Oral Health–Related Quality of Life After Gastric Bypass Surgery

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Abstract

Objective The aim was to examine how individuals treated for obesity with gastric bypass (GBP) surgery perceived their oral health and oral health–related quality of life (OHRQoL).

Method All individuals in one Swedish region who had undergone GBP surgery ($n = 1182$) were sent a postal questionnaire 2 years after surgery. The questionnaire comprised items on sociodemographics, oral symptoms and the Oral Health Impact Profile-49 to assess the OHRQoL.

Results The mean age was 47.6 years with 75% females, response rate 55.3%. The self-perceived oral health was rated low by 45% of the respondents. Gender differences were seen, for instance, regarding hypersensitive teeth (men 18.8%, women 30.8%, $p = 0.003$). Nine out of ten reported at least one oral impact experienced sometimes, fairly or very often, according to the Oral Health Impact Profile-49 (OHIP-49). The mean additive OHIP-49 score was 30.3 (SD 36.1). The associations between self-reported oral health and OHRQoL were consistent throughout. Tooth hypersensitivity generated an OR of 2.28 (95% CI 2.28–8.46) of having ≥ 2 impacts on OHRQoL.

Conclusion A large proportion of individuals having undergone GBP surgery reported problems with their oral health and impacts on their OHRQoL, indicating a need for medical and dental staff—surgeons and general practitioners as well as other health professionals—to offer oral health promotion and prevention measures.

Keywords Bariatric surgery · Oral health · Quality of life

Introduction

The prevalence of obesity is rising steadily and in 2016, 30% of the world's adult population were overweight (Body Mass Index (BMI) ≥ 25 kg/m²) and 13% were obese (BMI ≥ 30 kg/m²) [1]. In Sweden, the corresponding proportions at the time were 36% and 15%, respectively [2].

Obesity causes several health problems in those affected, with higher morbidity and mortality rates than in the general population [3, 4]. Quality of life is often reduced in obese individuals with poor physical and mental health, as well as social disabilities due to their weight [5]. In the oral cavity, obesity has also shown associations to periodontal disease and tooth loss [6–8].

Surgical treatment of morbid obesity is an effective method [9, 10] leading to long-term significant weight loss as well as reduced comorbidity and mortality rates [11]. However, bariatric surgery may be associated with both short- and long-term complications [10, 12]. In Sweden, laparoscopic gastric bypass (GBP) [10] surgery has hitherto been the procedure most commonly used [13] with the overall complication frequency around 8% in 2016 while long-term complications were estimated to be present in about 7% [13].

Oral complications arising from bariatric surgery are still sparsely studied. Published studies are often based on a mixed study population including outdated surgical procedures which make it difficult to apply the results to today's patients. However, some findings from studies with short

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follow-up periods after GBP surgery indicate an increased risk of tooth hypersensitivity, deeper periodontal pockets, and dental caries [14–17], although contradictory findings have also been reported [18, 19]. Likewise, a recent systematic review by Salgado-Pervalo et al. found inconclusive results with regard to bariatric surgery as a risk factor for caries development [20]. Cardozo et al. reported increased salivary flow rate with less dry mouth sensation after GBP surgery, which was discussed as an effect of reduced medication [19].

Improvements in the general health-related quality of life have been found after bariatric surgery [21]. These improvements followed shortly after surgery, correlated to initial weight loss and remained high in the long term. However, patients treated with bariatric surgery show poorer quality of life than the general population over time [21]. Little is known about the impact on the oral health-related quality of life (OHRQoL) [14]. Potential problems may include physical, psychological as well as social aspects, such as pain, speech difficulties, embarrassment due to ill-fitting dental prostheses, or feelings of shame about the appearance of one's teeth [22]. There is a need to include the patient perspective and assess the oral effects and the OHRQoL in individuals after bariatric surgery. The aim of this study was therefore to examine how individuals treated with GBP surgery perceived their oral health and OHRQoL.

Material and Methods

Study Sample

The sample comprised all individuals who had undergone GBP surgery in the Region of Västra Götaland, Sweden, during 2011 ($n = 1215$). One-sixth of the Swedish population resides in the region, which includes both rural and urban areas. The study was approved by the Research Ethics Committee of Gothenburg University (reg. no. 057-14). Based on the approval, the Scandinavian Surgery Obesity Registry (SOREg), a national quality registry for bariatric surgery in Sweden, provided contact information for the individuals in the sample [13]. The advisory board of the SOReg assessed the study independently in accordance with their standard procedures. All participants signed an informed consent form.

Data Collection

A postal questionnaire was distributed in September 2014, just over 2 years after surgical treatment to allow for enough time to have elapsed for stabilization of weight loss, dietary habits and general short-term complications. Non-respondents were

sent a reminder after 2 weeks. Questionnaires without consent were discarded ($n = 8$) (Fig. 1).

Variables and Instruments

The questionnaire comprised questions regarding demographic and socioeconomic characteristics, together with health-related variables. The demographic variables were gender and age (21–39 years/40–59 years/ ≥ 60 years). Socioeconomics was represented by educational level ($>$ compulsory school vs. compulsory school or less ≤ 9 years) and marital status (cohabiting vs. not cohabiting).

The participants reported their current self-perceived oral health (very good/good vs. rather bad/bad/very bad), self-assessed number of teeth (≥ 20 remaining teeth vs. < 20 remaining teeth/edentulous) and chewing ability (without difficulty vs. difficult/unable). Oral health habits were mirrored by the frequency of dental appointments during the last 5 years (regularly/at least once a year/3–4 appointments vs. 1–2 appointments/never), and the reason for the participant's last dental visit (routine examination vs. pain/other problem). The participants were also asked about perceived oral health problems before the surgical intervention (sometimes/seldom/never vs. very often/fairly often). Perceived oral symptoms included tooth hypersensitivity, acid reflux episodes and vomiting episodes (never/a few times a year vs. a few times a month/a few times a week/daily).

OHRQoL was assessed using the Swedish version of the Oral Health Impact Profile-49 (OHIP-49) instrument [22, 23], containing forty-nine items in seven domains: functional limitation (9 items), physical discomfort (9 items), physical disability (9 items), psychosocial discomfort (5 items), psychosocial disability (6 items), social disability (5 items), and handicap (6 items). Each item begins with the phrase 'Over the past year, how often have you experienced (...) because of

Fig. 1 Flow chart. Inclusion of participants

problems with your teeth, mouth, dentures or jaws?”. The response options were ‘never’ (0), ‘hardly ever’ (1), ‘occasionally’ (2), ‘fairly often’ (3) and ‘very often’ (4).

Calculation of the derived OHIP scores was made in two ways [24]. The first method was the additive method (OHIP-ADD), where scores for all items were summed up, giving a possible range from 0 to 196 (4×49). The simple count method (OHIP-SC) was the second method, where items answered with ‘very often’, ‘fairly often’ and ‘occasionally’ were given the value 1, and the answers ‘hardly ever’ and ‘never’ were given the value 0. The scores were summed up, giving a possible range of 0–49. For both methods, higher scores correspond to a greater impact on OHRQoL.

Statistical Analysis

Management of data and analyses were carried out in the SPSS (Statistical Package for Social Sciences) version 22.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used for demographic data, including mean values, standard deviations and ranges. Forms with ≥ 7 missing answers in the OHIP items were excluded from the data analysis of the OHIP ($n = 9$). In forms with missing information in 1–7 OHIP items, imputation was performed using the case mean substitution technique [25]. Differences in the proportions and distribution of scores were examined using the chi-square test and the Mann-Whitney U test. Correlations between the subscales in the OHIP were assessed using Spearman’s rank correlation. Cronbach’s alpha was used to test the internal consistency of all scales.

The associations between oral health variables and the OHIP, including the impact of possible confounders, were explored with bivariate and multivariate logistic regression analyses. For the analyses, the OHIP-SC was dichotomized into ‘having at least two impacts’ vs. ‘one or no impact’. The OHIP-ADD was dichotomized at the median value ($\geq$ median vs. $<$ median).

Results

Of the 1215 subjects according to the SOReg, 14 were deceased, 12 had emigrated and two had protected identities precluding contact. Five questionnaires were returned to sender for unknown recipient reasons. A total of 1182 postal questionnaires were sent out. After control for written consent, 653 (55.3%) forms remained for the analyses.

The sociodemographic characteristics of the participants are presented by gender in Table 1.

The mean age of the participants was 47.6 years (SD 12.0), that is, slightly higher than in the total sample of 1182 GBP patients (44.3 years, SD 11.8). The gender distribution in the total sample and among participants was similar with the majority being women (75%). Most participants were cohabiting

(65%) and had an education above compulsory school level (80.3%). No statistically significant gender differences were found in the sociodemographics.

Table 2 shows gender-specific characteristics in self-reported oral health, oral health status, symptoms and habits as stated by the participants 2 years after GBP surgery. About one of ten participants reported that they had had oral health problems ‘often’ or ‘very often’ prior to GBP surgery. Their current self-perceived oral health was rated as less good, with about 45% reporting very bad, bad or average oral health.

A greater proportion of men reported a larger number of missing teeth ($p = 0.020$) and infrequent visits to the dentist ($p \leq 0.001$), compared with women. One-fourth reported chewing problems (NS between genders). A sub-analysis revealed that having less than 20 teeth was significantly related to chewing problems (not in tables): 60% of those with < 20 teeth but only 18% of those with ≥ 20 teeth ($p < 0.001$). The most frequent problem was tooth hypersensitivity, with women (30.8%) reporting more problems than men (18.8%, $p = 0.003$). The participants had moderate problems with acid reflux (16.1%) and minor problems with vomiting episodes (8.9%) (NS between genders).

The OHIP-49 (add and single count) scales along with scales for the different dimensions/subscales and internal consistencies are presented in Table 3.

Almost 4 out of 5 participants (78.9%) reported at least one oral impact occasionally, fairly often or very often, with no difference between genders. Only 54 individuals (8.4%) reported no impact at all (not in table). The mean OHIP-ADD was 30.3 (SD 36.1); however, for the 1/5 of individuals reporting the most impact (not in table), the mean score was 91.4 (SD 32.3) to be related to the possible max score of 196. The mean OHIP-SC49 was 15.6 (SD 14.6) (max score 49).

The OHIP dimensions with the highest reported impact were functional limitation and physical pain ($\geq 80\%$), while more than half of the participants reported impacts in the dimensions of physiological discomfort and physical disability. In the subscale ‘physical pain’, women scored significantly higher than men (any impact, 86.3% vs. 78.7%, $p = 0.021$). However, men reported significantly more social disability than women (any impact, 43.1% vs. 32.3%, $p = 0.043$). There were no significant differences between the three age groups in the subscale scores. All scales and subscales displayed high internal consistency, with all Cronbach’s alpha values > 0.8 (Table 3).

Table 4 presents the matrix of correlations between the OHIP subscales, with all $r > 0.5$.

The highest correlations were seen between social disability and psychological disability and between psychological disability and physical disability. The social disability dimension generated the weakest correlations to functional limitation and physical pain.

Table 1 Characteristics of the study population, individuals having undergone GBP surgery $\geq$ 2 years ago, by gender

		Men <i>n</i> = 161 (24.7%)	Women <i>n</i> = 492 (75.3%)	<i>p</i> value
Age	Years	49.1 (12.9)	47.2 (11.8)	0.230
Age strata	21–39 years	37 (23.4)	128 (26.3)	0.070
	40–59 years	81 (51.3)	273 (56.2)	0.812
	$\geq$ 60 years	40 (25.3)	85 (17.5)	0.432
Marital status	Married/cohabitant	98 (61.2)	339 (68.9)	0.074
	Unmarried/not cohabitant	62 (38.2)	153 (31.1)	
Education	$\geq$ Compulsory school	124 (77.5)	404 (83.1)	0.110
	Compulsory school	36 (22.5)	82 (16.9)	

Age mean (SD), numbers and percentages. Missing cases 0.2–1.4%

The single-item variables were used as independent variables in bivariate and multivariate logistic regression analyses with the OHIP-SC dichotomized into ‘ $\geq$ 2 or more impacts’ vs. ‘less’ and the OHIP-ADD dichotomized at the median value as dependent variables (Table 5). In the multivariate analyses, adjustments were made for age, gender and socioeconomics (educational level and marital status). An overall pattern with positive associations was revealed, with the strongest associations between chewing ability and the OHIP-SC (adjusted OR 7.93, 95% CI 3.39–18.6) as well as the OHIP-ADD (adjusted OR 16.3, 95% CI 9.06–29.2). Current self-perceived oral health and the reason for the most recent dental visit were also strongly associated with both the OHIP-SC and the OHIP-ADD. The only non-significant associations in both crude and adjusted analyses were between dental visit habits and the OHIP-SC. Also, the association between reported problems before GBP surgery and the OHIP-SC was

attenuated by the adjustments applied (age, gender and socioeconomics).

When all the independent variables in the bivariate analyses, together with the possible confounders of age, gender and socioeconomics, were included in a multivariate model, only three explanatory variables were identified as statistically significant for the probability of having impacts as measured with the OHIP-SC. These were self-perceived oral health (OR 3.52, 95% CI 1.87–6.66), reason for dental visit (OR 2.26, 95% CI 1.08–4.70) and tooth hypersensitivity (OR 2.43, 95% CI 1.18–5.04). In the corresponding analyses, using the OHIP-ADD as the outcome, four statistically significant explanatory variables were identified: self-perceived oral health (OR 3.44, 95% CI 2.16–5.48), reason for dental visit (OR 2.70, 95% CI 1.60–4.55), tooth hypersensitivity (OR 3.38, 95% CI 1.98–5.76) and chewing ability (OR 5.77, 95% CI 2.72–12.22) (not in tables).

Table 2 Self-reported oral health, oral health habits and symptoms stated in questionnaires by participants having undergone GBP surgery $\geq$ 2 years ago. *p* values denoting gender differences

Variable	Rating	Men <i>n</i> (%)	Women <i>n</i> (%)	<i>p</i> value
Self-perceived oral health				
Stated oral health problems prior to surgery	Often/very often	15 (9.4)	41 (8.4)	0.709
Current self-perceived oral health	Average/bad/very bad	71 (44.7)	217 (44.5)	0.967
Oral health status				
Number of remaining teeth	$\leq$ 19 remaining teeth	37 (23.0)	73 (15.0)	0.020
Chewing ability	With caution/not at all	48 (29.8)	115 (23.5)	0.107
Oral symptoms				
Tooth hypersensitivity	A few times a month/a few times a week/daily	30 (18.8)	149 (30.8)	0.003
Acid reflux	A few times a month/a few times a week/daily	21 (13.2)	83 (17.0)	0.258
Vomiting	A few times a month/a few times a week/daily	12 (7.6)	45 (9.4)	0.501
Dental care habits				
Dental visits last 5 years	1–2 appointments/never	52 (32.7)	90 (18.6)	$\leq$ 0.001
Reason for last dental visit	Pain/other problems	53 (33.8)	155 (33.3)	0.922

Data are numbers and percentages

Missing cases 0.3–4.7%

Table 3 Oral Health Impact Profile (OHIP-49) and subscales. Numbers and percentages of participants having undergone GBP surgery ≥ 2 years ago and stating impacts. Internal reliability of scales/subscales measured with Cronbach's α

		Mean (SD)	Impact <i>n</i> (%)	Cronbach's α
OHIP-ADD 49		30.3 (36.1)	590 (91.6)*	0.981
OHIP-SC 49		15.6 (14.6)	514 (78.7)**	0.974
OHIP-49 subscales	Subscale (no of items)		Any impact* <i>n</i> (%)	
	Functional limitation (9)	6.8 (6.7)	557 (86.0)	0.860
	Physical pain (9)	7.4 (7.4)	534 (82.9)	0.912
	Psychological discomfort (9)	3.7 (5.3)	348 (53.9)	0.942
	Physical disability (5)	4.2 (6.4)	370 (57.5)	0.913
	Psychological disability (5)	3.6 (5.6)	300 (46.6)	0.945
	Social disability (5)	1.9 (3.6)	226 (35.0)	0.911
Handicap (6)		2.7 (5.0)	268 (41.5)	0.930

OHIP-ADD 49: number of individuals with any impact; OHIP-SC: number of individuals with impacts 'very often/fairly often/occasionally'

*Any impact 'very often/fairly often/occasionally/hardly ever'. Missing cases 0.8–1.4%

**Any impact 'very often/fairly often/occasionally'. Missing cases 1.4%

Discussion

The majority of the participants in the study having undergone GBP surgery reported problems with their oral health. The most frequent subjective problems were difficulty chewing and tooth hypersensitivity. The majority experienced impact on their oral health–related quality of life with many of them reporting physical pain.

A strength of the study was that the sample comprised all individuals who had undergone GBP surgery in a large region of Sweden during an entire year. The response rate was modest (55.3%), however, corresponding with recent similar studies [26]. The topic may have been perceived as sensitive [27]. For instance, feelings of guilt could be evoked if the person failed to adhere to post-op recommendations about diet. Possibly, those with a strong commitment or those with special health problems might also be more inclined to answer. On the other hand, people with no mouth problems may have refrained from responding because they considered the topic uninteresting. Another plausible reason for not responding could be survey response fatigue [28]. Ethical reasons precluded approaching non-responders; however, the age and gender distribution was similar in the drop-out group as in the total sample. The greater proportion of women in the

sample is consistent with previous studies, showing that more women than men undergo GBP surgery [29].

The study made use of well-validated questions and instruments [22, 23, 30]. The design with a self-reported form did entail a risk of memory bias and social desirability; that is, respondents might portray themselves in a more positive or more negative light [31]. The oral clinical implications of bariatric surgery were not examined in the study and need to be further investigated, preferably with a longitudinal design. The current adipose status, total weight loss and nutritional status would then be of interest [6, 32]. A qualitative approach might also generate more profound knowledge about how individuals perceive their oral health after bariatric surgery [33].

The number of teeth is often used as a proxy for dental health [34, 35] and having few teeth (< 20) was related to chewing problems, which could be expected [36]. Self-reported symptoms from the mouth were common in the study, with hypersensitivity of the teeth as the main reported symptom. This condition is often caused by dental erosion with lost enamel [37], which, in turn, can be caused by acid reflux and/or vomiting [38]. These two symptoms were, however, less frequent in the study, which could be expected, as both symptoms decrease or even disappear after the rearrangement of the gastrointestinal tract during GBP surgery [39].

Table 4 Spearman's correlations among the 7 dimensions of the Oral Health Impact Profile (OHIP-49)

	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability
Functional limitation	–					
Physical pain	0.797	–				
Psychological discomfort	0.782	0.780	–			
Physical disability	0.794	0.746	0.784	–		
Psychological disability	0.703	0.686	0.765	0.804	–	
Social disability	0.586	0.571	0.636	0.671	0.805	–
Handicap	0.692	0.661	0.752	0.725	0.799	0.772

Table 5 Discrimination ability of the Oral Health Impact Profile (OHIP-49) instrument between high- and low-scoring respondents in self-reported health measures

Independent variable	Rating	Total group <i>n</i> (%)	Having ≥ 2 impacts* according to OHIP-SC <i>n</i> (%)	OR	95% CI	Having an OHIP-ADD score above median value <i>n</i> (%)	OR	95% CI
Problems prior to GBP	Never/seldom/sometimes Often/very often	591 (91.3) 56 (8.7)	458 (78.6) 50 (90.9)	1 2.73 ^a 2.46 ^b	1 1.07–6.99 0.95–6.37	281 (48.2) 40 (72.7)	1 2.87 2.91	1 1.55–5.30 1.52–5.55
Self-perceived oral health	Very good/good Average/bad/very bad	359 (55.5) 288 (44.5)	243 (67.9) 265 (94.6)	1 8.36 ^a 7.76 ^b	1 4.75–14.72 4.38–13.74	100 (27.9) 220 (78.6)	1 9.46 8.98	1 6.55–13.66 6.15–13.12
Chewing ability	Without difficulties With caution/not at all	488 (75.0) 168 (25.0)	362 (74.6) 151 (96.2)	1 8.55 ^a 7.93 ^b	1 3.69–19.8 3.39–18.6	180 (37.1) 142 (90.4)	1 16.0 16.3	1 9.13–28.17 9.06–29.23
Tooth hypersensitivity	Never/a few times a year A few times a month/a few times a week/daily	464 (71.2) 179 (27.8)	344 (74.6) 162 (93.6)	1 5.01 ^a 4.39 ^b	1 2.63–9.55 2.28–8.46	180 (39) 137 (79.2)	1 5.94 5.63	1 3.94–8.97 3.67–8.64
Acid reflux	Never/a few times a year A few times a month/a few times a week/daily	543 (83.9) 104 (16.1)	417 (77.5) 92 (92.0)	1 3.34 ^a 3.01 ^b	1 1.58–7.07 1.41–6.42	251 (46.7) 70 (70.0)	1 2.67 2.38	1 1.68–4.23 1.49–3.82
Vomiting	Never/a few times a year A few times a month/a few times a week/daily	582 (91.1) 57 (8.9)	450 (78.4) 53 (94.6)	1 4.87 ^a 4.14 ^b	1 1.50–15.8 1.26–13.6	274 (47.7) 44 (78.6)	1 4.02 3.37	1 2.08–7.76 1.72–6.61
Number of own teeth	≥ 20 ≤ 20	537 (83.0) 110 (17.0)	412 (77.6) 99 (92.5)	1 3.57 ^a 3.59 ^b	1 1.69–7.56 1.65–7.82	236 (44.4) 85 (79.4)	1 4.83 5.66	1 2.93–7.96 3.25–9.84
Dental visit habits	Yes, regularly No	500 (77.9) 142 (22.1)	386 (78.1) 118 (84.3)	1 1.50 ^a 1.41 ^b	1 0.91–2.48 0.83–2.38	226 (45.7) 89 (63.6)	1 2.07 2.06	1 1.41–3.05 1.37–3.09
Reason for last dental visit	Check-up Pain/emergency	414 (66.6) 208 (33.4)	292 (71.4) 195 (94.7)	1 7.10 ^a 6.38 ^b	1 3.73–13.5 3.33–12.2	135 (33.0) 165 (80.0)	1 8.17 8.14	1 5.48–12.2 5.38–12.3

*Impact occasionally/fairly often/very often. ^a Crude association. ^b Association adjusted for age, gender, marital status, educational status

However, some individuals may still perceive problems and the findings are in line with those in an early paper by Heling et al. although their study included several bariatric surgical techniques [40]. A recent study showed that perhaps the treatment efficacy of GBP on reflux symptoms is overestimated, as many patients still require anti-reflux medication [41]. General causes for dental erosion can be excessive consumption of soft drinks with a low pH level [42]. This could possibly be part of an eating/drinking behaviour that was present prior to surgery [43]. Different eating disorders which make individuals gravitate towards high calorie/sugary foods are also known to be present in patients seeking bariatric surgery treatment [44].

As a whole, oral problems are likely to infer an impaired OHRQoL [23, 45]. A recent study could not verify associations between oral problems and OHRQoL in individuals having undergone bariatric surgery when inquiring a few items from the OHIP [46]. However, in our study using the full OHIP formula, most participants reported some impact on their OHRQoL. There was a positive skewedness with a large proportion reporting few impacts while a smaller group reported many impacts, similar to other studies [47, 48]. Sensitive individuals undergoing GBP surgery may develop more problems with their oral health and oral health-related quality of life. Also, all mean values in the seven subscales of OHIP were similar to the scores of subjects with malocclusion problems in a Swedish study that is statistically higher than in the general population [23]. Functional limitation and physical pain have often been the most frequently reported oral impacts in both patients and in the general population, akin to our findings [22, 23]. It is noteworthy that these dimensions generated the lowest correlation coefficients in relation to social disability, indicating that despite perceived problems, the impact on the individual's social life might be a minor issue. Still, all interrelationships between the different dimensions were strong, which also validated the high internal reliability of the full OHIP scales.

The OHIP-ADD showed stronger associations with other variables than the OHIP-SC, with two exceptions, acid reflux and vomiting, which strengthens the reasoning about these two symptoms being less frequent after GBP surgery. Thus, the additive method was a more sensitive method for measuring the magnitude of oral health-related quality of life. The simple count method might be seen more as an indicator of whether an impact is present [47].

The significant variables for experiencing a lowered OHRQoL in the multivariate models—self-perceived oral health, reason for dental visits, tooth hypersensitivity and chewing ability—should be considered by both medical and

dental staff—surgeons, general practitioners, dieticians, general dental practitioners, dental hygienists and others—when encountering GBP patients. The attenuation of the associations by the adjustments could be expected, as cohabitation and a high educational level often lower the risk of experiencing problems as a whole [35, 49].

Our results revealed some significant differences between genders. Men reported less favourable dental care habits with fewer dental visits and fewer remaining teeth than women. These findings are consistent with previous studies in Western countries [49]. A somewhat unexpected finding was that men reported more impacts in the OHIP dimension of social disability. This might be explained by obese men seeking medical care later and possibly have a higher BMI before GBP surgery than obese women [13, 50]. On the other hand, the female participants in our study more often reported tooth hypersensitivity and physical pain, which could be discussed in biological terms, as some studies show that women have greater pain perception than men [51]. Furthermore, it may be more acceptable for women to admit and express problems due to psychosocial expectations [52].

Conclusion

A large proportion of individuals having undergone GBP surgery reported problems with their oral health and impacts on their OHRQoL indicating a need for both medical and dental staff to offer oral health promotion and prevention measures.

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Data Availability The datasets used and analysed during the current study are available from corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethics Statement The study was approved in accordance with the ethical standards of the Research Ethics Committee of Gothenburg University (reg. no. 057-14) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent Statement Informed consent was obtained from all individual participants included in the study.

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