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ORIGINAL ARTICLE

Oral health of 65-year olds in Sweden and Norway: A global question and ICF, the latest conceptual model from WHO

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Abstract

Objective. The aims of this study were to identify explanatory factors of satisfaction with oral health among Norwegian and Swedish 65 year olds in terms of items from four different domains of ICF and to compare the strengths of the various ICF domains in explaining satisfaction with oral health. Further it was to assess whether the explanatory factors of ICF domains vary between Norway and Sweden. ***Materials and methods.*** In 2007, standardized questionnaires were mailed to all the residents in certain counties of Sweden and Norway who were born in 1942. Response rates were 73.1% (n = 6078) in Sweden and 56.0% (n = 4062) in Norway. ***Results.*** In total, 33 questions based on four different ICF domains were chosen to explain satisfaction with oral health. Logistic regression showed that four different ICF domains in terms of body function, body structure, activity/participation and environmental factors explained, respectively, 53%, 31%, 12% and 34% of the explanatory variance in the satisfaction with oral health. In the final analysis, only nine items were statistically significant ($p < 0.05$). ***Conclusion.*** This study indicates that ICF as a conceptual model could cover a broad spectrum of factors embedded in OHRQoL measured by a global question in Sweden and Norway. Nine items, representing four ICF domains, were important in the final model for explaining satisfaction with oral health.

Key Words: *elderly, global oral question, ICF, perceived oral health*

Introduction

Oral Health-Related Quality-of-Life (OHRQoL) is a term which has been used frequently in the last 30 years, but is still a vague concept without a clear definition [1-3]. What is essential is that it considers oral health to be a broader concept than the traditional biomedical oral health concept [4].

There are many different ways to measure OHRQoL. One way is using some of the existing multi-item inventories, while another is to use a single global oral health question. The single global oral health item has two main styles; focusing the patient's assessment of oral health and focusing the patient's satisfaction with oral health. According to Locker and Gibson [5] there is a degree of discordance between self-rated oral health and oral health satisfaction among older people which has been attributed to the expectations imbued in the concept of satisfaction. There are also a number of different conceptual models used in studies of health and oral health. The most common is based on the International Classification of Impairments, Disabilities and Handicap (ICIDH) from the World Health Organization (WHO) and has been described, e.g., by Locker [6], Wilson and Cleary [7] and Gilbert et al. [8].

In May 2001, the World Health Assembly of the World Health Organization approved the final version of the new International Classification of Functioning, Disability and Health (ICF) (Figure 1) to succeed the ICIDH [9,10]. Figure 1 shows the contemporary interpretation of the interactions between the different components in ICF [11]. The ICF provides the basis for WHOs overall approach to health and provides an ability to describe a person's functioning, disability and health from a

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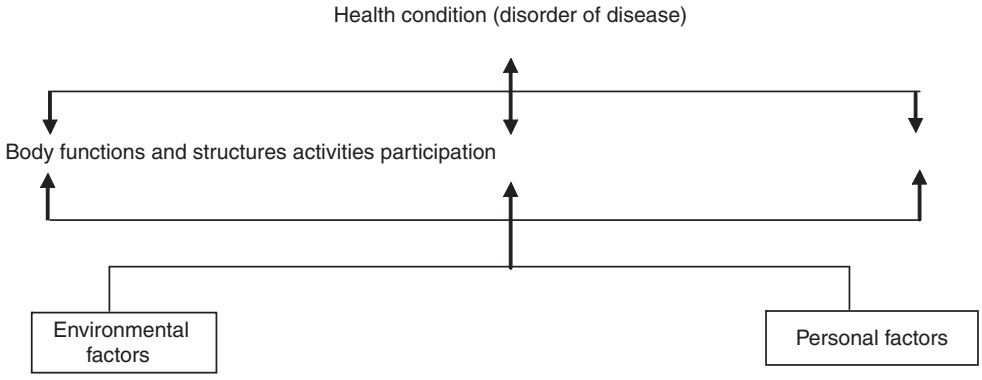

Figure 1. Current understanding of the framework of the ICF [11]. Two components, body function and body structures, belong to part 1 and two other components, activities and participation, belong to part 2.

bio-psychosocial model [11]. WHO describes the term 'functioning' as referring to all body functions, 'activities and participation' refers to activity limitations and participation restrictions, while 'disability' is similarly an umbrella term for impairments (Figure 1). The ICF also lists environmental factors that interact with all these components [11]. The ICF classification is among many other terms organized in *parts*, *components* and *domains* [12]. Only these major terms were considered to be sufficient for use in the present article. There are two parts composed of four components. Part one is composed of (1) body functions and body structures and (2) activities and participation. Part two is composed of (1) environmental factors and (2) personal factors (currently not classified in ICF). Domains are practical and meaningful sets of related physiological functions, anatomical structures, documents, information or areas of life. Domains form the various chapters and sections within each component and are specified by prefixes in each code. The ICF uses the following letters to represent these domains: b (body functions), s (body structure), d (activity and participation), e (environmental factors) [11]. Behind this letter, it is possible to add numbers, representing different levels in the diagnosis. The ICF framework and structure have been widely described and discussed [13,14] and will not be further described in this paper. For a detailed description of the ICF model see Reed et al. [13] and Bruyére, Van Looy and Peterson [14].

Despite being the latest conceptual model from WHO, few studies concerning oral health have used this model. Thus, it is important to increase knowledge about how the ICF model works in the oral health field.

Aims

The aims of this study were:

- To identify explanatory factors of satisfaction with oral health among Norwegian and Swedish 65 year olds in terms of items from four different domains of ICF.
- To compare the strengths of the various ICF domains in explaining satisfaction with oral health.
- To assess whether the explanatory factors of ICF domains vary between Norway and Sweden.

Materials and methods

Population and response rate

In 2007, a questionnaire was mailed to all persons who were born in 1942 and currently residing in two counties in Sweden (Örebro and Östergötland) and three counties in Norway (Hordaland, Sogn & Fjordane and Nordland). The questionnaire was initially developed in Swedish and was translated into Norwegian for the Norwegian sample. The population of 65-year-olds amounted to 3377 in Örebro and 4936 in Östergötland. The period of the study was from February to April 2007. The final response rate was 73.1% (n = 6.078 of the net population, n = 8.313). This study was part of a cohort study which was approved by the Ethics Committee in Örebro and Östergötland when it was initiated in 1992. The version of the questionnaire translated into Norwegian was mailed by Statistics Norway to all persons born in 1942 currently residing in Hordaland (n = 3831), Sogn & Fjordane (n = 975) and Nordland (n = 2442). The period of the study was from June to August 2007. The study was approved by the Ethics Committee of the Norwegian Social Science Services (NSD). The final response rate was 56.0% (n = 4062 of the net population, n = 7248). The population and response-rate has been described earlier (15), also see Table II [15].

Measures

The questionnaires were comprised of 65 main-questions on socioeconomic status in terms of country of

Table I. Categories and their ICF code for predictor variables as originally coded ( ) and recoded for analyses [ ]. Bivariate correlation with satisfaction with oral health status, $p < 0.001$.

Variables (ICF code)	Categories (code)	Dichotomization [code] Trihotomization [code]	Total % (*n*)	Spearman correlation
Gender	Male (1) Female (2)	Male (1) [1] Female (2) [0]	49.8 (5045) 50.2 (5095)	0.3
Dental appearance (b)	Very satisfied (1) Satisfied (2) Partly unsatisfied (3) Unsatisfied (4)	Satisfied (1,2) [1] Unsatisfied (3,4) [0]	78.1 (7737) 21.9 (2164)	< 0.001
Discomfort from tooth colors (b)	No worries/trouble (1) Some worries/trouble (2) Rather much worries/trouble (3) Great worries/trouble (4)	No/small worries/trouble (1,2) [1] Much worries/trouble (3,4) [0]	95.8 (9065) 4.2 (394)	< 0.001
Discomfort from tooth form (b)	As above	As above	97.2 (9005) 2.8 (261)	< 0.001
Discomfort from uneven teeth (b)	As above	As above	97.6 (8924) 2.4 (215)	< 0.001
Discomfort from over-bite (b)	As above	As above	98.4 (9033) 1.6 (150)	< 0.001
Discomfort from spaced teeth (b)	As above	As above	98.3 (8892) 1.7 (158)	< 0.001
Discomfort from crowded teeth (b)	As above	As above	96.0 (8854) 4.0 (365)	< 0.001
Toothache (b)	During the last 3 months (1) During the last year (2) More than a year ago (3) Have never had tooth ache (4) Can't remember toothache (5)	No toothache (4,5) [1] Remember toothache (1,2,3) [0]	50.5 (4937) 49.5 (4839)	< 0.001
Burning sensation in the mouth (b)	No problems (1) Some problems (2) Rather much problems (3) Much problems (4)	No or small problems (1,2) [1] Problems (3,4) [0]	98.7 (9141) 1.3 (123)	< 0.001
Pain around joints of the jaws (b)	As above	As above	97.8 (9116) 2.2 (203)	< 0.001
Chewing capacity (b)	Very good (1) Rather good (2) Less good (3) Bad (4)	Good (1,2) [1] Bad (3,4) [0]	93.5 (9284) 6.5 (642)	< 0.001
Mouth dryness (b)	No problems (1) Some problems (2) Rather much problems (3) Much problems (4)	No or some problems (1,2) [1] Problems (3,4) [0]	70.7 (6930) 29.3 (2872)	< 0.001
Discomfort from clicking/crepitation from the jaws (b)	No worries/trouble (1) Some worries/trouble (2) Rather much worries/trouble (3) Great worries/trouble (4)	No worries/trouble (1,2) [1] Some worries/trouble (3,4) [0]	97.7 (9074) 2.3 (214)	< 0.001
Discomfort from difficulties to open the jaw wide (b)	As above	As above	97.5 (9083) 2.5 (231)	< 0.001
Remaining own teeth (s)	All teeth remained (1) Missing some (2) Missing many (3) Missing nearly all (4) Edentulous (5)	All teeth (1) [2] Missing some (2,) [1] Missing many all or all (3,4,5) [0]	16.1 (1581) 56.9 (5587) 27.0 (2652)	< 0.001

Table I. (*Continued*).

Variables (ICF code)	Categories (code)	Dichotomization [code] Trihotomization [code]	Total % (*n*)	Spearman correlation
Blisters in mouth (s)	No problems (1) Some problems (2) Rather many problems (3) Many problems (4)	No or some problems (1,2) [1] Problems (3,4) [0]	98.2 (9177) 1.8 (168)	< 0.001
Problems to talk (s)	Daily or nearly daily problems (1) 1–2 times a week (2) 1–2 times a month (3) Less than 1 times a month (4) Never (5)	Never problems (5) [1] Problems (1,2,3,4) [0]	92.7 (9078) 7.3 (716)	< 0.001
Tooth brush (d)	Seldom/newer (1) Once a week (2) Once a day (3) Twice a way (4) More than twice a day (5)	Twice a day or more (4,5) [1] Less than twice a day (1,2,3) [0]	79.0 (7554) 21.0 (2002)	< 0.001
Tooth picks (d)	As above	As above	30.1 (2647) 69.9 (6151)	< 0.001
Smoking	Daily (1) Smoked sometimes (2) Smoked earlier (3) Never smoked (4)	No smoking (3,4) [1] Smoking (1,2) [0]	82.1 (8082) 17.9 (1760)	< 0.001
Meeting or talking to people during an ordinary week? (d)	0 (1) 1–2 (2) 3–5 (3) 6–10 (4) 11–15 (5) >15 (6)	>2 (3,4,5,6) [1] 0–2 (1,2) [0]	94.9 (9393) 5.1 (501)	< 0.001
Civil status (d)	Married/cohabitating (1) Unmarried/single (2) Divorced (3) Widow/widower (4)	Married/cohabitating (1) [1] Unmarried/single (2,3,4) [0]	78.0 (7742) 22.0 (2184)	< 0.001
Education (d)	Primary school (1) Secondary-/junior high school (2) High school/grammar school (3) University/college (4)	Higher (4) [1] Lower (1,2,3) [0]	23.0 (2239) 77.0 (7510)	< 0.001
Economic constraints (d)	No (1) Yes (2)	No (1) [1] Yes (2) [0]	89.5 (8879) 10.5 (1041)	< 0.001
Country (e)	Norway (1) Sweden (2)	Norway (1) [1] Sweden (2) [0]	40.1 (4062) 59.9 (6078)	0.80
Place of residence (e)	City (1) Town (2) Rural (3)	Countryside (2,3) [1] Densely populated (1) [0]	62.4 (6089) 37.6 (3674)	0.35
There is connection between beautiful and perfect teeth and the treatment of other people (e)	Agree absolutely (1) Agree mainly (2) Disagree (3) Absolutely disagree (4)	Agree (1,2) [1] Disagree (3,4) [0]	76.1 (7414) 23.9 (2331)	< 0.001
Minor esthetic imperfections of the teeth have no importance, only they function well (e)	As above	As above	88.0 (8569) 12.0 (1166)	< 0.001
A tooth loss that is visible is something to be ashamed of (e)	As above	As above	60.5 (5820) 39.5 (3802)	< 0.001
It does not matter how you look, as long as you can chew what you like (e)	As above	As above	22.9 (2214) 77.1 (7453)	0.77

Table I. (*Continued*).

Variables (ICF code)	Categories (code)	Dichotomization [code] Trihotomization [code]	Total % (*n*)	Spearman correlation
Time to travel to and from the dentist (e)	45 min or less (1) More than 45 min (2)	45 minutes or less (1) More than 45 min (0)	79.9 (7395) 20.1 (1863)	< 0.001
Positive beliefs about keeping teeth lifelong (e)	Absolute (1) Perhaps (2) Perhaps not (3) Absolutely not (4)	Yes (1,2) [1] No (3,4) [0]	83.2 (7544) 16.8 (1522)	< 0.001
Private or public dental care (e)	Private (1) Public (2) Nor private nor public (3) Do not remember (4)	Private (1) [1] Public (2) [0]	77.3 (7274) 22.7 (2136)	< 0.001

birth, place of residence, education and marital status in addition to general health, health- and oral health-related behaviors, clinically related and subjective oral health status and the eight-item 'oral impacts on daily performance' (OIDP) frequency inventory. From these questions, measures were chosen to assess oral health within the four domains in the ICF model. This means that the items chosen from the questionnaire should represent all four domains, as described earlier, in the ICF classification [11]. The variables were selected because they were examples of variables which could be connected to ICF codes, were possible to find in this survey and finally because they represented earlier known important factors for oral health.

Satisfaction with oral health status was assessed using a global oral health question: 'Are you in general satisfied with your teeth?' with response categories ranging from (1) Yes, very satisfied to (4) No, absolutely not satisfied. For analysis, this measure was dichotomized into (0) Satisfied with teeth (including original categories 1 and 2) and (1) Not satisfied with teeth (including original categories 3 and 4).

The original independent variables, the coding and recoding is presented in Table I. Body function (ICF code b) was measured by 14 questions, Body structure (ICF code s) was measured with three questions, Activities/Participation (ICF code d) was measured with seven questions and finally the Environmental (ICF code e) domain was measured with nine questions.

Statistical methods

Data were analyzed using the Statistical Package for Social Sciences 15 (SPSS Inc. Chicago, IL). Bivariate analyses between satisfaction with oral health and 33 independent variables from four ICF domains were conducted using cross-tabulations and Chi Square statistics. Satisfaction with teeth was examined by multiple binary logistic regression analysis. Body function factors (ICF code b) were set in domain I, body structure factor (ICF code s) in domain II, activity and participating factors (ICF code d) in domain III and environmental factors (ICF code e) in domain IV. Initially, four multiple logistic regression analyses were conducted (not in table) with the variables separately for each ICF domain (including all variables that were statistically significantly associated, $p < 0.001$, with satisfaction with oral health in the bivariate analysis). Variables that were statistically significantly associated ($p < 0.001$) with oral health satisfaction after these initially analyses were used in the final stepwise multivariable logistic regression analysis, using the logit model, Odds Ratio (OR) and 95% Confidence Interval (CI), Table III. In addition, gender and country belongingness were variables forced into the multivariable logistic regression analyses. A reduction of independent variables, optimal less than 10, has been recommended by Altman [16]. Multicollinearity tests were performed when testing the final model [17].

Results

Predicting variables, non-response analyses and participant characteristics

A total of 33 questions based on the four different ICF domains were chosen to explain satisfaction with oral health (Table I). Table I shows the categories and their ICF code for predictor variables as originally coded and recoded for analyses. Internal non-response analysis gave different result for each independent variable, varying between 2.3% (smoking) and 13.5% (toothpicks). Bivariate correlation with satisfaction with oral health status, $p < 0.001$ demonstrated that only four of originally 33 independent variables did not show significant correlation with satisfaction with teeth [gender (OR 0.30), place of residence (OR 0.35), country (OR 0.80) and finally the view that 'It does not matter how you

Table II. Comparison of Norwegian and Swedish respondents with non-respondents according to gender and level of education.

	Norway			Sweden		
	Respondents, *n* (%)	Non-respondents, *n* (%)	Chi-square and probability (*p*)	Respondents, *n* (%)	Non-respondents, *n* (%)	Chi-square and probability (*p*)
Men	2047 (50.4)	1568 (49.2)	$\chi^2 = 0.99$ (1 df)	2998 (49.3)	1191 (53.4)	$\chi^2 = 10.27$ (1 df)
Women	2015 (49.6)	1618 (50.8)		3080 (50.7)	1044 (46.7)	
Total number*	4062 (100.0)	3186 (100.0)	$p = 0.319$	6078 (100.0)	2235 (100.0)	$p < 0.001$
Primary education	1295 (38.9)	874 (22.7)		2341 (44.1)	649 (22.1)	
Secondary education	1017 (30.6)	2622 (68.1)	$\chi^2 = 1075.91$ (2 df)	1686 (32.1)	1660 (56.5)	$\chi^2 = 539.52$ (2df)
College/university	1016 (30.5)	355 (9.2)		1233 (23.4)	627 (21.4)	
Total number*	3328 (100.0)	3851 (100.0)	$p < 0.001$	5260 (100.0)	2936 100.0	$p < 0.001$

*The differences in total numbers between gender and education were due to information from different registers from Statistics Norway and Statistics Sweden.

look, as long as you can chew what you like' (OR 0.77)].

According to the Central Bureau of Statistics of Norway and Sweden, the gender distribution of respondents and non-respondents in the study group reflected that of the population. The level of education of the responders from both Norway and Sweden deviated from that of the non-responders. The socio-demographic distribution between the Swedish and Norwegian participants differed to a statistically significantly degree ($p < 0.01$) with respect to native born or not, place of residence, education and marital status. Non-response analyses and participant characteristics has been described earlier [15], also see table II.

Determinants of satisfaction with oral health within a conceptual model

Satisfaction with teeth regressed on these four ICF domains showed different explanatory values. Measured by Nagelkerke's R^2, the results for body function (b), body structure (s), activity/participating (p) and environmental domains (e) (separately) were 0.53, 0.31, 0.12 and 0.34, respectively (not presented in Table). Nineteen of the 33 original variables (e.g. country, living area, education and civil status) did not reach the level of statistical significance to be included in the final model. Table III presents the final regression analysis. The test for multicollinearity showed a condition index <15, indicating the absence of serious problems with intra-correlations. In the final stepwise multivariable logistic regression, gender, dental appearance, toothache, burning sensation in mouth, chewing capacity and mouth dryness were included (Nagelkerkes $R^2 = 0.53$), explaining 53% of the variance in step I. All variables except gender were statistically significant. In step II remaining own teeth, blisters in mouth and problems to talk were added, increasing Nagelkerkes R^2 from 0.53 to 0.61. Blisters in mouth did not reach statistical significance and OR for chewing capacity decreased in step II (from 38.65 to 15.27). In step III smoking and economic constraints were added, with a minor increase in Nagelkerkes R^2, but without smoking reaching statistical significance. In the final step three more factors were added, positive beliefs about keeping teeth lifelong, country and private or public dental care. Private/public dental care did not reach statistical significance and OR for remaining teeth decreased in this step (from 15.77 to 9.79). Nine variables demonstrated significant OR in this step. Four variables represented ICF domain b, dental appearance (OR = 25.44, 95% CI = 21.11–30.66), toothache (OR = 1.58, 95% CI = 1.33–1.89), burning sensation in mouth (OR = 3.07, 95% CI = 1.36–6.82) and chewing capacity (OR = 6.80, 95% CI = 3.83–12.05). Two variables represented ICF domain s, remaining own teeth (OR = 9.79, 95% CI = 6.75–14.19) and problems to talk (OR = 1.70, 95% CI = 1.18–2.45). One variable represented ICF domain d, economic constraints (OR = 2.27. 95% CI = 1.69–3.04) and finally two variable representing ICF variable e, 'positive beliefs about keeping teeth lifelong' (OR = 6.49, 95%CI = 5.18–8.19) and country (OR = 1.31, 95%CI = 1.07–1.61). The final model explained 65% of the variance (Nagelkerkes $R^2 = 0.65$).

To study whether or not the relationship of the independent variables and satisfaction with oral health varied across gender and country, a number of logistic regression models with two-ways interactions were conducted. Statistically significant two-way interaction occurred between gender and 'appearance of teeth' (model chi square = 2727.27, df = 15, $p < 0.001$), gender and 'tooth ache' (model chi square = 2726.58, df = 15, $p < 0.001$), gender and 'teeth' (model chi square = 3753.42, df = 15, $p < 0.001$), indicating that the effect of those variables on tooth satisfaction varied as a function of gender. Stratified analyses by gender revealed that dental

Table III. Satisfaction with teeth in Sweden and Norway regressed stepwise on four different ICF domains (body function, body structure, activity/participation, environmental factors).

Variables (ICF classification)		OR (Nagelkerkes R^2) Step 1 (0.53)	OR (Nagelkerkes R^2) Step 2 (0.61)	OR (Nagelkerkes R^2) Step 3 (0.62)	OR (Nagelkerkes R^2) Step 4 (0.65)	95% CI Step 4
Gender	Female	1				
	Male	1.03	1.05	1.05	1.07	0.90–1.28
Dental appearance (b)	Unsatisfied	1				
	Satisfied	23.26***	23.40***	22.86***	25.44***	21.11–30.66
Toothache (b)	Remember toothache	1				
	Not remember toothache	1.89***	1.72***	1.70***	1.58***	1.33–1.89
Burning sensation in the mouth (b)	Problem	1				
	No problem	2.60***	2.52*	2.56*	3.07**	1.38–6.82
Chewing capacity (b)	Bad	1				
	Good	38.65***	15.27***	13.01***	6.80***	3.83–12.05
Mouth dryness (b)	Problem	1				
	No problem	1.41***	1.16	1.09	1.07	0.88–1.30
Remaining own teeth (s)	Missing all or nearly all teeth		1			
	Missing some		2.81***	2.79***	2.62***	1.85–3.70
	All teeth remaining		16.36***	15.77***	9.79***	6.75–14.19
Blisters in mouth (s)	Problem		1			
	No problem		1.19	1.10	0.96	0.45–2.06
Problems to talk (s)	Problems		1			
	Never problems		2.55***	2.40***	1.70**	1.18–2.45
Smoking (d)	Smoking			1		
	Never smoked			0.93	1.05	0.86–1.29
Economic constraints (d)	Refrain from dentistry			1		
	No refrain from dentistry			2.72***	2.27***	1.69–3.04
Positive beliefs about keeping teeth lifelong (e)	No				1	
	Yes				6.49***	5.15–8.19
Country(e)	Norway					
	Sweden				1.31*	1.07–1.61
Private or public dental care					1	
					1.06	0.88–1.30

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

appearance was more strongly associated with satisfaction among females (OR = 29.8) than among males (OR = 21.48), whereas having all teeth and not remembering toothache were more strongly associated with satisfaction among males (OR = 14.69, 1.88) than among females (OR = 7.26, 1.36). No statistically significant two-way interactions occurred between country and the independent variables, thereby indicating only minor differences in the variation of explanatory factors across Norway and Sweden.

Discussion

In accordance with the propositions of the ICF conceptual framework, the present results suggest that all four concepts such as body function (b), body structures (s), activity and participation (d) and environmental (e) impact on oral health. Partly consistent with previous findings, this study found that dental appearance, chewing capacity, retaining one's own teeth and positive beliefs about the possibility of keeping teeth lifelong were the strongest predictors of oral impacts [15,18,19]. The results from the final model showed a higher explanatory value of Nagelkerke's R^2 compared to similar studies [20,21]. All ICF domains were represented by the variables that were statistically significantly associated with satisfaction with oral health in the final model. As this model lacks hierarchical structure, it is difficult to analyze if these results depend on mediating or moderating factors hiding activity and environmental factors, but some observations can (despite that) be drawn from the result. OR for chewing capacity decreased after remaining own teeth were included in the model, indicating that some effect from chewing seems to be mediated by remaining teeth, indicating that both those factors are important. In the same way did OR for remaining teeth decrease after 'positive beliefs about keeping teeth lifelong' were included, indicating a close connection between these variables.

Many studies have used a single global oral health question to measure OHRQoL. Still, there is limited knowledge about the underlying factors for this synthesis of different factors leading to this single measure. Few studies have used ICF as a conceptual model and ICF has not been used to any great extent to explain oral health, even if some attempts have been made to introduce this model [22,23]. MacEntee [23] concluded that 'application of the framework and language of the ICF to the major domains of oral health provides the basis for a new biopsychosocial model of oral health function and disablement'. Jelsma [24], in a review article, found only 18 papers with ICF in the keywords from all professions in Sweden, with no examples from dentistry.

The present study is one of the first large population-based surveys about OHRQoL researching factors from a different model (ICF) than the one that is often used (ICIDH). This conceptual model is of great importance for improvement of health systems in the world. As Dr Bruntland, representing WHO; stated 'Unless we measure health, we cannot manage and improve health systems. The ICF is the ruler with which we will take precise measurements of health and disability' [25].

By examining the relationships between the global oral health question scores and the four ICF domains in a single regression model, it was possible to obtain a better understanding of their combined effects and to compare the strength of the influence from each. The result can be considered as fairly representative for 65-year old people in Sweden and Norway, even if some caution is necessary. Earlier non-response analysis has shown some differences in gender and education with higher level of responses from females and from those with primary education. Neither did the variable gender reach the significance level in the final mode nor did education, to be included as independent variable in the final model but never-the-less could these differences bias the result. However, gender and sex differences between respondents and non-respondents may have led to some selection bias. Whereas a larger proportion of females might have resulted in over-estimation of satisfaction with oral health, the larger proportion of participants having lower level education might have had the opposite effect. A low response rate might in itself not necessarily imply non-response bias. However, there is a risk that responders might have differed from the population on a number of variables that were not accounted for in the data collection. Finally, this study focused on relationships between satisfaction with oral health and ICF-related variables. In this situation issues concerning the external validity is not that sensitive as when the focus is on estimates of prevalence's of oral health.

This study draws strength from using a conceptual model proposed by WHO and by using a global question as a dependent variable. This is a well-known instrument and is commonly used as a gold standard for assessing the validity of multi-item OHRQoL instruments [26-28]. The global question in this study has been used and validated with acceptable psychometric properties [15]. It is also a merit that this is one of the first studies using ICF to understand oral health [24]. Finally, this study was a large census study in two countries with moderate-to-high response rates.

There is always a possibility that many important influencing factors of self-reported oral health are missing and thereby do not contribute to the explanatory models. However, the model fit in terms of Nagelkerke's R^2 for the final model was 0.65, which

indicates a good explanation of the outcome by the models used. There is also a challenge to be among the first when studying a new conceptual model because there are few possibilities to compare this result with others. Another problem with ICF is problems with missing or overlapping codes [24]. This is notable in this study too, where some of the variables chosen to represent participation also could have been chosen to represent environment. Jelsma [24] stated that there are issues that need to be addressed by the WHO ICF group and this process is already underway. If the purpose of the study had been to validate linking results between this survey and ICF codes, it has been proposed to use, for example, multiple raters and some linking rules [12]. In this study, we have partly followed these rules, as have many other researchers [29]. This can be deemed satisfactory in this study depending on the decision to only link the letter prefix in ICF with the items and to not go further and link them in a deeper level with numbers. Further research in order to link oral health surveys to ICF is desirable.

To summarize, this study identified nine important variables, explaining 65% of satisfaction with oral health and linked these nine variables to four domains in ICF, indicating that one domain (body function) had the strongest correlation with satisfaction with oral health. It also highlighted the need for more studies, using path modeling, using earlier described linking rules, focusing on correlations between ICF domains and oral health variables.

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