when an independent variable changes by 1 unit.
(*) $P \leq .10$; * $P \leq .05$; ** $P \leq .01$; *** $P \leq .001$.
*OHI FUNC*= oral health impact on oral function; RC = reference category; *df* = degrees of freedom.

also significantly associated with *OHI FUNC*, as was the variable *importance of cost for dental care* in model C.

The regression coefficient gives the percentage units by which the dependent variables change when an independent variable changes by 1 unit. A maximum contrast between the lowest and highest value for each variable was calculated in the A models. For example, the association between *general health in relation to age peers* and *OHI EA*—regression coefficient 2.8—means that *OHI EA* is almost 3% worse for each unit change in general health in relation to age peers. Since the range was 1 to 5, this means that those with extremely poor general health had $5 \times 2.8 = 14$ percentage units worse *OHI EA* than those with better health than their age peers. They also had 13 percentage units worse *OHI PSYCH* and 21 percentage units worse *OHI FUNC* than those with better health than their age peers. The negative regression coefficients for *female* and *age* mean, for example, that *OHI FUNC* is 2.5% worse for women compared to men and 0.2% worse for each year of age.

*Place of residence, education,* and *not working* were the only social attributes that were associated with any of the dependent variables in model A. *General health in relation to age peers*, *age,* and *importance of oral health and regular dental care* were the 3 individual attributes that were associated with all 3 dependent variables in model A, as well as *number of teeth*. None of the *denture* variables were associated with the dependent variables in model A. *Need care–cost barrier* and *refrained from dental visits because of the cost* were the 2 variables of dental care attitudes that were associated with all 3 dependent variables in model A.

For those with few or no remaining teeth (Table 5), it was obvious that it was not important whether a denture was fixed or removable in terms of OHRQOL. *Need care–cost barrier, importance of oral health and regular dental care,* and *importance of income and social activities* were associated with OHRQOL in this model. When the variable *all others* was selected, *removable denture* covaried strongly with OHRQOL (Table 6). For that selected group, associations were also found between OHRQOL and the variables *general health in relation to age peers, need care–cost barrier,* and *refrained from dental visits because of the cost*.

**Table 5** Multiple-Regression Coefficients and Significance for *OHI EA, OHI PSYCH,* and *OHI FUNC* for the Category *Few or No Remaining Teeth*

| Independent variable (range) | *OHI EA* (n = 123) | *OHI PSYCH* (n = 123) | *OHI FUNC* (n = 123) |
|---|---|---|---|
| Social attributes | | | |
| Social network (2–8) | 1.3 | 2.0 | 2.1 |
| Place of residence (1–5) | 0.8 | −0.9 | −0.6 |
| Education (1–3) | 2.1 | 1.9 | 2.7 |
| Not working (0–1) | 1.9 | 3.0 | 9.8* |
| Has not always lived in Sweden (0–1) | −3.0 | −7.1 | −7.9 |
| Unmarried or living alone (0–1) | 1.5 | −2.2 | −3.2 |
| Individual attributes | | | |
| Female (0–1) | −5.7* | −3.8 | −8.6* |
| Age (50–75 y) | −0.3 | −0.7* | −0.5 |
| General health in relation to age peers (1–5) | 5.4** | 2.0 | 2.9 |
| Importance of oral health and regular dental care (5–25) | 1.6*** | 2.0** | 2.1** |
| Importance of income and social activities (6–20) | −1.3* | −2.1* | −2.5** |
| Denture | | | |
| Natural teeth only (RC) | – | – | – |
| Fixed partial denture (0–1) | −1.4 | 2.1 | −2.9 |
| Removable denture (0–1) | −3.4 | −2.9 | −2.8 |
| Dental care attitudes | | | |
| Importance of convenient dental care (4–21) | 0.0 | −0.6 | −0.6 |
| Importance of cost for dental care (1–5) | 1.1 | 2.8 | 1.6 |
| Too high cost (0–1) | 2.6 | 6.5 | 8.2(*) |
| Refrained from dental visits because of the cost (0–1) | 5.2 | 6.8 | 6.1 |
| Need care–cost barrier (0–1) | 8.3* | 16.0** | 10.1(*) |
| Adjusted $R^2$ | 0.36 | 0.32 | 0.27 |
| Model significance (*P*) | .000 | .000 | .000 |
| F | 4.83 | 4.23 | 3.44 |
| *df*1/*df*2 | 18/104 | 18/104 | 18/104 |

The regression coefficient gives the percentage units by which the dependent variable changes when an independent variable changes by 1 unit.
(*)$P \le .10$; *$P \le .05$; **$P \le .01$; ***$P \le .001$.
OHI EA = oral health impact on everyday activities; OHI PSYCH = oral health impact on the psychologic dimension; OHI FUNC = oral health impact on oral function; RC = reference category; *df* = degrees of freedom.

**Table 6** Multiple-Regression Coefficients and Significance for *OHI EA, OHI PSYCH,* and *OHI FUNC* for the Category *All Others*

| Independent variable (range) | *OHI EA* (n = 965) | *OHI PSYCH* (n = 1,000) | *OHI FUNC* (n = 995) |
|---|---|---|---|
| Social attributes | | | |
| Social network (2–8) | 1.5 | 0.3 | 0.5 |
| Place of residence (1–5) | 0.3 | −0.4 | −1.0** |
| Education (1–3) | 2.9 | 0.2 | −0.1 |
| Not working (0–1) | 0.7 | 0.0 | 2.0 |
| Has not always lived in Sweden (0–1) | 0.4 | −1.2 | −0.4 |
| Unmarried or living alone (0–1) | 0.1 | 0.6 | −0.9 |
| Individual attributes | | | |
| Female (0–1) | 0.6 | 0.4 | −1.1 |
| Age (50–75 y) | −0.1** | −0.2* | −0.1 |
| General health in relation to age peers (1–5) | 2.1*** | 2.5*** | 4.3*** |
| Importance of oral health and regular dental care (5–25) | 0.0 | 0.0 | 0.1 |
| Importance of income and social activities (6–20) | 0.1 | 0.0 | −0.1 |
| Denture | | | |
| Natural teeth only (RC) | – | – | – |
| Fixed partial denture (0–1) | 0.9 | 1.0 | 3.8** |
| Removable denture (0–1) | 2.7** | 5.1*** | 7.1*** |
| Dental care attitudes | | | |
| Importance of convenient dental care (4–21) | −0.2* | −0.3* | −0.4* |
| Importance of cost for dental care (1–5) | 0.3 | 0.7* | 0.6 |
| Too high cost (0–1) | 0.5 | 0.2 | 2.2* |
| Refrained from dental visits because of the cost (0–1) | 2.3** | 6.0*** | 4.7** |
| Need care–cost barrier (0–1) | 3.9** | 11.0*** | 10.0*** |
| Adjusted $R^2$ | 0.11 | 0.18 | 0.18 |
| Model significance (*P*) | .000 | .000 | .000 |
| F | 5.59 | 13.22 | 12.89 |
| *df*1/*df*2 | 18/946 | 18/981 | 18/976 |

The regression coefficient gives the percentage units by which the dependent variable changes when an independent variable changes by 1 unit.
(*)$P \le .10$; *$P \le .05$; **$P \le .01$; ***$P \le .001$.
OHI EA = oral health impact on everyday activities; OHI PSYCH = oral health impact on the psychologic dimension; OHI FUNC = oral health impact on oral function; RC = reference category; df = degrees of freedom.

## Discussion

### *Main Results*

The obvious main result is that general and oral health are closely linked, illustrating the point made by Locker[13] that health should be viewed holistically and encompass the whole body. *General health in relation to age peers* had the strongest correlation with all 3 dependent variables of OHRQOL and in all models.

*Number of teeth* and *need care–cost barrier* also had strong correlations with all 3 dependent variables in the A models, as did *age* and *refrained from dental visits because of the cost*. The variable *removable denture* correlated with all dependent variables in the B and C models. Subjects with few or no remaining teeth felt that an RPD affected their OHRQOL less negatively than all other subjects did.

### *Individual Attributes*

It is hardly surprising that general health in relation to age peers correlates with OHRQOL. The results again corroborate the view that oral health is a crucial part of general health[13] and that general disease conditions produce various oral sequelae and thus affect oral health and OHRQOL.[14] In an earlier study of the present sample, poorer general health in relation to age peers correlated with reduced number of teeth as well as with utilization of dental care less than once per year.[9] It is interesting to discuss, but not possible to conclude from the present study, whether a reduced number of teeth is the result of poor general health or the opposite—that a reduced number of teeth could cause poorer general health.

### *Cost-Related Variables*

A perceived need for dental care with no possibility of obtaining it because of the cost, along with avoidance of dental visits because of the cost, was found to correlate with OHRQOL. These 2 variables, in a previous study of the sample, were found to have a higher impact on low dental care utilization than the categories that did not involve problems with cost.[9] Experiences and attitudes like these could negatively affect a person's self-image, since the ability to attain the level of desired oral health is reduced. In a recent Swedish study of the psychologic effects of tooth loss, such changes in self-image were described by patients whose dental status was deteriorating.[15]

### *Dental Status: Number of Teeth and Denture*

The reliability of responses to questionnaires concerning dental status can of course be discussed. However, it was shown in at least 2 previous Swedish studies that congruence between the clinical and the questionnaire findings was good.[16,17] In this study, the aim concerning number of teeth and presence and type of denture was merely to obtain a means to measure the experience and opinion of tooth loss and denture wearing than to determine the exact status. From prosthodontic practice, clinicians know that experience and acceptance of tooth loss can vary dramatically. The impact of losing only 1 tooth, even if it is a molar, can be devastating for one person, whereas the presence of only 1 remaining tooth can be a lifeline for someone else. Such circumstances, along with a person's life situation, including age, general health, socioeconomic status, and cultural background, are all factors that influence attitudes and opinions concerning QOL.[18–20]

Because earlier studies[2,3] found that the number of remaining teeth correlates with OHRQOL, it is not surprising that the results are similar in the present study. The subjects who had few or no remaining teeth in this study were, in a previous study, found to be 16 times more likely to underutilize dental care than the other individuals in the sample.[9] This probably influenced their oral health and their attitude, as recorded in their OHRQOL score.

It is surprising, however, that removable dentures were not significantly associated with any of the dependent variables in the A models and thus did not constitute an important factor in determining good or bad OHRQOL. As referred to in a study analyzing determinants of dissatisfaction with dentures, it is known that "dissatisfaction with complete dentures is a common phenomenon, as 25% of denture wearers have severe problems with their dentures."[21] In an older Swedish study, the relative importance of the event "getting dentures" was ranked 33 of 48 possible serious life events, whereas "lose 1 or more teeth" was ranked 28.5.[22] (A rank of 48 was given to the most frequently reported serious event.)

More recent research has tended to focus on comparing the impact of bone-anchored FPDs[23] or full-arch implant-retained prostheses[24] on OHRQOL with the impact of RPDs or CDs on OHRQOL, to the benefit of implant-retained constructions.

To further investigate this somewhat unexpected result in the present study, models were run both with (A) and without (B and C) the crucial variables to determine whether there was an interaction between the variables *number of teeth* and *denture*. When *number of teeth* was excluded, *removable denture* was found to covary with all dependent variables of OHRQOL in each of the 3 regression models. Although wearing a removable denture can be related to functional, esthetic, and social problems, it is obviously even more

decisive, in terms of OHRQOL, to be stricken with tooth loss. A study of the emotional effects of tooth loss in edentulous people confirms this assumption.[25]

There was also a difference concerning the impact of FPDs versus removable dentures on OHRQOL, between those with few or no remaining teeth and the rest of the population (*all others*). For the latter category, it was important that a denture was fixed, which confirms the results of a previous study[6] in which the majority (90%) of the study population regarded it as very important to have either their natural teeth, FPDs, or a combination of these. There were significant differences for those with removable dentures. Only 80% of the subjects regarded it as very important to have either their natural teeth or FPDs or a combination of these[6]; this result might have different explanations.

About 25% to 50% of RPDs are seldom or never used.[26,27] Of the remaining 50% to 75% of RPDs, the majority are estimated to be well accepted by their wearers. An older Swedish study concluded that denture acceptance is related to many variables.[28] That study also found that agreement between patients' and examiners' opinions about the function of CDs is poor. One explanation for the acceptance of removable dentures could be simply the satisfaction of having a denture at all.[29] A further explanation could be, according to the theory of cognitive dissonance, that satisfaction with removable dentures is a rationalization, ie, the development of an attitude through behavioral change.[30] For different reasons, one accepts and is pleased with a new situation, despite a negative attitude initially. There might be other explanations, such as general health, age,[31] cultural and social factors, and cost factors.

Nonresponse was biased, with an overrepresentation of edentulous individuals. Telephone interviews revealed that one reason these nonresponders did not participate was because they thought the study did not concern them, since they were edentulous. The title of the questionnaire was literally translated "How do your teeth impact your quality of life?" which might have been misleading. It would have been more correct to add "dentures" into the question. Most likely, however, the edentulous nonresponders would report similar opinions as the edentulous participants in the study. A cautious assumption is that the participation of more edentulous individuals would strengthen rather than diminish the results.

One strength of the study is that all 3 models had high adjusted $R^2$ values, which argues for the reliability of the models. Further, the results are stable between models. The weakness of the study is that the nonresponse was biased, with an overrepresentation of edentulism.

## Conclusion

The number of remaining teeth is more important than the type of denture in explaining OHRQOL. It is less important that a denture is fixed for those with few or no remaining teeth, in contrast to all others. Explanations are also found in general health and various aspects of dental care costs.

## Acknowledgments

This study was supported by the Scania County Council, Public Dental Health Services, and the Faculty of Odontology, Malmö Univeristy.

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*Literature Abstract*

**Timing and presentation of recurrent oral and oropharyngeal squamous cell carcinoma and awareness in the outpatient clinic**

The purpose of this retrospective study was to review the frequency and timing of outpatient appointments in patients with recurrence of oral and oropharyngeal cancer of squamous cell carcinoma (SCC) origin. A secondary purpose was to gain an indication of patients' awareness of signs and symptoms with regard to the recurrence. All consecutive patients that underwent surgery for previously untreated oral and oropharyngeal SCC at the unit from 1995 to 1999 were included in this study. In July 2003, the unit's oncology database, histopathology reports, and death certificates were reviewed for the 278 eligible patients. The unit's recall policy was that during the first year of follow-up, the patients were seen in 1-month intervals. During the second year of follow-up and thereafter, patients were seen at 2-month intervals. Calculations of appointment attendance were made for every patient, consisting of a yearly ratio of the months that the patient attended the appointments to the total months of that year. Thus, a patient attending all appointments in the first year had a ratio of 1 and in the second year, a ratio of 0.5. Medical notes on the day of each patient's recall examination were reviewed for indications of patient awareness, such as new symptoms reported that would be associated with recurrent disease and if the patient requested that their planned appointment time be moved to an earlier date due to the new symptoms. A total of 54 patients (19%) developed recurrent disease between 3 and 61 months (median, 8 months). The median ratio of attendance in the first year after operation for patients with recurrence was 0.75 and 0.55 for the second year. At least 57% (31 of 54) of the patients were unaware that they had a problem, as determined by the medical chart review.

**Kissun D, Magennis P, Lowe D, Brown JS, Vaughan ED, Rogers SN.** *J Oral Maxillofac Surg* 2006;44:371–376. **References:** 17.
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