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Original article

Effect of age on quality of life after gastric bypass: data from the Scandinavian Obesity Surgery Registry

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Abstract

Background: Whether patients aged 60 years or older should be recommended bariatric surgery is still controversial.

Objective: To assess the effect of age on health-related quality of life (QoL) over time after gastric bypass.

Setting: Data from the Swedish national registry for bariatric surgery.

Methods: Data of 57,215 patients undergoing gastric bypass were retrieved from the Scandinavian Obesity Surgery Register with a follow-up rate at 1,2, and 5 years at 89%, 69%, and 59%, respectively. Patients were divided into 5-years age intervals. Odds ratios for the relative mean changes in QoL were compared by logistic regression.

Results: Preoperatively, patients aged 60 years or older scored better on mental aspects (Mental Component Summary score, MCS) of RAND-36 (Short Form Health Survey (higher values better)) as well as OP (Obesity related Problem scale (lower values better)) better than the entire cohort of patients (MCS: mean [95% CI], 46.2 [45.5–46.9] versus 43.5 [43.4–43.7], respectively; OP: mean [95% CI], 55.3 [54.0–56.6] versus 64.1 [63.9–64.4], respectively), whereas the Physical Component Summary (PCS) scores of patients aged 60 years or older were lower (mean [95% CI], 32.3 [31.7–32.8] for the ≥60-yr cohort versus 36.4 [36.2-36.5] for the entire cohort; $P < .001$ for all). In all age groups, MCS was improved at 1 and 2 years but decreased to baseline at 5 years. The postoperative improvements in PCS and OP were sustained in all age groups. Although the relative increases for PCS and OP in patients aged ≥60 years were somewhat lower compared with the entire cohort at 5 years, the values were well above baseline levels (mean [95% CI], 41.0 [40.0–42.0] versus 32.3 [31.7–32.8] and 22.2 [20.3–24.0] versus 55.3 [54.0–56.6], respectively; $P < .001$).

Conclusion: Mental QoL is transiently improved after bariatric surgery without marked differences between age groups. However, patients aged ≥60 years report pronounced and sustained improvements in physical and obesity-specific QoL 5 years postoperatively. These observations support previous studies that older patients should not be denied bariatric surgery from a risk-benefit perspective, solely based on age. (Surg Obes Relat Dis 2022;18:1313–1322.) © 2022 American Society for Metabolic and Bariatric Surgery. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Keywords: Quality of Life; Elderly; Obesity; Gastric; Bypass

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Over the last decades, the prevalence of obesity with its related co-morbidities has increased worldwide [1,2]. Results with treatment modalities such as dietary regimens, physical activity, and pharmacologic agents are often unsatisfactory in the long term.

In contrast, bariatric (weight-reducing) surgery has been shown to be associated with marked and sustained weight loss as well as improvement or resolution of co-morbidities [3,4]. Accordingly, the number of bariatric surgical procedures worldwide has increased from 350,000 to almost 700,000 procedures between year 2000 and 2016 [5]. With increased volumes, and with the introduction of fast-track programs, the results in terms of complication rates and time to recovery after bariatric surgery have improved.

A controversial issue is whether people with severe obesity and older age should be considered for bariatric surgery. In the 1991 National Institute of Health (NIH) Consensus Development Panel report [6], it was stated that bariatric surgery should, in general, be restricted to patients aged 18 to 59 years, mainly owing to an assumed unacceptable increased risk of complications in older patients. Therefore, in many countries, including Sweden, national guidelines recommend that patients older than 59 years should only occasionally be offered bariatric surgery [7]. However, we [8] and others [9] have reported that, compared with younger individuals, older patients suffer from a small but acceptably increased risk of complications in the range of 2% to 3% after bariatric surgery. Considering that older patients benefit from high rates of resolution or improvement in obesity-related co-morbidities [4,10,11], available data strongly suggest that from a risk–benefit perspective, patients should not be denied consideration for bariatric surgery solely based on higher age.

Another important aspect of obesity and the effects of weight loss is related to self-reported quality of life (QoL). Mental as well as physical aspects of QoL are known to be markedly affected in people with obesity [12] and improved after weight loss [13]. Whether the positive effects on self-reported QoL after bariatric surgery differ between old and younger patients is still not fully described [14].

Therefore, to further characterize the benefits of surgery-induced weight loss in older patients, we aimed to evaluate outcome in terms of health-related quality of life (HRQoL) in relation to age after gastric bypass using a large cohort from the Scandinavian Obesity Surgery Registry (SOReg).

Methods

The Scandinavian Obesity Surgery Registry

The Swedish nationwide quality registry for bariatric surgery was established in 2007 and is repeatedly validated, with a near complete registration (>98%) of all procedures performed in Sweden [15–17]. The Swedish National Board of Health and Welfare financially support the registry, which is approved by the Swedish Surgical Society. Patients are registered before surgery (baseline), at 6 weeks (including 30-days complications), and at 1, 2, 5, and 10 years after surgery.

We retrieved prospectively collected data for all patients operated with primary gastric bypass during the period May 1, 2007, and December 31, 2018, which were analyzed retrospectively. During this period, bariatric surgery was performed at 38 different hospitals in Sweden [17], with a total of 57,226 patients who had undergone primary gastric bypass. Of these, 2687 patients were aged 60 years or older. An age-related stratification was made according to the World Health Organizations (WHO) definition into 5-year intervals [18], with separate groups for all patients aged ≥60 years, ≥70 years, and <20 years, respectively.

Health-related quality of life measurements

In SOReg, the quality of life instruments RAND-36 (Short Form 36-Item Health Survey) and Obesity-related Problems scale (OP) are used. In this study, the data recorded preoperatively and at 1, 2, and 5 years after surgery were collected and analyzed.

Short form health survey

RAND-36, a well-validated global instrument for estimating health-related quality of life measurements (HRQoL), measures a variety of mental and physical dimensions [19]. The instrument consists of 36 questions, divided in 4 physical and 4 mental health dimensions transformed into a total domain score between 1 and 100, where 100 equals the best QoL and 0 equals the worst possible outcome. The dimensions of HRQoL are divided and summarized into a Physical Component Summary score (PCS) and a Mental Component Summary score (MCS), based on a computer-generated calculation. PCS is a combination of the dimensions Physical Function, Role–Physical, Bodily Pain, and General Health, whereas MCS combines Vitality, Social Function, Role–Emotional, and Mental Health. In RAND-36, data on age- and sex-matched controls are available for comparison, as well [19].

Obesity-related Problems scale

OP is a Swedish, validated, obesity-specific instrument to measure an individual's QoL in relation to obesity [20]. OP consists of 8 questions about psychosocial problems related to obesity in patients undergoing bariatric surgery. It is expressed on a scale from 0 to 100 but has the reverse direction compared with SF-36, that is, a higher value indicates worse QoL. OP is a disease-specific QoL instrument and is therefore seldom used in individuals without obesity [20].

Table 1
Patient details*

Number of patients	54,539 (<60 yr)	2687 (≥60 yr)	*P* value
Demography			
Male (n)	12,845 (23.6)	916 (34.1)	<.001
Female (n)	41,694 (76.4)	1771 (65.9)	<.001
Age, median (IQR), yr	40.1 (32–48)	62.6 (61–64)	
Age female, median (IQR), yr	39.6 (32–49)	62.5 (60–64)	
Age male, median (IQR), yr	41.6 (34–50)	62.8 (61–64)	
Smoking (n)	5266 (13.1)	144 (7.6)	<.001
Operative data			
Weight at surgery (kg), median (IQR)	114.7 (101–126)	112.0 (98–124)	<.001
BMI at surgery, median (IQR)	40.0 (36.4–42.9)	39.3 (35.7–42.3)	<.001
Operative time, median (IQR), min	74.0 (49–89)	86.0 (56–103)	<.001
Laparoscopic surgery (n)	52,437 (96.1)	2479 (92.3)	<.001
Open surgery (n)	1739 (3.2)	157 (5.8)	<.001
Conversion to open surgery (n)	363 (.7)	51 (1.9)	<.001
Complications (within 6 wk after surgery)			
Any postoperative complication (n)	4722 (8.7)	305 (11.4)	<.001
Anastomotic leakage (n)	644 (1.2)	50 (1.9)	<.01
Postoperative bleeding (n)	1018 (1.9)	59 (2.2)	.254
Deep infection/abscess (n)	502 (.9)	45 (1.7)	<.001
Minor wound infection (n)	593 (1.1)	60 (2.3)	<.001
Any cardiovascular complications (n)	72 (.1)	26 (1.0)	<.001
Any tromboembolic events (n)	69 (.1)	4 (.2)	.768
Any pulmonary complications (n)	384 (.7)	29 (1.1)	<.05

IQR = interquartile range; BMI = body mass index.
* Patients were divided in <60 and ≥60 years (percentages in brackets unless stated otherwise).

Outcome

The outcomes were defined as HRQoL measurement as assessed by RAND-36 (MCS and PCS) and OP over time, and the mean relative change between date of surgery and at year 1, 2, and 5 after surgery in the various age groups in relation to the entire cohort.

Covariates

Defined characteristics were analyzed at baseline to determine the univariate predictors of the different outcome variables. A stepwise logistic modeling was used in the multivariate analysis for including the covariates, where a *P* value < .15 was considered relevant. In the regression model, the final adjustment variables were sex, occurrence of diabetes, and hypertension.

Statistics

Results are presented as mean or median (range, interquartile range [IQR]), percentage, or odds ratio (OR) with a 95% confidence interval (CI) when appropriate. For comparison between continuous variables, we used 2-tailed *t* tests, and χ^2 test was used for binominal variables. HRQoL outcomes (SF-36 and OP) were analyzed with repeated measurements ANOVA over 1, 2, and 5 years. A logistic regression model was used to estimate ORs to compare the relative mean change in MCS, PCS, and OP from baseline in each age group with the entire cohort at 1, 2, and 5 years. Exposure was defined as age and outcome was HRQoL over time as defined above. A *P* value < .05 was considered significant. All data were analyzed using STATA version 13.1.

Loss to follow-up

All patients in the cohort had data registered at baseline. Registration of follow up was performed at predefined dates according to SOReg (1, 2, and 5 years after surgery). Patients without registered data at any of the follow-up times were excluded in the statistical analysis for that date.

Sensitivity analysis

A comparison was made between baseline data for patients with or without 5-year follow-up data with unpaired *t* test and χ^2 test when appropriate. Thereafter a logistic regression was used to identify independent predictors at baseline for 5-year follow-up.

Ethics

The study was approved by the Regional Ethical Committee (Swedish Ethical Review Authority, Dnr 2011/1624-31/1A).

Results

Patients and operative data

Table 1 illustrates patient characteristics and perioperative data for patients <60 years and those ≥60 years separately. The entire cohort included 57,226 patients, and

Table 2
Distribution of patients included, divided in 5-year intervals at baseline (0) and follow-up at 1, 2, and 5 years after surgery

Years after surgery	Age groups													
	<20	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	≥60	60–64	65–69	≥70	Total
(0)	956	3831	5450	6601	8276	9272	8587	6759	4805	2687	2145	495	47	57215
(1)	736 (81)	3027 (83)	4304 (85)	5349 (87)	6944 (89)	7918 (90)	7395 (91)	5838 (93)	4235 (94)	2365 (94)	1904 (94)	423 (93)	38 (93)	48111 (90)
(2)	494 (61)	2006 (62)	2816 (64)	3617 (67)	4676 (67)	5590 (71)	5165 (72)	4132 (75)	3072 (78)	1818 (81)	1439 (81)	350 (83)	29 (83)	33,386 (70)
(5)	233 (47)	1085 (54)	1514 (56)	2019 (55)	2849 (58)	3313 (61)	3051 (65)	2300 (68)	1889 (74)	1154 (78)	924 (78)	215 (79)	15 (83)	19,407 (62)

Values within brackets represent percentage of eligible patients.

2687 of these (4.7%) were aged ≥60 years. Compared with those younger than 60 years, the group of older patients included fewer women and smokers. Moreover, older patients had lower preoperative body mass index (BMI), longer duration of the operation (86.0 versus 74.0 minutes, $P < .001$), and more open procedures more complications within 6 weeks after surgery (11.4% versus 8.7%, $P < .001$) (Table 1).

Age groups and frequency of follow-up. Table 2 illustrates the distribution of patients on age groups and rates of follow-up at the various time points. The median age for the entire cohort was 40.1 years and patients aged 40 to 44 years constituted the largest group. The frequency of follow-up was 89%, 69%, and 59% of all patients at 1, 2, and 5 years after surgery, respectively. Most patients in the ≥60-year group were between 60 and 64 years (80%). In general, there were higher follow-up rates for older patients compared with the ones in the younger groups (Table 2).

Postoperative weight loss

The weight loss over time was less pronounced in older patients compared with the total cohort as well as to the patients in the younger groups (Table 3). Compared with the total cohort, all individuals older than 44 years displayed less pronounced weight loss ($P < .01$), while those younger than 40 years lost more weight (Table 3). For patients in the age group 40 to 44 years, there was no difference in weight loss at 1 and 2 years compared with the total cohort.

Mental Component Summary score

Preoperatively, there was a relation between age and MCS in older patients scoring higher values compared with younger (Table 4, Fig. 1). When compared with the entire cohort, all age groups older than 39 years except patients aged ≥70 years scored MCS higher ($P < .01$), whereas MCS scores were lower in patients aged 39 years and younger. One year after surgery, there was a statistically significant increase in MCS scores in all age groups (Table 4, Fig. 1). In Table 5, ORs (95% CI) for the relative changes in MCS in the various age groups compared with the total cohort of patients (reference). Thus, in multivariate analysis with comparison to all patients, it was found that this increase in MCS at 1 year was lower in age groups 55 to 59 and 40 to 49 years, whereas all patients below 30 years and ≥ 70 years showed an increased improvement (Table 5). Although less pronounced, MCS scores were still improved in all age groups at 2 years postoperatively (Table 4, Fig. 1), and the differences in improvements in MCS compared with all patients were the same in the individual age groups as at 1 year (Table 5).

At 5 years, most of the improvements in MCS scores at 1 and 2 years after surgery were obliterated (Table 4, Fig. 1). Nevertheless, compared with before surgery, there were

Table 3
Total weight loss (% [95% CI]) from date of surgery until year 1, 2, and 5

	Weight loss, year 1*	Weight loss, year 2*	Weight loss, year 5
Total	31.6 (31.5–31.7)	31.9 (31.8–32.0)	28.0 (27.8–28.1)
>70	25.1 (22.5–27.8)	27.8 (24.8–31.0)	24.0 (19.1–29.0)
65–69	25.0 (24.1–25.8)	25.5 (24.4–26.5)	23.0 (21.4–24.5)
60–64	27.3 (27.0–27.7)	27.7 (27.3–28.2)	24.5 (23.9–25.2)
>60	26.9 (26.5–27.2)	27.3 (26.9–27.7)	24.2 (23.6–24.8)
55–59	28.9 (28.7–29.1)	29.00 (28.7–29.3)	25.9 (25.4–26.3)
50–54	29.8 (29.6–30.0)	30.1 (29.8–30.4)	26.3 (25.9–26.7)
45–49	30.5 (30.3–30.7)	30.7 (30.4–30.9)	27.2 (26.8–27.5)
40–44	31.5 ns (31.3–31.7)	31.7 ns (31.5–31.9)	27.7 (27.3–28.0)
35–39	32.6 (32.4–32.8)	33.0 (32.7–33.2)	28.8 (28.4–29.2)
30–34	33.7 (33.5–33.9)	33.9 (33.7–34.2)	29.9 (29.5–30.4)
25–29	34.7 (34.5–34.9)	35.2 (34.9–35.5)	31.0 (30.4–31.5)
20–24	35.0 (34.8–35.3)	35.8 (35.5–36.2)	31.7 (31.1–32.3)
<20	32.7 (32.1–33.3)	34.1 (33.3–34.9)	30.8 (29.3–32.3)

CI = confidence interval; ns = not significant.
* $P < .01$, versus total cohort except those marked by ns.

small but significant differences in MCS scores in all age groups compared with baseline, of which some were higher and some lower. When comparing the postoperative relative change in MCS at 5 years, there was a general trend towards higher and lower values in younger and older patients, respectively (Table 5). The multivariate analysis showed that this change was statistically significant higher in patients younger than 30 years and lower in those aged between 50 to 59 years. For patients older than 60 years, however, the relative change in MCS at 5 years did not differ compared with the entire cohort, OR .95 (95% CI .83–1.09).

PCS score

As expected, and in contrast to MCS, the preoperative physical component summary was lower for older individuals compared with younger (Table 4, Fig. 2). At 1 year postoperatively, a statistically significant improvement was seen in all individual age groups and accordingly, for the entire cohort as well.

Compared with the entire cohort, the increase in PCS at 1 year after surgery did not differ markedly across age groups. The only statistically significant difference was an increased improvement in patients aged 50 to 59 years and a reduction in those aged 35 to 39 years (Table 5). At 2 years, the improvement in PCS had levelled off in all age groups (Fig. 2). The only difference in the increase in PCS compared with the entire cohort was found in patients younger than 20 years who displayed a 26% higher improvement (Table 5).

At 5 years, the improvement in PCS was better preserved in all patients compared with MCS. In general, the improvement was more pronounced in younger patients (Table 4, Fig. 2). In a multivariate analysis, and compared with all patients, this was statistically significant higher for patients aged <20 years (OR, 1.42) and lower for patients aged ≥60 (OR, .82) and 65 to 69 years (OR, .69) (Table 5).

Table 4
Mental Component Summary, Physical Component Summary, and Obesity-related Problems Scale preoperatively (0) and at 1, 2, and 5 years after surgery

	Mental Component Summary				Physical Component Summary				Obesity-related Problems Scale			
	0	1	2	5	0	1	2	5	0	1	2	5
Total	43.5 (43.4–43.7)	47.6 (47.5–47.8)	45.8 (45.6–46.0)	43.5 (43.2–43.8)	36.4 (36.2–36.5)	49.8 (49.7–49.9)	49.1 (48.9–49.3)	46.2 (46.0–46.5)	64.1 (63.9–64.4)	18.8 (18.6–19.1)	21.3 (21.0–21.7)	26.2 (25.7–26.8)
≥70	43.4 (36.1–50.8)	50.3 (43.3–57.4)	48.6 (40.7–56.4)	42.4 (29.3–55.5)	30.0 (24.3–35.7)	41.2 (33.9–48.5)	39.4 (32.4–46.5)	32.5 (22.0–43.1)	49.8 (40.7–58.8)	8.1 (3.4–12.8)	25.0 (8.7–41.3)	31.1 (−.2 to 62.9)
65–69	47.3 (45.6–48.9)	51.0 (49.5–52.5)	48.2 (46.1–50.3)	47.1 (44.5–49.8)	32.4 (31.1–33.8)	43.7 (42.3–45.2)	42.5 (40.7–44.4)	38.1 (35.7–40.6)	51.1 (47.9–54.2)	16.7 (14.2–19.3)	18.0 (15.0–21.0)	23.3 (18.9–27.7)
60–64	46.0 (45.2–46.8)	50.2 (49.5–51.0)	50.2 (49.5–51.0)	47.0 (45.8–48.3)	32.3 (31.7–32.9)	45.3 (44.6–46.0)	44.8 (43.9–45.7)	41.9 (40.8–43.0)	56.4 (54.9–57.9)	15.8 (14.7–17.0)	16.2 (14.8–17.6)	21.8 (19.7–23.9)
≥60	46.2 (45.5–46.9)	50.4 (49.7–51.1)	48.8 (48.0–49.7)	47.0 (45.9–48.1)	32.3 (31.7–32.8)	44.9 (44.3–45.6)	44.3 (43.5–45.1)	41.0 (40.0–42.0)	55.3 (54.0–56.6)	15.9 (14.9–16.9)	16.6 (15.3–17.9)	22.2 (20.3–24.0)
55–59	46.1 (45.6–46.6)	49.2 (48.7–49.7)	48.3 (47.6–48.9)	45.8 (44.8–46.7)	33.0 (32.6–33.5)	47.0 (46.5–47.5)	46.6 (46.0–47.1)	42.4 (41.6–43.3)	58.3 (57.4–59.3)	16.1 (15.3–16.9)	17.2 (16.1–18.2)	22.1 (20.5–23.7)
50–54	44.9 (44.5–45.4)	48.3 (47.9–48.6)	46.9 (46.3–47.4)	45.9 (45.1–46.7)	34.1 (33.7–34.4)	47.7 (47.3–48.1)	47.3 (46.8–47.8)	44.5 (43.8–45.2)	59.9 (59.1–60.7)	16.7 (16.0–17.4)	18.6 (17.7–19.6)	23.1 (21.6–24.7)
45–49	44.8 (44.5–45.2)	48.2 (47.9–48.6)	46.1 (45.5–46.6)	43.1 (42.4–43.8)	35.5 (35.2–35.8)	49.0 (48.6–49.3)	48.6 (48.1–49.0)	45.1 (44.5–45.8)	62.0 (61.3–62.7)	17.1 (16.5–17.7)	19.0 (18.2–19.9)	23.9 (22.5–25.2)
40–44	44.4 (44.1–44.8)	47.8 (47.4–48.2)	46.0 (45.5–46.5)	43.1 (42.4–43.8)	36.7 (36.4–37.0)	50.5 (50.2–50.8)	49.7 (49.3–50.1)	47.0 (46.4–47.6)	63.2 (62.6–63.9)	17.6 (17.0–18.2)	20.3 (19.4–21.1)	24.7 (23.4–26.0)
35–39	43.2 (42.8–43.5)	47.5 (47.1–47.9)	44.9 (44.4–45.5)	42.2 (41.5–43.0)	37.4 (37.1–37.8)	51.3 (51.0–51.6)	50.5 (50.1–51.0)	48.2 (47.6–48.9)	66.5 (65.9–67.2)	18.2 (17.5–18.8)	21.0 (20.0–21.9)	27.2 (25.8–28.6)
30–34	42.2 (41.8–42.6)	46.4 (46.0–46.9)	44.8 (44.1–45.4)	40.7 (39.8–41.7)	38.3 (37.9–38.6)	51.6 (51.3–52.0)	50.9 (50.5–51.4)	48.8 (48.0–49.6)	68.2 (67.5–68.9)	20.9 (20.2–21.7)	24.8 (23.7–25.9)	30.5 (28.8–32.2)
25–29	40.6 (40.2–41.1)	46.0 (45.4–46.5)	43.4 (42.6–44.1)	41.0 (39.9–42.1)	38.5 (38.2–38.9)	52.0 (51.6–52.4)	51.1 (50.5–51.6)	50.0 (49.2–50.9)	70.0 (69.3–70.8)	23.5 (22.5–24.4)	28.4 (27.0–29.8)	33.3 (31.2–35.4)
20–24	39.2 (38.7–39.8)	45.1 (44.5–45.8)	42.7 (41.9–43.6)	40.1 (38.8–41.4)	38.9 (38.5–39.4)	52.3 (51.9–52.8)	52.0 (51.4–52.7)	49.3 (48.3–50.3)	70.4 (69.5–71.3)	26.8 (25.7–27.9)	31.7 (30.1–33.3)	37.1 (34.5–39.6)
<20	39.4 (38.3–40.5)	45.0 (43.7–46.4)	41.9 (40.2–43.7)	39.2 (36.2–42.4)	39.1 (38.2–40.0)	51.2 (50.2–52.3)	51.9 (50.7–53.1)	50.5 (48.4–52.6)	67.0 (65.1–68.9)	27.6 (25.2–30.0)	34.4 (30.7–38.0)	37.1 (30.1–43.3)

Data are given as mean values (95% confidence interval); all values in for respective age groups significant versus baseline (total cohort) ($P < .001$).

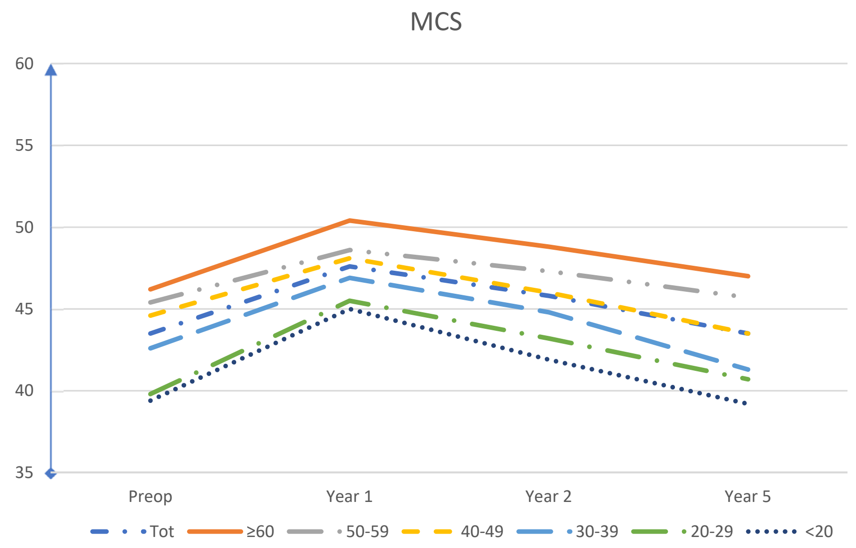

Fig. 1. Mental Component Summary (MCS) preoperatively, at year 1, 2, and 5 after primary gastric bypass. Age groups: >60, 50–59, 40–49, 30–39, 20–29, and <20 yr.

Nevertheless, the increase in PCS in patients aged ≥60 years was still well above the preoperative values (41.0 versus 32.3, $P < .001$) (Table 4).

OP scale

For OP scale, the preoperative values showed, in line with mental component summary, an age-related difference with lower (better) scores in older patients compared with younger (Table 4, Fig. 3, $P < .001$). This relation was preserved throughout the 5 years of follow-up. At 1 year after surgery, a marked improvement in OP scores was seen in all age groups which, in comparison with the entire cohort, was increased in patients aged 45 to 59 years and decreased in all age groups younger than 35 years (Table 5).

Although somewhat less pronounced compared with year 1, OP scores were still well below the preoperative values at 2 years postoperatively (Table 4, Fig. 3, $P < .001$). Furthermore, the same age groups displayed significant differences in improvements compared with the entire group, except for the lack of significance for patients aged 30 to 34 and <20 years (Table 5).

At 5 years, the improvement in OP scores were slightly further reduced in all age groups (Fig. 3). Again, however, the relation between age groups was preserved and the values were still well improved compared with preoperatively. Compared with the entire cohort, the improvement in OP scores was significantly lower in age groups ≥60, 60 to 64, and 25 to 34 years, and higher in patients aged 45 to 54 years (Table 5).

Sensitivity analysis

In the sensitivity analysis, eligible patients with and without 5-year data were compared at baseline. Patients with 5-year follow-up had lower BMI (40.2 versus 40.8, $P < .001$), were older (42.3 versus 39.2 years, $P < .001$), and included fewer males (22.1% versus 23.6%, $P < .001$). Furthermore, 5-year follow-up was more common in patients with treatment for diabetes (14.8 versus 12.2%, $P < .01$), hypertension (27.0 versus 21.9%, $P < .01$), dyslipidemia (10.4 versus 8.5%, $P < .01$), and OSAS (9.6 versus 7.9%, $P < .01$) and more uncommon in those with ongoing pharmacological treatment for depression (13.4% versus 14.6%, $P < .01$). For baseline health-related quality of life measurements, patients with 5-year data scored improved MCS (44.9 versus 43.2, $P < .001$), PCS (37.2 versus 36.4, $P < .001$), and OP (61.4 versus 64.9, $P < .001$). In multivariate analysis, the OR for 5-year follow-up was found to be increased in patients with baseline treatment for diabetes (OR, 1.25; 95% CI, 1.17–1.34; $P < .01$), hypertension (OR, 1.32; 95% CI, 1.25–1.40; $P < .01$), dyslipidemia (OR, 1.25; 95% CI, 1.15–1.35; $P < .01$), and obstructive sleep apnea syndrome (OSAS) (OR, 1.25; 95% CI, 1.15–1.35; $P < .01$) and decreased in patients with depression (OR, .90; 95% CI, .84–.96; $P < .01$).

Discussion

In this large, register-based study, we evaluated the changes in self-reported QoL after primary gastric bypass in relation to age with particular emphasis on patients above 60 years. We demonstrate that mental aspects of QoL (MCS) were scored higher in older patients compared with younger before as well as after surgery with a similar, although almost completely transient, improvement over time. For obesity-specific QoL (OP) over a span of 5 years, older patients scored better compared with younger, with a marked improvement in all age groups. As expected, for

Table 5
Odds ratio (OR [95% CI]) for relative change in Mental Component Summary, Physical Component Summary, and Obesity-related Problems Scale in the various age groups compared with the total cohort of patients (reference) at 1, 2, and 5 years after surgery

	Mental Component Summary			Physical Component Summary			Obesity-related Problems Scale		
	1	2	5	1	2	5	1	2	5
Total	1	1	1	1	1	1	1	1	1
>70	3.23 (1.26–8.27)*	2.34 (.89–6.14)	2.57 (.58–11.39)	1.37 (.65–2.89)	1.05 (.47–2.38)	.66 (.23–1.95)	2.06 (.80–5.28)	.58 (.27–1.25)	.69 (.22–2.17)
65–69	.87 (.71–1.07)	.89 (.71–1.11)	.97 (.72–1.31)	.94 (.76–1.16)	1.02 (.81–1.29)	.69 (.52–.93)*	.89 (.72–1.11)	.91 (.71–1.16)	.86 (.62–1.19)
60–64	.97 (.88–1.07)	1.01 (.90–1.14)	.94 (.81–1.09)	1.03 (.93–1.14)	1.07 (.95–1.21)	.88 (.75–1.02)	1.02 (.91–1.13)	.99 (.87–1.12)	.82 (.70–.97)*
>60	.96 (.88–1.06)	1.00 (.90–1.11)	.95 (.83–1.09)	1.01 (.92–1.11)	1.06 (.95–1.18)	.82 (.72–.95)*	1.00 (.91–1.11)	.96 (.85–1.07)	.82 (.71–.95)*
55–59	.91 (.85–.97)*	.85 (.78–.92)*	.89 (.80–.99)*	1.10 (1.03–1.19)*	1.01 (.93–1.10)	1.05 (.93–1.17)	1.12 (1.03–1.21)*	1.19 (1.08–1.30)*	1.11 (.98–1.26)
50–54	.97 (.92–1.03)	.95 (.87–1.02)	.88 (.80–.97)*	1.13 (1.06–	1.05 (.97–1.13)	1.05 (.94–1.16)	1.16 (1.09–1.24)*	1.10 (1.02–1.20)*	1.15 (1.02–1.28)*
45–49	.93 (.88–.98)*	.91 (.86–.97)*	.92 (.84–1.00)	.99 (.94–1.05)	.95 (.89– 1.02)	.98 (.89–1.07)	1.06 (1.00–1.12)*	1.06 (.98–1.14)*	1.11 (1.01–1.23)*
40–44	.89 (.84–.93)*	.91 (.86–.97)*	.92 (.85–1.00)	.96 (.91–1.01)	.94 (.88– 1.00)	1.02 (.94–1.12)	1.05 (.99–1.11)	1.02 (.95–1.09)	1.07 (.97–1.18)
35–39	.99 (.94–1.05)	1.01 (.94–1.08)	1.06 (.97–1.17)	.92 (.87–.97)*	.99 (.92– 1.06)	.95 (.86–1.04)	1.01 (.95–1.08)	.99 (.92–1.07)	.99 (.89–1.09)
30–34	1.01 (.95–1.08)	1.04 (.97–1.13)	.99 (.89–1.11)	.96 (.90– 1.02)	1.02 (.95– 1.11)	1.01 (.90–1.12)	.88 (.82–.94)*	.93 (.86–1.01)	.83 (.74–.93)*
25–29	1.21 (1.13–1.30)*	1.20 (1.10–1.31)*	1.28 (1.13–1.46)*	1.00 (.93– 1.07)	.99 (.91– 1.08)	.96 (.85–1.09)	.89 (.83–.96)*	.88 (.80–.96)*	.85 (.75–.96)*
20–24	1.46 (1.34–1.59)*	1.57 (1.41–1.75)*	1.62 (1.38–1.90)*	1.00 (.92–1.08)	1.06 (.96– 1.18)	1.15 (.99–1.33)	.83 (.76–.90)*	.82 (.74–.91)*	.94 (.81–1.09)
<20	1.29 (1.09–1.52)*	1.32 (1.07–1.61)*	1.42 (1.03–1.97)*	1.08 (.92–1.27)	1.26 (1.02– 1.55)*	1.42 (1.02–1.97)*	.75 (.63–.88)*	.90 (.73–1.11)	1.08 (.77–1.50)

* Indicates statistical significance from reference.

physical aspects of QoL (PCS), older patients scored lower, but at 5 years postoperatively, the marked improvements in physical QoL were well retained in all age groups.

We [8] and others [9,10] have previously demonstrated that bariatric surgery could be considered safe in patients aged ≥60 years. We have also reported that patients in this age group benefit from pronounced resolution of obesity-associated co-morbidities [4,8]. Another important aspect of obesity is related to its influence on QoL. It is well known that people with obesity report markedly reduced QoL compared with people with normal weight [21], and improvement in this respect could be considered the ultimate goal for bariatric surgery. Previous studies have reported improvements in QoL after surgery as well as lifestyle-induced weight loss [13,21,22], but the literature on improvement in QoL in older patients undergoing bariatric surgery compared with younger is sparse. In the current study, we therefore specifically evaluated the influence of age on QoL in order to further characterize the effect of bariatric surgery in older patients. For comparison of various ages, we used the WHO's age-related stratification into 5-year intervals.

In this study, we defined patients aged ≥60 years as "old." Although this limit might seem low, the recommendation in the 1991 NIH consensus report that bariatric surgery should primarily be offered to patients between 18 and 60 years [6] is still adhered to in Sweden as well as in other countries [23]. Furthermore, age from 60 years is defined as "old" by WHO [18]. Nevertheless, in our material 4.7% of patients were 60 years or older, showing that, in Sweden, surgeons begin to question this age limit for bariatric surgery, at least in selected cases.

For assessment of QoL, the global instrument RAND SF-36 and the disease-specific OP are reported in SOReg and were therefore used in this study. Both are commonly used and well validated, including in a Swedish population [19,20,24]. The use of a global instrument, covering mental as well as physical aspects of QoL in combination with a disease-specific instrument should have the potential to cover most important aspects of QoL in patients undergoing bariatric surgery., Although there might be slight differences in the various dimensions of RAND-36 compared with the summary score for MCS and PCS, we consider it sufficient to only use the latter for the purpose of this study.

For MCS preoperatively, there was a clear trend towards better scores in older individuals in general, which might be explained by the possibility that older patients do not suffer from stigmatization and other obesity-associated mental affections to the same extent as younger patients [25]. Although the relatively marked improvement in MCS at 1 year was somewhat more pronounced in younger patients, most of this had subsided at 5 years after surgery. This confirms previous data showing that the effects on mental aspects of QoL after bariatric surgery are relatively transient [26,27]. Nevertheless, the relative improvement after 5

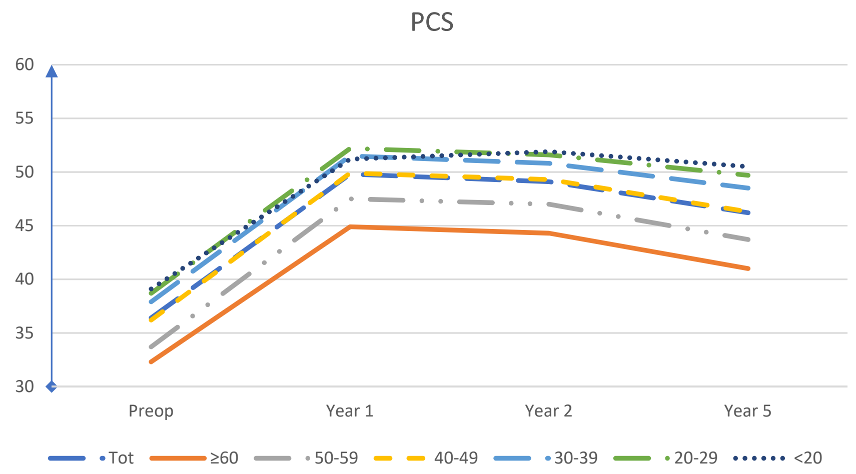

Fig. 2. Physical Component Summary (PCS) preoperatively, at year 1, 2, and 5 after primary gastric bypass. Age groups: >60, 50–59, 40–49, 30–39, 20–29, and <20 yr.

years in patients over 59 years did not differ compared with the entire cohort.

The reduced PCS scores in older patients have also been reported previously in patients with and without obesity [21,26,27], presumably associated with the reduction in general physical functioning together with an increase in the prevalence of obesity-associated co-morbidities with increasing age. The marked improvement in PCS at 1 year was, in parallel with weight loss and resolution of co-morbidities, better sustained over time in all age groups compared with MCS. The somewhat inferior relative improvement in PCS at 5 years in older patients might be explained by slightly reduced weight loss and/or remaining co-morbidity. Nevertheless, this group of patients still had a marked and well sustained improvement in self-reported QoL at 5-year follow-up.

As for MCS, older patients scored obesity-specific QoL (OP) better than younger, presumably reflecting less influence of obesity on psychosocial factors in patients at higher age. Also, it might be speculated that older individuals have fewer problems facing bariatric surgery and adapting to changes in daily life after the operation. However, compared with MCS, OP scores were preserved markedly better over 5 years in all age groups. Although the relative increase in patients aged ≥60 years was slightly lower compared with the entire cohort, the scores were well improved compared with preoperatively and still higher compared to all other age groups.

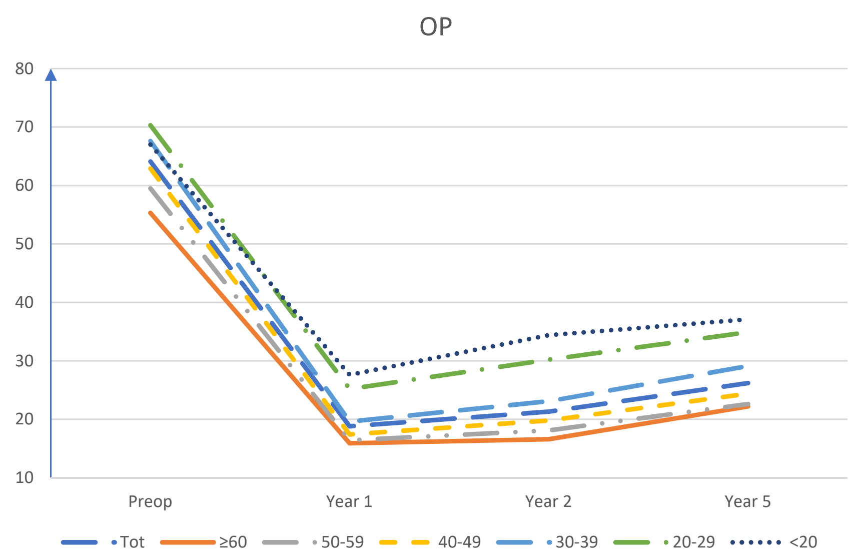

Fig. 3. Obesity-related Problems Scale (OP) preoperatively, at year 1, 2, and 5 after primary gastric bypass. Age groups: >60, 50–59, 40–49, 30–39, 20–29, and <20 yr.

We have no explanation for the somewhat lower relative improvement in MCS and OP in older patients compared with the entire cohort. Although this was statistically significant, the absolute differences were modest. As reported previously [9], the weight loss over time was also somewhat reduced in older patients. However, in contrast to previous reports [28], we were unable to detect any relation between postoperative relative weight loss and improvements in any aspects of QoL (data not shown). Previous studies have shown that also a modest weight loss in the range of ≥5% is associated with improvements in QoL over 1 to 2 years, irrespective if this was achieved by surgery or by conservative means [29]. We therefore assume that the slightly, although statistically significant, inferior improvements in QoL noted in older patients in our study are of relatively minor clinical relevance.

Limitations of our study include, as for all register-based studies, risk of bias such as underreporting data, selection bias, incomplete collection of data, lack of information on confounders, and misinformation due to data quality. Our sensitivity analysis also showed that patients with follow-up data at 5 years were older, included fewer males, had more co-morbidities and scored QoL higher compared with those with missing data. However, the differences were relatively small, and we adjusted for relevant confounders, indicating that our data are representative for most patients undergoing gastric bypass. We also lack information as to why patients ≥60 years were accepted for surgery and can therefore not exclude that these represent a selected group of patients with different criteria for surgery compared with younger patients. The number of patients in higher ages, that is, ≥70 years, was low, which makes our conclusions basically limited to patients older than 60 years in general. Finally, we included only patients undergoing gastric bypass, and it could not be excluded that our data are not fully representative for patients undergoing other bariatric procedures such as for example, sleeve gastrectomy.

Strengths of our study include the use of a very large nationwide register with an almost complete registration and high follow-up rates over time in combination with data from well-validated instruments assessing various aspects of self-reported QoL.

In conclusion, our data from this study show that, in similarity to younger individuals, older patients display marked and sustained improvements in important aspects of HRQoL after surgery-induced weight loss up to 5 years. This corroborates previous findings that bariatric surgery in this group of patients is associated with similar rates of complications and resolution of obesity-associated co-morbidities as in younger patients [4,8,30]. Taken together, this further supports that older patients should not be excluded from bariatric surgery solely based on age. Rather, a thorough and individual evaluation from a risk–benefit perspective should be done in order to identify patients who could be expected to gain the most from bariatric surgery.

Disclosures

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