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Factor Analyses of the Oral Health Impact Profile - Overview and studied population

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Abstract

Purpose—A desideratum of oral health-related quality of life (OHRQoL) instruments - such as the Oral Health Impact Profile (OHIP) - is that they accurately reflect the structure of the measured construct(s). With this goal in mind, the Dimensions of Oral Health-Related Quality of Life (DOQ) Project was proposed to investigate the number and nature of OHRQoL dimensions measured by OHIP. In this report, we describe our aggregate data set for the factor analyses in the project, which consists of responses to the 49-item OHIP from general population subjects and prosthodontics patients from 6 countries, including a large age range of adult subjects and both genders.

Material and methods—The DOQ Project's aggregate data set combines data from 35 individual studies conducted in Croatia, Germany, Hungary, Japan, Slovenia, and Sweden.

Results—The combined data set includes 10,778 OHIPs from 9,348 individuals (N=6,349 general population subjects, N=2,999 prosthodontic patients). To elucidate the OHIP latent structure, the aggregated data were split into a Learning Sample (N=5,173) for exploratory

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analyses and a Validation Sample (N=5,022) for confirmatory analyses. Additional data (N=583) were assigned to a third data set.

Conclusion—The Dimensions of Oral Health-Related Quality of Life Project contains a large amount of international data and is representative of populations where OHIP is intended to be used. It is well-suited to assess the dimensionality of the questionnaire.

Keywords

Oral Health Impact Profile; Factor analysis; questionnaire; general population; prosthodontic patients

1. Introduction

The concept of oral health-related quality of life (OHRQoL) describes the patient-perceived impact of orofacial conditions and the effect of dental interventions. The Oral Health Impact Profile (OHIP), developed in 1994 by Slade and Spencer [1], is a widely used OHRQoL instrument. Based on Locker's conceptual model of oral health [2], the 49 OHIP questions were originally grouped into seven domains, each represented by five to nine items. The resulting profile of seven domain scores characterizes the broader impact from oral diseases and disorders.

According to best practices in measurement theory, a set of items should ideally measure one latent construct (or attribute) [3]. Each scale formed by multiple items should therefore be unidimensional enough to be a meaningful measure of the attribute. A larger attribute (e.g., OHRQoL) often contains several smaller attributes (e.g., OHRQoL dimensions). A profile of related dimensions scores describes distinct parts of the larger attribute and is often accompanied by a total score for the larger attribute as a whole. Obviously, the questionnaire's dimensional structure will have a fundamental influence importance on its score validity and reliability.

In order for the OHIP to be a good measure of OHRQoL, the theoretical seven-domain structure ought to be confirmed empirically. However, previous studies, for example [4–13], have not agreed on the number and the nature of OHIP's dimensional structure. Nevertheless, all studies have rejected the original seven-domain model [5–13] with one exception [4]. These studies employed many different methodologies such as an empirically derived population-response model [4], experts' assignment of the OHIP items to dimensions [5], exploratory factor analysis [6], and confirmatory factor analysis [7]. Previous studies have also considered a variety of subject populations. Patient populations included Turkish patients with Behcet's disease and recurrent aphthous stomatitis [6], Italian TMD patients [8], Chinese partially edentulous patients seeking dental implant therapy [9], and Brazilian edentulous patients [10]. Non-patient populations included Spanish healthy workers [7], German general population subjects [11], Chinese community subjects [12], and Japanese workers [13]. Because the psychometric properties of an instrument, such as its dimensionality, may differ across populations, conflicting OHIP dimensionality findings could be due to the different populations studied.

From a practical point of view, not all populations of interest for the OHIP can be studied simultaneously, but investigating “typical” dental patients and general population subjects is feasible and they are important target populations. Furthermore, large consecutive samples of patients and random samples of the general population, covering a wide age range and containing both genders would represent these populations well. Because the OHIP is a global measure with versions in more than 20 languages [14], an international approach to the investigation of OHIP structure is desirable. The Dimensions of Oral Health-Related Quality of Life Project (DOQ) employs this approach.

Our objective in this report is to provide an overview of the project, to characterize the studied samples in the project's secondary data analysis part, and to discuss the importance of the population studied for determining the dimensionality of the OHIP.

2. Materials and Methods

2.1. Oral Health Impact Profile

The original 49-item OHIP (OHIP-49) was developed by Slade and Spencer in 1994 [1]. Subsequently, abbreviated versions were developed, for example, with 14 [15] or 5 items [16]. Additionally, condition-specific versions have been developed, for example, for temporomandibular disorders [8], for edentulous individuals [17] and to assess dental aesthetics [18]. Built on Locker's conceptual model of oral health [2], OHIP-49 items are grouped into 7 domains: Functional Limitation (9 items), Physical Pain (9 items), Psychological Discomfort (5 items), Physical Disability (9 items), Psychological Disability (6 items), Social Disability (5 items), and Handicap (6 items). Subjects rate how frequently they have experienced the impact on a 5-point ordinal scale (0 = ‘never’, 1 = ‘hardly ever’, 2 = ‘occasionally’, 3 = ‘fairly often’, 4 = ‘very often’). Some OHIP versions also offer the response option ‘don't know’. Whereas the original OHIP used the past 12 months as the reference period, a one-month recall period has been used more frequently to capture more recent oral health impacts. Three OHIP-49 items are specific to denture-related impacts (e.g., uncomfortable dentures) and are therefore not applicable to subjects without partial or complete dentures. Conversely, some items refer strictly to natural teeth (e.g. brushing teeth), but subjects often interpret the term “teeth” to include natural teeth and tooth replacements such as fixed, partial, or complete prosthodontics. The original OHIP included item weights, but weighted scores were found not to be more informative than simple sum scores [19]. Most often, either a sum score for all 49 items or the sum of each of the seven domains are reported.

2.2. Study design

The purpose of the Dimensions of Oral Health-Related Quality of Life Project is to determine the structural validity of the OHIP. The present study is a secondary data analysis using available international data. Target populations were dental patients, represented by prosthodontics patients, and general population subjects. When the project started in June of 2012, data from existing studies were included when they originated from countries with the following characteristics:

- (i) Availability of all questionnaire items from a culture/language with a 49-item OHIP with published psychometric properties about validity and reliability;
- (ii) Availability of both a random sample of general population subjects and a sample of prosthodontic patients; and
- (iii) Availability of adult subjects covering a large age range (min to max age: >40 years) for both genders.

These criteria lead to the inclusion of OHRQoL studies from Croatia, Germany, Hungary, Slovenia, and Sweden. Because the majority of data came from general population subjects, to increase the number of patients in the project, data from Japanese prosthodontics patients were added to the study, leading to 35 original studies included in the DOQ Project.

For 31 of the 35 studies (see Tables 1, 2 and 3), study design and subject characteristics were described in detail in the original publications. The patient samples represented the broad spectrum of prosthodontics patients treated with fixed, removable, complete or implant-supported dentures. The general population subjects represented national, regional and local random samples. In the four studies without primary publications, subjects had similar characteristics compared to those included in the published studies: A sample of Croatian complete denture-wearers (reference A in Tables 1 and 2) was similar to a sample of German complete denture-wearers [20]. Two samples of prosthodontic patients in Croatia (Reference B, Table 1 and 2) and Slovenia (Reference D, Table 1 and 2) receiving dental implant therapy were similar to a recent study in this same patient population in Croatia [21]. A sample of Slovenian general population subjects (Reference C, Tables 1 and 2) who were from rural regions of Slovenia was similar to general population Slovenian subjects studied before [22].

2.3. Analytic Approach

Exploratory (EFA) and confirmatory (CFA) factor analyses are often used to determine structural validity or dimensionality [23]. EFA summarizes the information contained in all items with a smaller number of latent variables, called factors. These factors are interpreted as the latent dimensions of a test. CFA, alternatively, tests specific hypotheses about the relationships between the observed items and the latent factors. Because EFA suggests the hypothesis for CFA, it is important to use these techniques with different sets of data, which we call the Learning Sample and the Validation Sample. Therefore, we will first explore OHIP dimensions with EFA using the Learning Sample of the DOQ Project. The chosen solution to the EFA will then be confirmed or rejected with CFA in the Validation Sample.

We derived the Learning Sample and the Validation Sample in the following way:

1. For cross-sectional studies, data were randomly assigned to one of two sets using a random number generator provided by the statistical software STATA [24]. Half of the subjects were assigned to the Learning Sample, and the remaining half were assigned to the Validation Sample.
2. For longitudinal studies with exactly two assessments per subject, all assessments for one occasion were assigned to the Learning Sample and all assessments for the

other occasion were assigned to the Validation sample. We randomly assigned the two occasions (and all subject data within the particular occasion) to the Learning or Validation Sample.

3. For longitudinal studies with three or more assessments per subject, the first two assessments were assigned to the Learning or Validation Sample in the same manner as described in paragraph 2. Data from the third assessment were put into an Additional Sample. Further assessments were discarded.

Because subjects from longitudinal studies were included two or three times, the total number of observations in the three data sets (Learning, Validation, Additional Sample) was larger than the number of subjects in the DOQ Project.

2.4. Data analysis

To describe our data, we distinguished between the populations of prosthodontic patients and general population subjects. We also distinguished between random, consecutive, and convenience sampling. Within the random population samples, we differentiated between national, regional (e.g., in more than one city or in a geographical region), and local (e.g., in a particular city) samples to characterize the sample frame. The denture status of prosthodontic patients was categorized into fixed partial dentures (FPD), removable partial dentures (RPD), complete dentures (CD), and implant-supported prosthodontics (Imp). To provide demographic information, the mean and standard deviation of age and the proportion of women in the studies were also recorded.

The level of OHRQoL was characterized by the OHIP-49 summary score mean and standard deviation as well as median and the lower and upper lower quartile of the data. For the 46 items not referring specifically to dentures, missing OHRQoL information was characterized by the number of subjects with complete item information and the number of missing item responses.

3. Results

3.1. Number of studies and subjects

The international data set of the Dimensions of Oral Health-Related Quality of Life Project contained 10,778 OHIP-49s from 9,348 individuals (6,349 general population subjects, 2,999 prosthodontic patients) within 35 previously completed studies (Tables 1, 2, and 3). After splitting the data into three sets, the Learning Sample contained 5,173 and the Validation Sample contained 5,022 patients and general population subjects whereas the Additional Sample consisted of 583 prosthodontic patients only.

3.2. Demographic characteristics and missing information

In both the Learning and Validation Samples, the ratio of general population subjects to prosthodontic patients was about 3:2. Prosthodontic patients averaged about 10 years older than general population subjects. Both patient and general population subjects tended to contain slightly more women than men. Germany contributed the largest number of subjects, and Croatia contributed the smallest. Less than 1% of item responses were missing and less

than 10% of all subjects did not have complete OHIP data, excluding three denture-related items.

3.3. Oral health-related quality of life impairment

As expected, prosthodontic patients reported higher average OHIP scores than general population subjects. The distribution of OHIP scores demonstrated positive skew in both populations, though higher skewness was found among general population subjects. In the Additional Sample, which contained only follow-up scores from prosthodontic patients, average OHIP scores were lower than the patient scores included in the Learning and Validation Samples but higher than scores from general population subjects.

3.4. Similarity of Learning, Validation, and Additional sample

Overall, the Learning and Validation Samples were similar in terms of sociodemographic characteristics, missing data frequency, and OHIP total score distribution. The Additional Sample was similar to the other two samples in sociodemographics, missing data pattern and mean OHIP scores.

4. Discussion

The Dimension of Oral Health-Related Quality of Life Project attempts to identify the dimensional structure of the Oral Health Impact Profile. The first stage of this project will suggest a dimensional structure and the second stage will test this structure. The investigated populations are dental patients, represented by prosthodontic patients, and general population subjects. These two populations represent important populations in which the instrument is intended to be used.

4.1. Target populations for OHIP

Oral health is of interest in several populations (Fig. 1). Most important would be the general population because it contains all subjects in a defined area. Measuring the patient-perceived impact of oral conditions is of public health relevance because this impact, conceptualized as OHRQoL, is a significant component of health in general. Populations with specific oral diseases (dental patients) are also of interest because measuring the effects of dental interventions from the patient's perspective is of particular interest for researchers, clinicians, and patients alike. Conceptually, patients are part of the general population. Due to practical reasons, they are usually studied in treatment centers.

4.2. General populations subjects and their OHIP data

When OHRQoL levels were studied in the general population of an entire country (Fig. 1), population registers, for example Folkbokföringen, a civil registry of Swedish inhabitants maintained by the Swedish Tax Agency, provided an ideal sampling frame because all possible subjects were listed. From such a source population, a random sample was selected to represent the population. These subjects were approached for participation, and data were collected from those who agreed to participate.

In the DOQ Project, three of nine studies in the general population were national studies. The Swedish study used a population registry [44]. In the other two studies in Germany [26,28], a multistage sampling technique sampled geographical districts from a list of all available districts in Germany. Within each selected district, households were selected randomly and then within each household, the survey participant was selected at random. Only these national studies and two additional local studies provided details about the source population, including response rates. Response rates varied from 35% to 100%. In two Hungarian samples [36,37], the questionnaire was given to subjects during a mandatory lung screening, leading to 100% response rates. When subjects participated in our population studies, OHIP data contained a low proportion of missing values. Item non-response was therefore less relevant in our studies.

In conclusion, the major challenges for studying OHRQoL in general population subjects were whether the sampling frame is representative of the target population and whether subject non-response was substantial when individuals in the source population were approached. We did not observe substantial differences in OHIP-49 scores and subject characteristics when both regional and national samples were available and compared within a particular country. Similarly, we did not observe differences in score distributions or subject characteristics associated with differences in response rates. We caution, however, that the small number of studies did not allow for a thorough investigation of these potential systematic differences. Overall, a clear pattern of OHIP score distortion was not apparent from selecting a particular sampling frame or from subject non-response.

4.3. Dental patients and their OHIP data

When OHRQoL was studied in dental patients (Fig.1), the patients of an entire country represented the target population. Here, selection of study participants was challenging because these patients were impossible to identify for sampling. Therefore, treatment centers were selected as source populations based on practical considerations. In particular, all of the patients came from university-based centers. Only two countries contributed more than one treatment center, which limited the representativeness of patients in a particular country in general.

Sampling from patients in a particular treatment center was not a challenge. Even when random sampling methods were not used, larger consecutive patient samples approximated the underlying source population reasonably well. Convenience samples were more problematic, especially when they were small. Most of our patient studies were consecutive samples and the number of patients was usually not small ($N < 30$ subjects). Therefore, these samples seemed to represent the treatment center's population reasonably well. Subject non-response was also not a challenge. Of the patients who agreed to be in the study, most provided complete OHIP information, with a small number of patients lost at follow-up in longitudinal studies. Item non-response was not substantial for our studies, specifically because OHIP data collection was often supervised by staff.

In conclusion, the major challenge faced in studying OHRQoL in dental patients was whether the patients in the treatment centers were representative of the target population of patients in a particular country. The small number of studies per country limited the ability

to detect bias within a particular country or between consecutive and convenience samples. It is therefore difficult to determine how well the patients represented the patient population in a particular country, or whether the sampling technique made a difference. Similar to the general population studies, we did not find clear patterns of how OHIP scores were influenced by selection of a particular source population, use of a particular sampling technique, or subject non-response.

Finally, prosthodontics patients, in our opinion, represent dental patients well. First, the number of prosthodontics patients is large. They represent a substantial proportion of dental patients in general. Second, prosthodontic patients usually suffer from tooth loss resulting from the two major oral diseases, caries and periodontitis, or from dental trauma and processes leading to substantial loss of tooth structure such as erosion and attrition. Therefore, tooth loss may be regarded as dentistry's major or "typical" outcome and prosthodontic patients may therefore be regarded as "typical" dental patients. Third, prosthodontic treatment is usually not performed in isolation. Extractions, periodontal and endodontic treatment, as well as therapy with fillings among other treatments, are often performed in conjunction with prosthodontic treatment. Therefore, these patients receive many typical (frequently performed) oral interventions.

4.4. Strength and limitations

Although the secondary data analysis part of the DOQ Project attempted to represent the relevant populations, generalizing data to countries and cultures not included in the DOQ Project assumes that the OHIP is invariant across cultures. A previous study found evidence for "a reasonable degree of cross-cultural consistency," among Australian individuals as well as English-speaking and French-speaking Canadians, [47] but more formal assessments of measurement invariance have not yet been performed for the OHIP.

In our studies, the OHIP was most often given as a self-administered questionnaire, although studies sometimes used personal interviews. While the method of administration can potentially influence questionnaire responses, substantial influences on OHIP data were not found previously [35]. Most of our studies used the 1-month recall period as a framework for the oral health impact. While the reference period for reporting impacts should be important for the magnitude of OHIP scores, substantial differences between 1-month and 12-month recall periods were not observed for OHIP scores in Finnish patients [48] or in German individuals [27].

4.5. Conclusion

Establishing the structural validity of the OHIP requires a large sample of responses that accurately represent the target populations. In the Dimensions of Oral Health-Related Quality of Life Project, a large data set was aggregated from general population and prosthodontic patients from six countries, but an extension to other dental patient populations is desirable. For general population subjects, selection of the sampling frame and subject non-response were identified as factors that can bias OHIP scores when assessing dimensionality. For dental patients, selection of the source population was important. Overall, our data represented the target populations reasonably well. While each

research question needs an individual assessment of selection and information bias, we believe that this large data set of international general population and prosthodontic patients is suitable for assessing the dimensional structure of the Oral Health Impact Profile.

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Figure 1.

Conceptual flowchart to select general population subjects and prosthodontic patients in the six countries of the Dimensions of Oral Health-Related Quality of Life Project

Table 1

Learning Sample of the Dimension of Oral Health-Related Quality of Life Project: Demographic characteristics, OHIP score magnitude, and missing data of general population subjects and prosthodontics patients

Country	Population	Sampling#	Patient characteristics ^{\$}	Reference	N	Age mean (SD)	% women	OHIP49 mean (SD)	OHIP49 median (Q ₁ –Q ₃)	No of missing items* (% missing)	No of subjects with complete item information* (% of subjects)
Croatia	general	Rand (Reg)		[25]	76	37.4 (15.6)	62	21.5 (18.3)	17.5 (4.0–32.0)	0 (0.0)	76 (100)
	prosthodontic	Cons	CD	A ^Ø	84	78.0 (9.8)	68	29.2 (26.1)	19.5 (13.0–34.0)	0 (0.0)	84 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	B ^Ø	30	48.1 (12.7)	37	42.8 (12.7)	42.0 (34.0–52.0)	0 (0.0)	30 (100)
Germany	general	Rand (Nat)		[26]	1013	44.1 (16.2)	51	15.7 (21.7)	7.0 (1.0–22.0)	132 (0.3)	926 (91.4)
	general	Rand (Reg)		[27]	82	38.2 (11.8)	67	14.3 (20.1)	7.5 (3.0–13.0)	3 (0.1)	80 (97.6)
	general	Rand (Nat)		[28]	404	50.2 (16.6)	51	18.2 (23.0)	9.0 (2.0–23.5)	23 (0.1)	387 (95.8)
	prosthodontic	Conv	CD	[20]	25	72.8 (9.5)	64	22.8 (16.8)	18.0 (10.0–36.0)	0 (0.0)	25 (100)
	prosthodontic	Conv	FPD, RPD, CD	[29]	21	54.2 (14.8)	52	28.2 (26.3)	25.0 (12.0–38.0)	13 (1.3)	16 (76.2)
	prosthodontic	Cons	FPD, RPD, CD	[30]	219	55.8 (15.9)	47	31.2 (25.4)	25.0 (12.0–42.0)	61 (0.6)	175 (79.9)
	prosthodontic	Conv	FPD, RPD, CD	[27]	30	50.7 (21.1)	53	22.0 (16.1)	21.0 (10.0–29.0)	0 (0.0)	30 (100)
	prosthodontic	Conv	FPD, RPD, CD	[31]	103	56.2 (14.7)	55	42.6 (34.8)	32.0 (12.0–71.0)	0 (0.0)	103 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[32]	23	46.1 (15.5)	52	67.2 (43.7)	68.0 (24.0–)	3 (0.3)	20 (87)
	prosthodontic	Cons	FPD, RPD, CD	[33]	125	54.7 (15.8)	50	31.1 (28.3)	21.0 (9.0–43.0)	44 (0.8)	99 (79.2)
Hungary	prosthodontic	Cons	FPD, RPD, CD	[34]	73	57.7 (15.4)	51	40.1 (29.5)	31.0 (19.0–55.0)	3 (0.1)	70 (95.9)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[28]	153	62.0 (14.3)	56	34.5 (27.0)	28.0 (14.0–46.0)	39 (0.6)	127 (83)
	prosthodontic	Conv	FPD, RPD, CD	[35]	42	57.5 (15.7)	57	21.3 (27.2)	12.5 (5.0–23.0)	10 (0.5)	35 (83.3)
	general	Rand (Loc)		[36]	530	46.8 (17.5)	50	12.5 (17.5)	7.0 (3.0–15.0)	8 (0.0)	523 (98.7)
	general	Rand (Loc)		[37]	100	49.6 (17.4)	46	10.6 (12.6)	7.0 (3.0–15.0)	0 (0.0)	100 (100)
	prosthodontic	Conv	FPD, RPD, CD	[37]	71	50.5 (18.0)	66	47.5 (30.8)	39.0 (20.0–70.0)	0 (0.0)	71 (100)
Japan	prosthodontic	Conv	FPD, RPD, CD	[38]	56	53.3 (14.3)	59	48.9 (31.4)	39.0 (23.0–70.0)	8 (0.3)	52 (92.9)
	prosthodontic	Conv	FPD, RPD, CD	[37]	73	52.0 (15.7)	64	50.1 (29.3)	44.0 (31.0–67.0)	7 (0.2)	69 (94.5)
	prosthodontic	Cons	FPD, RPD, CD	[39,40]	251	54.0 (17.0)	65	42.0 (31.8)	37.0 (15.0–63.0)	35 (0.3)	225 (89.6)
	prosthodontic	Cons	FPD, RPD, CD	[39]	37	46.5 (18.4)	68	31.2 (28.9)	24.0 (9.0–52.0)	0 (0.0)	37 (100)
	prosthodontic	Cons	FPD, RPD, CD	[40]	38	28.4 (6.8)	53	16.6 (19.3)	10.5 (5.0–21.0)	0 (0.0)	38 (100)
	prosthodontic	Cons	FPD, RPD, CD	[40]	30	62.8 (9.3)	77	63.6 (37.0)	63.5 (37.0–92.0)	0 (0.0)	30 (100)

Country	Population	Sampling#	Patient characteristics [§]	Reference	N	Age mean (SD)	% women	OHIP49 mean (SD)	OHIP49 median (Q1–Q3) ⁺	No of missing items [*] (% information missing)	No of subjects with complete item information [*] (% of subjects)
	prosthodontic	Cons	FPD, RPD	[41]	58	57.4 (10.7)	67	32.7 (27.2)	23.0 (11.0–51.0)	0 (0.0)	58 (100)
	prosthodontic	Cons	FPD, RPD	[42]	122	63.1 (8.8)	73	48.2 (29.6)	47.0 (24.0–68.0)	38 (0.7)	98 (80.3)
	prosthodontic	Cons	FPD, RPD	[43]	86	67.8 (9.1)	60	48.0 (31.0)	45.5 (27.0–71.0)	3 (0.1)	85 (98.8)
Slovenia	general	Rand (Reg)		[22]	200	41.3 (12.3)	76	24.7 (27.0)	15.0 (8.0–30.5)	0 (0.0)	200 (100)
	general	Rand (Reg)		C [∅]	89	40.9 (10.9)	85	33.8 (26.4)	26.0 (14.0–46.0)	44 (1.1)	78 (87.6)
	prosthodontic	Cons	FPD, RPD, CD	[22]	30	55.6 (12.7)	83	54.9 (36.4)	51.5 (24.0–81.0)	0 (0.0)	30 (100)
	prosthodontic	Cons	FPD, RPD, CD	[22]	32	38.3 (14.7)	59	34.1 (25.6)	27.5 (11.5–52.5)	0 (0.0)	32 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	D [∅]	65	53.2 (19.6)	57	23.3 (22.3)	19.0 (10.0–26.0)	0 (0.0)	65 (100)
Sweden	general	Rand (Nat)		[44]	683	50.4 (17.2)	55	19.4 (24.3)	11.0 (5.0–24.0)	613 (2.0)	570 (83.5)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[45,46]	119	48.7 (17.0)	48	35.2 (37.2)	23.0 (7.0–52.0)	44 (0.8)	92 (77.3)
All	general				3177	46.3 (16.7)	55	17.3 (22.4)	9.0 (3.0–22.0)	823 (0.6)	2940 (92.5)
	prosthodontic				1996	56.2 (16.9)	58	37.9 (30.8)	30.0 (14.0–55.0)	308 (0.3)	1796 (90.0)

[∅] References A, B, C, and D refer to samples described in the Material and Methods under Study Design,

^{*} excluding the 3 denture-specific items;

[#] Rand: Random, Cons: Consecutive, Conv: Convenience sample; Nat: national, Reg: regional, Loc: local sample;

[§] FPD: Fixed partial denture, RPD: removable partial denture, CD: complete dentures, Imp: Implant-supported prosthodontics,

⁺ Q1–Q3: First quartile to third quartile

Table 2

Validation Sample of the Dimension of Oral Health-Related Quality of Life Project: Demographic characteristics, OHIP score magnitude, and missing data of general population subjects and prosthodontics patients

Country	Population	Sampling#	Patient characteristics ^{\$}	Reference	N	Age mean (SD)	% women	OHIP49 mean (SD)	OHIP49 median (Q ₁ –Q ₃)	No of missing items* (% information missing)	No of subjects with complete item information* (% of subjects)
Croatia	general	Rand (Reg)			75	40.0 (17.9)	64	24.9 (19.7)	20.0 (6.0–35.0)	0 (0.0)	75 (100)
	prosthodontic	Cons	CD	A ^Ø	84	76.8 (9.5)	63	28.9 (27.3)	21.5 (12.5–35.5)	0 (0.0)	84 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	B ^Ø	30	48.1 (12.7)	37	87.9 (25.5)	90.5 (73.0–99.0)	0 (0.0)	30 (100)
	general	Rand (Nat)		[26]	1013	42.6 (16.2)	53	14.5 (21.7)	6.0 (0.0–19.0)	106 (0.2)	937 (92.5)
Germany	general	Rand (Reg)		[27]	81	38.4 (10.9)	67	16.6 (19.0)	10.0 (3.0–22.0)	2 (0.1)	79 (97.5)
	general	Rand (Nat)		[28]	403	49.8 (16.0)	54	19.7 (24.7)	10.0 (3.0–26.0)	47 (0.3)	372 (92.3)
	prosthodontic	Conv	CD	[20]	25	72.2 (9.5)	68	14.5 (11.8)	12.0 (7.0–18.0)	0 (0.0)	25 (100)
	prosthodontic	Conv	FPD, RPD, CD	[29]	21	54.2 (14.8)	52	27.0 (26.4)	20.0 (7.0–41.0)	2 (0.2)	19 (90.5)
	prosthodontic	Cons	FPD, RPD, CD	[30]	190	55.8 (15.9)	46	31.4 (27.7)	23.0 (11.0–45.0)	60 (0.7)	153 (80.5)
	prosthodontic	Conv	FPD, RPD, CD	[27]	30	50.7 (21.1)	53	25.5 (18.8)	26.0 (10.0–35.0)	0 (0.0)	30 (100)
	prosthodontic	Conv	FPD, RPD, CD	[31]	105	56.0 (14.5)	56	22.6 (29.0)	11.0 (4.0–31.0)	0 (0.0)	105 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[32]	23	46.1 (15.5)	52	75.4 (41.5)	64.0 (47.0–102.0)	8 (0.8)	15 (65.2)
	prosthodontic	Cons	FPD, RPD, CD	[33]	124	54.8 (15.9)	49	24.2 (24.1)	16.0 (4.0–37.0)	36 (0.6)	102 (82.3)
	prosthodontic	Cons	FPD, RPD, CD	[34]	72	59.3 (14.5)	57	39.8 (29.9)	30.5 (18.5–56.5)	2 (0.1)	70 (97.2)
Hungary	prosthodontic	Cons	FPD, RPD, CD, Imp	[28]	153	61.5 (13.3)	59	32.7 (28.2)	24.0 (12.0–47.0)	41 (0.6)	123 (80.4)
	prosthodontic	Conv	FPD, RPD, CD	[35]	42	57.5 (15.7)	57	21.3 (24.3)	15.0 (7.0–22.0)	0 (0.0)	42 (100)
	general	Rand (Loc)		[36]	529	46.0 (18.3)	51	13.1 (18.0)	7.0 (2.0–16.0)	4 (0.0)	526 (99.4)
	general	Rand (Loc)		[37]	100	48.7 (17.5)	59	12.5 (22.1)	5.0 (1.5–14.5)	1 (0.0)	99 (99)
Japan	prosthodontic	Conv	FPD, RPD, CD	[37]	72	47.1 (19.2)	65	38.3 (27.5)	36.5 (15.0–49.5)	0 (0.0)	72 (100)
	prosthodontic	Conv	FPD, RPD, CD	[38]	32	58.1 (15.2)	53	46.6 (24.4)	42.0 (26.5–66.5)	4 (0.3)	28 (87.5)
	prosthodontic	Conv	FPD, RPD, CD	[37]	73	52.0 (15.7)	64	48.8 (30.5)	42.0 (24.0–65.0)	16 (0.5)	65 (89)
	prosthodontic	Cons	FPD, RPD, CD	[39,40]	251	55.1 (16.3)	65	42.0 (31.2)	39.0 (14.0–63.0)	44 (0.4)	223 (88.8)
	prosthodontic	Cons	FPD, RPD, CD	[39]	37	46.5 (18.4)	68	34.8 (28.2)	32.0 (9.0–52.0)	0 (0.0)	37 (100)
	prosthodontic	Cons	FPD, RPD, CD	[40]	38	28.4 (6.8)	53	13.2 (15.8)	6.5 (2.0–24.0)	0 (0.0)	38 (100)
	prosthodontic	Cons	FPD, RPD, CD	[40]	30	62.8 (9.3)	77	40.6 (29.1)	35.0 (15.0–63.0)	0 (0.0)	30 (100)

Country	Population	Sampling [#]	Patient characteristics ^{\$}	Reference	N	Age mean (SD)	% women	OHIP49 mean (SD)	OHIP49 median (Q ₁ –Q ₃ ⁺)	No of missing items [*] (% information missing)	No of subjects with complete item information [*] (% of subjects)
	prosthodontic	Cons	FPD, RPD	[41]	57	59.9 (9.2)	74	33.2 (26.3)	25.0 (12.0–55.0)	0 (0.0)	57 (100)
	prosthodontic	Cons	FPD, RPD	[42]	122	63.4 (8.6)	62	45.2 (29.2)	46.0 (22.0–60.0)	20 (0.4)	108 (88.5)
	prosthodontic	Cons	FPD, RPD	[43]	85	68.3 (9.6)	60	49.8 (32.9)	48.0 (22.0–72.0)	6 (0.2)	82 (96.5)
Slovenia	general	Rand (Reg)		[22]	200	41.4 (13.1)	71	26.1 (26.3)	15.0 (9.0–34.5)	0 (0.0)	200 (100)
	general	Rand (Reg)		C ^Ø	88	38.7 (12.1)	73	28.0 (22.1)	22.0 (12.0–39.5)	9 (0.2)	79 (89.8)
	prosthodontic	Cons	FPD, RPD, CD	[22]	30	55.6 (12.7)	83	58.0 (36.5)	57.0 (24.0–71.0)	0 (0.0)	30 (100)
	prosthodontic	Cons	FPD, RPD, CD	[22]	32	38.3 (14.7)	59	40.4 (26.2)	31.0 (22.0–61.0)	0 (0.0)	32 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	D ^Ø	65	53.6 (17.4)	72	25.0 (17.6)	21.0 (12.0–34.0)	0 (0.0)	65 (100)
Sweden	general	Rand (Nat)		[44]	683	50.9 (18.0)	55	17.8 (22.6)	10.0 (4.0–22.0)	881 (2.8)	556 (81.4)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[45,46]	27	52.0 (17.4)	67	52.8 (39.4)	44.0 (24.0–77.0)	14 (1.1)	20 (74.1)
All	general				3172	45.7 (17.1)	55	17.0 (22.3)	9.0 (3.0–22.0)	1050 (0.7)	2923 (92.2)
	prosthodontic				1850	56.8 (16.6)	60	36.6 (30.7)	28.0 (12.0–55.0)	253 (0.3)	1685 (91.1)

Ø References A, B, C, and D refer to samples described in the Material and Methods under Study Design.

* excluding the 3 denture-specific items;

[#] Rand: Random, Cons: Consecutive, Conv: Convenience sample; Nat: national, Reg: regional, Loc: local sample;

^{\$} FPD: Fixed partial denture, RPD: removable partial denture, CD: complete dentures, Imp: Implant-supported prosthodontics,

⁺ Q1–Q3: First quartile to third quartile

Table 3

Additional Sample of the Dimension of Oral Health-Related Quality of Life Project: Demographic characteristics, OHIP score magnitude, and missing data of general population subjects and prosthodontics patients

Country	Population	Sampling#	Patient characteristics [§]	Reference	N	Age mean (SD)	% women	OHIP-49 mean (SD)	OHIP-49 median (Q ₁ –Q ₃ ⁺)	No of missing items* (% information missing)	No of subjects with complete item information* [% of subjects]
Germany	prosthodontic	Conv	FPD, RPD, CD	[29]	21	54.2 (14.8)	52	28.0 (29.7)	17.0 (10.0–44.0)	1 (0.1)	20 (95.2)
	prosthodontic	Cons	FPD, RPD, CD	[30]	208	55.7 (15.8)	47	25.7 (21.3)	21.0 (9.0–34.5)	54 (0.6)	174 (83.7)
	prosthodontic	Conv	FPD, RPD, CD	[31]	101	56.5 (14.4)	55	11.7 (15.8)	4.0 (1.0–14.0)	0 (0.0)	101 (100)
	prosthodontic	Cons	FPD, RPD, CD, Imp	[32]	23	46.1 (15.5)	52	61.4 (43.3)	62.0 (30.0–75.0)	5 (0.5)	18 (78.3)
	prosthodontic	Cons	FPD, RPD, CD	[33]	126	54.8 (15.9)	49	37.8 (31.8)	28.5 (12.0–59.0)	22 (0.4)	107 (84.9)
Hungary	prosthodontic	Conv	FPD, RPD, CD	[35]	42	57.5 (15.7)	57	25.1 (25.8)	21.0 (9.0–28.0)	8 (0.4)	36 (85.7)
	prosthodontic	Conv	FPD, RPD, CD	[38]	62	54.9 (14.6)	60	26.4 (34.8)	15.0 (8.0–25.0)	11 (0.4)	54 (87.1)
All					583	55.3 (15.5)	51	27.4 (28.5)	19.0 (7.0–38.0)	101 (0.4)	510 (87.5)

* excluding the 3 denture-specific items;

Cons: Consecutive, Conv: Convenience sample;

§ FPD: Fixed partial denture, RPD: removable partial denture, CD: complete dentures, Imp: Implant-supported prosthodontics,

+ Q1–Q3: First quartile to third quart