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ORIGINAL ARTICLE

Prosthetic dental restorations in Swedish samples: prevalence and agreement between self-report, clinical findings, and influence on quality of life

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ABSTRACT

Objective: To determine the prevalence of dental prosthetic restorations in an adult population, to study the agreement between self-reports and clinical findings of prosthetic restorations, and to study answers from a questionnaire in relation to the prevalence of prosthetic restorations.

Material and methods: A questionnaire was sent to a sample of 10,000 adults. A further sample of 1000 individuals was invited to answer the questionnaire and also participate in a clinical study. The agreement between self-report and clinical findings was analyzed, as were the associations between prosthetic restorations and questionnaire responses, using the chi^2 test.

Results: A total of 40% of the sample had fixed dental prostheses (FDP), 2.7% had removable dentures. The agreement between self-report and clinical findings was 93%. 34.7% of the individuals with no prosthetic restorations were university graduates and 4% of individuals with removable complete dentures. Oral health had the greatest impact on the quality of life of younger individuals with FDP, with an OHIP-14 (Oral Health Impact Profile) score of 7.3 for the age group 20–39 years compared to 4.9 for the age group 65–89 years. **Conclusion:** The questionnaire method can be a cost-effective way to determine the prevalence of prosthetic restorations.

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Self-assessment; quality of life; agreement; fixed partial dentures; removable dentures

Introduction

In both Sweden and the rest of Europe, edentulism rates are in decline, but great differences are found between each country [1]. Decreasing rates of edentulism is a contributing factor to the increase in the number of fixed dental prostheses (FDP), i.e. the number of dental crowns, bridges and implants found in the population. In Sweden, FDPs are made on a large scale compared to other European countries. One reason may be the beneficial national dental funding system in Sweden, which creates opportunities for citizens to have the economic resources for more extensive oral rehabilitation, including FDP. Depending on study design and inclusion criteria, 29–51% of the Swedish population has reported having an FDP [2–5]. Earlier studies on the prevalence of prosthetic restorations have been performed on specific age groups in different regions of Sweden, however, studies of adults of all ages are lacking [4,6,7].

The agreement between self-reported clinical findings and the dentists' reports has been studied concerning number of remaining teeth, periodontitis, dental caries, tooth loss, and removable dentures [7–11]. The level of agreement has been found to be good both concerning the number of remaining teeth and the presence of removable dentures [7,8,10,12]. However, studies regarding the agreement for the presence of FDPs are lacking. Given that FDPs are common and costly treatments indicating a population's oral status and willingness to spend money on their oral status, further studies on the degree of agreement between patient and dentist in this area can be of great value. The results of studies on agreement may be included in epidemiological studies performed with questionnaires or interviews.

The result of treatments with prosthetic restorations has mostly been analyzed concerning the technical and clinical measures of efficacy. However, the results of various treatments can be analyzed using different measures of efficacy [13]. The patient aspects—for example, patient satisfaction, perception of function, oral health-related quality of life (OHRQoL) and willingness to pay for treatment—have been studied to a lesser extent, and the Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU) identified a gap in the knowledge concerning patient aspects as measurements of treatment efficacy [14]. Studies on patient satisfaction have been performed since the report from SBU, but these have been mostly on implant-supported restorations and removable dentures [15].

The first aim of the study was to describe the prevalence of fixed and removable dental prostheses in the adult population of a county in the southern part of Sweden. The second aim was to study the agreement concerning the prevalence of self-reported findings and the clinical findings of prosthetic dental restorations. In addition the third aim was to study if there were any differences between

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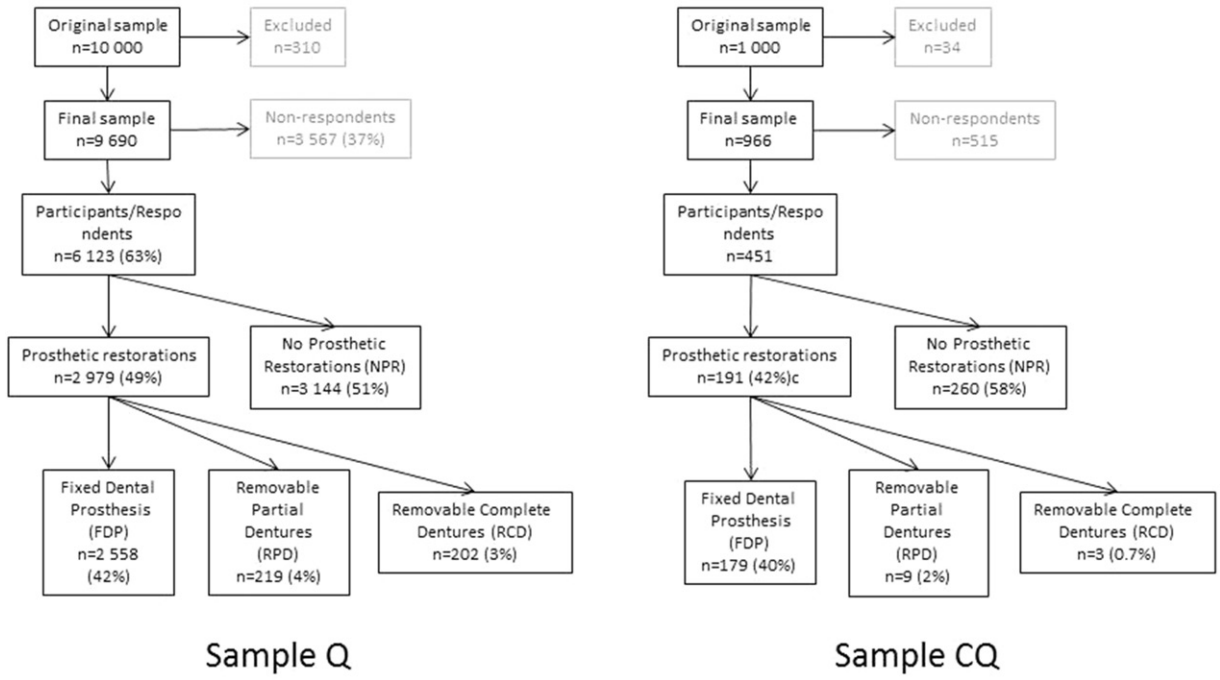

Figure 1. Flow charts of sample Q (Questionnaire) and sample CQ (Clinical examination and Questionnarie).

individuals without prosthetic restorations (NPR), with FDP, and with removable dentures concerning perceptions of oral health, need for dental treatment, willingness to pay for dental treatment, oral health-related quality of life and certain socioeconomic factors.

Materials and methods

The study population consisted of two randomly selected samples, the Questionnaire group (Q) and the Clinical and Questionnaire group (CQ). Both samples included individuals aged 20–89 years who were registered as residents of the county of Skåne Sweden and were obtained from the government's Swedish Population Register (SPAR).

Sample Q (Questionnaire group)

In 2006, a total of 10,000 individuals were invited to answer a questionnaire via mail in a study on oral health. Of this sample, 121 individuals had moved from the region, 166 had an unknown address and 23 were deceased, thus leaving a total of 9690 remaining individuals (Figure 1). The questionnaire was answered by 6123 individuals (63%), of which 57% were women and 43% were men.

The questionnaire consisted of 58 questions, including OHIP-14, (Oral Health Impact Profile) in Swedish [16]. A more-detailed description of the questionnaire was published earlier [17]. The questions used in the analyses of this study were dichotomized and are accounted for in Table 1.

Based on the individuals' answers to the question, What dental restorations do you have in your mouth?, four groups of individuals were created from the answer alternatives: dental crown, dental bridge, dental implant, removable partial prosthesis, removable complete prosthesis, and none of the above. The groups are: those with no prosthetic restoration (NPR), those with fixed dental prosthesis (FDP), those with removable partial dentures (RPD), and those with removable complete dentures (RCD). The individuals were then divided into three age groups: 20–39, 40–64, and 65–89 years.

Sample CQ

In 2007, another sample containing 1000 individuals was invited via telephone to answer the same questionnaire as sample Q and also participate in a clinical study. Eleven individuals had moved from the region, 14 had an unknown address, and nine were deceased, thus leaving 966 remaining individuals. A total of 451 (47%) individuals participated, of which 232 (51%) were women and 219 (49%) were men (Figure 1). All the individuals were informed about the method and purpose of the study and signed a consent form.

The examination included four digital bitewings and panoramic radiographs. Five intraoral clinical photographs were taken. The clinical examination included intraoral registration by dental mirror and probe. The examinations were performed by eight dentists, of which four performed 90% of the examinations. They were coordinated through comprehensive written instructions, practice and discussion of clinical cases. A more extensive description of the examination has been published elsewhere [18].

The number of functioning teeth (natural teeth that can be used for chewing) was calculated, excluding the third molar. The numbers of dental crown restorations, FPD, RPD, RCD, implant-supported reconstructions and type of post and core were registered as well asthe materials used for the

Table 1. The different restoration groups' (No prosthetic restorations [NPR], Fixed dental prosthesis [FDP], Removable partial dentures [RPD], Removable complete dentures [RCD]) answers to the questionnaire (%). Differences between the restorations groups were significant with a *p*-value of <0.000.

Question	Answer	NPR	FDP	RPD	RCD	Total
Are you satisfied with your teeth in general?	Satisfied	71	60	35	46	65
	Not satisfied	29	40	65	54	35
Are you satisfied with the appearance of your teeth?	Satisfied	66	59	40	51	62
	Not satisfied	34	41	60	49	38
How do you rate your oral health today compared to those in your age group?	Better	41	38	19	13	38
	Worse	59	62	81	87	62
How do you rate your general health today compared to those in your age group?	Better	88	88	76	66	87
	Worse	12	12	24	34	13
How do you rate your need for dental treatment today?	High	24	35	54	41	30
	Low	76	65	46	59	70
Can you chew hard foods like crisp bread or apples?	Yes, without difficulty	88	73	31	27	78
	No, finding it difficult	12	27	69	73	22
How much money do you think is the most you can spend on dental treatment/year?	Less than 50€	16	6	14	25	12
	Between 50–299€	70	68	72	60	69
	More than 300€	14	26	14	15	19
What are your tobacco smoking habits?	Smoke daily	14	15	24	27	15
	Do not smoke daily	86	85	76	73	85

NPR $n = 3144$, FDP $n = 2558$, RPD $n = 219$, and RCD $n = 202$.

Table 2. Table presenting the accordance (93%) between the clinical findings and the individuals' self-report on prosthetic restorations based on the answer to the question 'What restoration do you have in the mouth?' in the questionnaire: No prosthetic restorations (NPR), Fixed dental prosthesis (FDP), Removable partial dentures (RPD), Removable complete dentures (RCD) in sample QC.

		Clinical findings			
		NPR	FDP	RPD	CRD
Questionnaire	NPR	226	9	0	0
		52.0%	2.1%	0.0%	0.0%
	FDP	17	172	0	0
		3.9%	39.5%	0.0%	0.0%
	RPD	1	0	3	0
		0.2%	0.0%	0.7%	0.0%
	CRD	2	0	0	5
		0.5%	0.0%	0.0%	1.1%

The light grey fields show the percentage of individuals with agreement between clinical findings and self-report in the whole sample ($n = 435$).

crowns (gold, gold with acrylic veneers, metal ceramic, or full ceramic).

The individuals were divided into the same four prosthetic restoration groups as sample Q (NPR, FDP, RPD, and RCD). If an individual had a complete denture in one jaw and crowns in the other, he or she was placed in the RCD group. Individuals with bridges in one jaw and partial dentures in the other were placed in the RPD group (i.e. the removable replacement determined the group). The individuals were divided into the same three age groups as sample Q: 20–39, 40–64, and 65–89 years.

After 15 missing answers to the question What dental restorations do you have in your mouth?, were taken into account 435 individuals remained. The clinical findings of prosthetic restorations were compared with the individuals own report on prevalence of prosthetic restorations, and the percentage of accordance was calculated (Table 2). In addition, a Fleiss kappa value was calculated.

Chi-square tests were performed on the four prosthetic restoration groups against questions from the questionnaire concerning general satisfaction with teeth, satisfaction with teeth's appearance, rating of one's oral health, rating of one's general health, dental treatment need, ability to chew hard foods, money to spend on dental care, smoking habits, and the socio-economic background factors of age, sex and education. A *p*-value <0.05 was considered significant. All results presented in this paper are significant with a *p*-value of <0.000 unless otherwise reported in the text.

For the non-response analysis of sample *Q*, a logistic regression analysis using response/non-response as the dependent variable was performed. The analysis showed that both independent variables, i.e. age and gender, were significant. The likelihood of a non-response was higher for men (OR =1.65) and the likelihood for response increased with age (OR =1.15). A more detailed description of the respondents and the non-respondents has been published elsewhere [17].

A logistic regression analysis of sample CQ showed significant differences ($p = 0.002$) in participation in the clinical study due to age. Individuals between the ages 80–89 were less likely to participate (OR =2.82). No significant differences between sexes were found. A more detailed description of the respondents and the non-respondents has been published earlier [18].

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS version 18). The study was approved by the Ethical Board at the University of Lund, Sweden, number 513/2006.

Results

Prevalence of prosthetic restorations

Of the 451 clinically examined individuals in sample CQ, 260 (58%) were without prosthetic restorations and 191 (42%) had prosthetic restorations. The number of individuals with FDP was 179, which is 40% of the sample. A total of nine had RPD, which amounts to 2% of the sample. There were three with RCD, which is 0.7% of the sample (Figure 1). The mean number of functioning teeth was 27 for the group without prosthetic restorations and 24 for the FDP group. In the RPD group, the mean number of functioning teeth was nine. No significant difference was found between men and women concerning the frequency of prosthetic restorations.

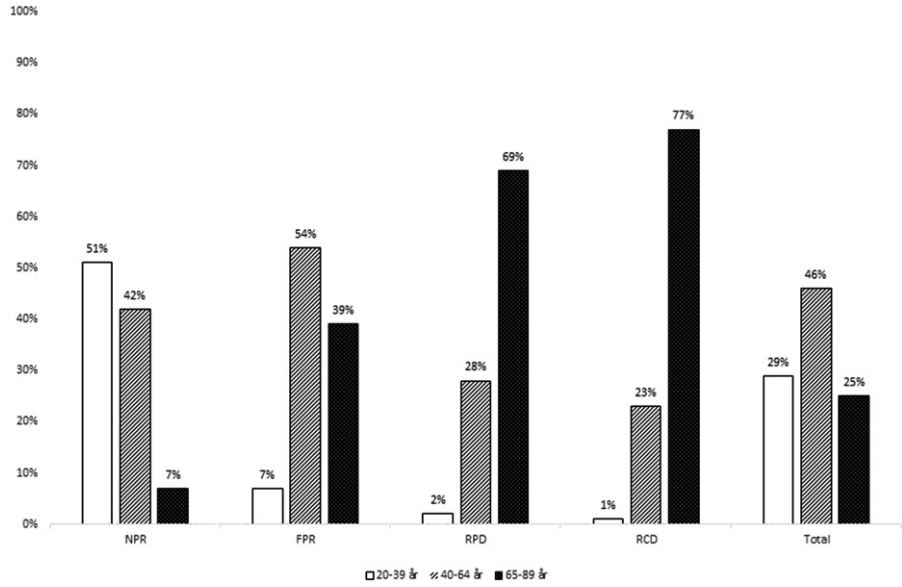

Figure 2. Sample Q. The distribution of study participants over three age groups (20–39, 40–64 and 65–89-year-olds) within each restoration group [no prosthetic restorations (NPR), fixed prosthetic restorations (FPR), removable partial dentures(RPD), removable complete dentures (RCD)], and for the total group of participants.

Table 3. Presenting the mean, standard deviation and range of OHIP-14 for each restoration group: No prosthetic restorations (NPR), Fixed dental prosthesis (FDP), Removable partial dentures (RPD), Removable complete dentures (RCD) and the OHIP-14 score in three age groups (20–39 years, 40–64 years, and 65–89 years).

	NPR	FDP	RPD	RCD
Mean	4.7	5.9	11.1	13.0
Std. deviation	7.0	7.6	10.8	12.4
Range	0–56	0–56	0–49	0–56
Age group				
20–39	4.7	7.3	10.3	56.0 ($n = 1$)
40–64	4.7	6.3	16.2	20.2
65–89	4.6	4.9	8.7	9.7

The material used for dental crowns was mainly metal ceramic (76%), and the remaining 24% was evenly distributed with gold, gold with acrylic veneers, and full ceramic. For the bridges, a metal ceramic framework represented 82% and full gold 17%. There were no ceramic bridges in the sample and only two bridges in gold with acrylic veneers. Of the 6123 individuals in sample Q, a total of 3144 (51%) reported that they did not have any prosthetic restorations and 2979 (49%) had prosthetic restorations. The number of individuals with FDP was 2558 (42%), RPD 219 (4%) and RCD 202 (3%) (Figure 1). Differences were found between the age groups (Figure 2). A total of 39% of the individuals answered that they had all their teeth left, and 2.3% reported that they were edentulous. No significant differences were found between women and men regarding the self-reported presence of prosthetic restorations.

Agreement between clinical findings and self-report

When comparing the clinical findings in sample CQ with the individuals' self-report on prosthetic restorations based on the answer to the question, What restoration do you have in your mouth?, we found 93% agreement. When excluding RPD and RCD, the agreement was 94% (Table 2). The Fleiss kappa value was 0.87 showing a very good strength of agreement.

Prosthetic restorations and associations with questionnaire findings and socioeconomic factors

To address the third aim of this study concerning the differences between the four restoration groups, analyses were conducted on sample Q. This was due to the high agreement between the studied individuals' self-report and the examiners' report in sample CQ in combination with the larger sample size in sample Q. The results of the analyses on the associations between questions selected from the questionnaire and the prosthetic groups are presented in Table 1.

General dissatisfaction with one's teeth was highest in the RPD group and lowest in the NPR group. The highest dissatisfaction with appearance was also found in the RPD group. Of the RCD group, one third thought they were inferior to their peers concerning self-perceived general health, the highest level of the four groups. The lowest self-perceived general health was found in the RCD group of individuals (40–64 years), where 50% perceived worse general health when comparing themselves to their age peers. Individuals between 65–69 years with FDP were those most likely to perceive their general health to be superior when comparing themselves to their age peers.

The highest percentage of individuals who perceived a high need for dental treatment was found in the RPD group. Individuals in the 40–64 age group with RPD were the group with the largest share of individuals who perceived a high need for dental treatment (64.3%).

Difficulties chewing hard foods were almost seven times more common in the RPD and RCD groups than in the NPR group. Age was clearly related to the perception of chewing difficulties. Individuals in the NPR group showed the largest

differences between the age groups, where chewing difficulty was reported by 8.4% of the 20–39 years group, 14.6% of the 40–64 years group, and 32.3% of the 65–89 years group.

The results show a correlation between educational level (compulsory, upper-secondary school, or university) and prosthetic restorations. The highest percentage of university graduates is found in the NPR group at 34.7% and a lower percentage of 26.2% in the FDP group as well as 10.5% in the RPD group and 4.0% in the RCD group.

The NPR group had the lowest OHIP-14 score and the RCD group had the highest. The same ratio between the four groups was found within the different dimensions of OHIP-14 (functional limitation, physical pain, psychological discomfort, psychological discomfort, physical disability, social disability, psychological disability, and handicap). Oral health had a larger impact on the quality of life of younger individuals with prosthetic restorations (Table 3).

Discussion

Prosthetic restorations were common in the adult population of Skåne, while removable restorations were uncommon. A high level of agreement was found between the self-reported findings and the clinical findings regarding prosthetic restorations, both concerning fixed and removable restorations. The individuals with removable restorations were less satisfied with their appearance and health, perceived a higher dental treatment need, had a lower willingness to pay for dental treatment, and perceived a worse oral-health-related quality of life than those with fixed restorations.

The response rate in sample Q corresponds with other published surveys from the past decade. Today, a certain percentage of non-responders (around 30–35%) must be accepted for questionnaire studies in Scandinavia. A non-response analysis was performed on sample *Q* in an earlier publication. The findings of that analysis show a lower response rate for men, and that the likelihood for response increased with age [17]. Given that the prevalence of prosthetic restorations is low in the younger age groups, the low response rate most likely did not have an impact on the results for the total population.

A weakness of the present study is the low response rate in sample CQ. Low participation rates are expected in clinical studies using randomized samples because a clinical study demands more of the individual in terms of effort and time than questionnaire studies. A non-response analysis was also performed on sample CQ in an earlier publication. When the participants in sample CQ were compared with the entire adult population of the region, the representativeness was good concerning ethnicity and educational level. However, the lack of older individuals (80–89 years) among the participants may have affected the results [19]. There is a risk of under registration of prosthetic restorations in the CQ sample due to the lower representation of individuals in the oldest age group.

The prevalence of removable dentures was low in both samples and almost identical to the results from the same period in a longitudinal study carried out in a different region in Sweden [4]. Together, these findings validate the large decline in Sweden of persons with removable dentures. The highest proportion of adults with FDPs was found in the 40–64 years age group. This has also been shown in other studies, where fixed restorations were more frequent than removable dentures among subjects in this age group [2]. When comparing, for example, Finland and Sweden, some researchers found that the increased prevalence of FDPs depends on the Swedish National dental funding system [20]. In a review study, Zitzmann et al. found that if an individual is missing only few teeth, then these are more likely to have been replaced with FDP or have no replacements, while the likelihood of removable dentures increases with the number of missing teeth [5]. An average adult in Sweden has lost very few teeth, even in old age. The high number of remaining teeth in combination with the dental funding system in Sweden can thus explain the high prevalence of FDP and low prevalence of removable dentures in our study. A higher prevalence of removable dentures was found in the group of individuals with the lowest level of education. The same finding was made in the review by Zitzmann et al. [5]. The number of remaining teeth and removable dentures can also be related to educational level [18,21]. Although the Swedish National dental funding system has made it possible for many individuals to afford dental care and FDP, differences concerning received treatment and oral health due to socioeconomic factors still remain.

Descriptions of the prevalence of the materials used for FDPs are scarce. Therefore, comparisons with other studies are difficult. However, most FDPs in this study were metal-supported ceramic constructions, with no information about the metal material. This result reflects dentists in Sweden's preferred choice of construction for many years. Today, full ceramic constructions are gaining ground, and if the study were performed today, then the figures would probably look different, with full ceramic reconstructions representing a larger part of the sample.

The agreement between clinical finings and self-reports on prosthetic restoration is high. Thus, when an individual answered that they had one or more single crowns, the examiner most likely registered that the individual had at least one single crown. The agreement between clinical findings and the individuals' self-report was equally high when the calculations were performed with or without the groups with removable dentures. Interestingly, the agreement for removable dentures was slightly lower than the agreement for fixed restorations. Three individuals reported that they had removable dentures although the clinical examination reported none. It is possible that the patients did indeed have removable dentures, as reported in the questionnaire, but had not brought them to the examination or told the examining dentist about them. If this was the case, the agreement would be better and the result more in line with expectations. The agreement was most likely influenced by the low number of individuals with removable dentures.

With so few individuals in these groups, the results may be uncertain. Other studies on FDP are few, but the self-reporting on removable dentures has been well studied and validated [7,8,12]. Pitiphat et al. found accurate self-reports on the presence of fixed prostheses to the level of distinguishing the number of crowns, abutments, and pontics. They concluded that self-reports provide reasonably valid estimates for the number of remaining teeth, fillings, root canal therapy, and fixed and removable prosthetic restorations [10]. Our very high agreement concerning fixed restorations may be the result of the non-specific question. The participants were only asked to report if they had any restorations and were not asked to specify how many or the location of these restorations. Due to the high agreement between clinical findings and self-report, with this article we can, further validate the self-reporting of prosthetic restorations. Self-reporting can save time and costs in studies on the prevalence of dental restorations.

Individuals with no prosthetic restorations were those who were most satisfied with their teeth in general and with the appearance of their teeth. Also to a higher degree, they rated their oral health as better than others in their age group and were more satisfied with their chewing ability. This was true in comparison to all of the restorations groups. These individuals had the most remaining teeth and the least experience of oral diseases, which was likely to have influenced their degree of satisfaction. This group was also the most educated group, and other studies have shown the association between education and oral health [22,23]. The second most satisfied group was the group with fixed restorations. This was a group with good oral status and also the group that were most likely to have spent the most money on their oral health. The questionnaire also showed that this was the group most willing to pay larger sums of money for oral care. This shows that the group with fixed restorations found oral health to be important enough to prioritize. This was a group with a relatively high educational level, which may reflect a higher income, which in turn means the ability to pay for more advanced and costly treatments.

Many studies have been conducted on implant-supported prosthetic restorations and oral health-related quality of life (OHRQoL), and the correlation between an improved OHRQoL and dental implants is well documented [24,25]. There have also been studies that have found an improved OHRQoL after receiving RPD [26]. Most studies on OHRQoL and prosthetic restorations are studies performed during and directly after the prosthetic treatment. John et al. found that individuals who received a removable denture prosthesis up to at least one year after receiving their treatment perceived poorer OHRQoL than those who received fixed restorations [27].

However, this study describes a cross-sectional view, and the individuals who answered the OHIP-14 did not perceive a direct association between these questions and the prosthetic treatments. As the OHIP-14 was put in a general oral perspective, one can get a wider description of the OHRQoL of individuals with different types of prosthetic restorations. The individuals with removable dentures were those with the highest score on OHIP-14. This group consisted of older individuals and individuals who had experienced tooth loss. Therefore, the higher score could be not only the result of dissatisfaction with the function or esthetics of their removable dentures but also a sign of problems due to other oral conditions related to the tooth loss, which then led to the choice of removable dentures. Socioeconomic factors can be associated to tooth loss and removable dentures and associations have been found between these factors and the OHIP score [28,29].

The younger individuals with prosthetic restorations had the highest score on OHIP-14. It was thus the group with the highest oral impact on their quality of life. This finding is not surprising, as these restorations are rare in young individuals in Sweden and the expectation of a healthy unrestored mouth, such as the mouths of one's peers, could not be retained by the individuals who had received prosthetic restorations.

To conclude, the questionnaire method can be a cost-effective way to conduct large surveys on the prevalence of both fixed and removable prosthetic restorations in an adult population due to the high agreement between self-reports and clinical findings. For clinicians who want scientific support when discussing the benefits of prosthetic treatments with their patients, this study has contributed to research on the positive correlation between prosthetic therapy and satisfaction with oral health, chewing ability and quality of life.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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