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Sociodemographic Differences and Time Trends of Bariatric Surgery in Sweden 1990–2010

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Abstract

Background—The aim of the present study was to examine demographic and socioeconomic differences and time trends of bariatric surgery in Sweden during 1990–2010.

Methods—An open cohort of all individuals aged 20–64 years was followed between 1990 and 2010. Socioeconomic differences were examined during two periods: 1990–2005 and 2006–2010 using cumulative rates in a closed cohort. Hazard ratios (HRs) of bariatric surgery were calculated in these two periods using Cox regression models.

Results—A majority of the 22,198 individuals that underwent bariatric surgery were women (76.3 %). Women were more likely to undergo surgery in younger ages (30–39 years), while men were more likely to undergo surgery around 10 years later (40–49 years). The number of surgeries increased substantially during the second period. During the whole period, the dominating surgical

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method was gastric bypass contributing to 69.4 % of the procedures. HRs for bariatric surgery were highest for individuals with intermediate educational level and intermediate-low income in both periods. For married/cohabiting and/or employed individuals, the HRs were highest during the first period whereas an opposite pattern was seen in the second period.

Conclusions—Individuals in the lowest socioeconomic groups undergo bariatric surgery less often than those with intermediate income and educational level, although previous research has shown that those with low socioeconomic status have the highest rates of morbid obesity. The failure to identify eligible individuals for surgery may result in negative effects on those individuals with the largest need for weight loss.

Keywords

Obesity; Bariatric surgery; Socioeconomic differences; Time trends

Introduction

Obesity (i.e., body mass index [BMI] ≥30 kg/m^2) is one of the major global health problems [1]. In Sweden, the prevalence of obesity has doubled over the last 20 years [2]. Obesity is associated with numerous comorbidities, such as diabetes, hypertension, cardiovascular disease, and sleep apnea syndrome [3, 4].

Lifestyle modification (diet and exercise) is most often recommended for obese individuals, including those morbidly obese (BMI≥40 kg/m^2) [5–7]. However, conventional methods of weight loss have often been ineffective in achieving sustained weight loss in morbidly obese individuals. The best weight loss programs have only maintained a sustained excess body weight loss of 10 %. This small reduction in excess body weight has little if any effect on obesity-related comorbidities in the morbidly obese population [8–10].

Bariatric surgery may be an appropriate treatment in patients refractory to nonsurgical therapy and who have either morbid obesity or moderate obesity (BMI 35.0–39.9 kg/m^2) plus a major obesity-related comorbidity [6, 7]. Studies have demonstrated that bariatric surgery reduces weight by 33 % in the early postoperative years [11] and 14–25 % after 10 years [12]. Surgery is associated with remission rates of 66–88 % in medical comorbidities [13] and significant reduction in 15-year mortality in comparison to nonsurgical-matched controls [12]. Quality of life, self-esteem, and employment status are also improved after surgery, [14] and surgical costs appear to be recouped within 2–4 years [15].

In countries with private health-care insurance systems, socioeconomic factors play a major role in determining which individuals undergo bariatric surgery, despite medical eligibility. Significant disparities according to race, income, educational level, and insurance type exist [16]. Since Sweden has a universal health-care insurance system, the patients' socioeconomic factors should not be a major barrier to receiving surgery. However, we hypothesize that there still may be socioeconomic disparities among patients that undergo bariatric surgery. In Sweden, all hospital care, publicly funded and private, is registered by the National Board of Health and Welfare that administrates a nationwide registry including surgical and diagnostic codes [17]. To the best of our knowledge, this is the first nationwide

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study that tests our hypothesis, in a country with universal health-care system, meaning that the access to health care will not constitute a confounder in the present study, which represents a novel contribution to previous literature.

The primary aim of this study was to investigate the potential impact of sociodemographic characteristics on the rate of bariatric surgery. The secondary aim was to evaluate time trends in terms of incidence rates as well as choice of surgical methods between 1990 and 2010.

Materials and Methods

Data used in this study were retrieved from a nationwide database, at the Center for Primary Health Care Research, Lund University [18, 19]. The database incorporates longitudinal hospitalization data for the entire population from the Swedish Inpatient Register, provided by the National Board of Health and Welfare. Population-wide documentation regarding demographic and socioeconomic variables was obtained from the Total Population Register, provided by Statistics Sweden, the Swedish government-owned census bureau. Additional individual-level linkages in the database included data from the national Cause of Death Register [18] and the Immigration Register (to identify dates of immigration and/or emigration). All linkages were performed by the use of an individual national identification number that is assigned to each permanent resident in Sweden for their lifetime. This number was replaced by a serial number for each person in order to provide anonymity.

The follow-up period started on January 1, 1990 and proceeded until first hospitalization for bariatric surgery, death, emigration, or the end of the study period on December 31, 2010. We divided this period into two periods, i.e., 1990–2005 and 2006–2010 since there was a large increase in the number of surgeries during the second period.

Outcome Variable

The outcome variable was bariatric surgery. We used the Swedish Inpatient Register to identify main diagnoses of obesity and operation in the study population. The International Classification of Disease (ICD) versions 9 and 10 were used to identify patients with a diagnosis of obesity (ICD-9, 278A and ICD-10, E66) [20]. The Swedish Classification of Operations and Major Procedures was used to identify patients undergoing bariatric surgery: operation codes 4751– 4753 before 1997, or codes JDF00–JDF01, JDF10–JDF11, and JDF20–JDF21 from 1997 and onwards. The subtypes of bariatric surgery were defined as gastroplasty (codes 4751 and JDF00–JDF01), gastric bypass (codes 4752 and JDF10–JDF11), and gastric banding (codes 4753 and JDF20–JDF21).

Individual Variables

The individual variables were defined at baseline.

Gender Male or female

Age: Age was categorized as 20–29, 30–39, 40–49, or 50–64 years.

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Family Income: Family income was calculated as annual family income divided by the number of members in the family. The income calculation was weighted, taking the ages of the family members into account. Children were given lower consumption weights than adults. The calculation was performed as follows: the sum of all family members' incomes was multiplied by the individual's consumption weight divided by the family members' total consumption weight. The final variable was calculated as empirical quartiles from the distribution [21] and classified as low, intermediate-low, intermediate-high, and high.

Marital Status: Individuals were classified as married/cohabitating or single.

Educational Attainment: Educational attainment was classified as follows:

1. Low: completion of compulsory school or less (≤9 years)
2. Intermediate: practical high school or some theoretical high school (10–11 years)
3. High: theoretical high school and/or college (≥12 years)

Employment was defined as yes or no.

Statistical Analysis

1. Incidence rates—Person-years were calculated for all individuals from the start of follow-up until first hospitalization for bariatric surgery, death, emigration, or closing date (December 31, 2010). Age, gender, period, and subtypes of operation-specific incidence rates were calculated for the whole follow-up period. Relative weights used to calculate the incidence rates were based on the 2000 European standard population [22].

2. Hazard ratios (HRs)—Separate analyses were performed for the periods 1990 to 2005 and 2006 to 2010. The rationale for dividing the entire follow-up period into two unequal periods was that there was a large increase in the number of performed bariatric surgery from 2006, and one of the goals of this study was to examine time trends.

The associations between the individual variables and the outcome were analysed with Cox regression models. Cox proportional hazard models are used to study the association between certain variables and the time it takes for a specified event to happen, in this case the first event of bariatric surgery. First, a univariate Cox regression was performed for each variable. Next, a multivariate Cox regression model including all variables was calculated. All analyses were performed using the SAS version 9.2 (SAS Institute, Cary, NC, USA) [23].

Ethical Considerations

This study was approved by the Ethics Committee at Lund University.

Results

As shown in Table 1, a total number of 22,198 individuals (5,258 men, 23.7 %, and 16,940 women, 76.3 %), aged 20–64 years underwent bariatric surgery between 1990 and 2010 in

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Sweden. Women underwent surgery mainly between 30 and 39 years of age (32.2 %), while men underwent surgery mainly between 40 and 49 years of age (34.3 %).

Table 2 shows cumulative rates for the two periods 1990–2005 and 2006–2010. Bariatric surgery was more common in women in both periods. Individuals who were married/cohabitating, had intermediate-low income, or intermediate educational level had the highest rates in both periods. The cumulative rates were highest for employed individuals during the first period whereas it was equal for employed and unemployed individuals during the second period.

Table 3 shows the Cox regression models that estimate the probability of undergoing bariatric surgery in relation to the individual variables in two different models (univariate and multivariate models). Female gender was associated with significantly higher covariate-adjusted hazard ratios (HRs) of surgery in both periods. Additionally, having intermediate educational level and intermediate-low family income was associated with higher probability of undergoing surgery in both periods. All these results were statistically significant except for intermediate-low income in the first period. Being employed was associated with a higher HR to undergo surgery during the first period but a lower HR during the second period. For married/cohabiting individuals, the HRs were highest during the first period whereas an opposite pattern was seen in the second period.

Figure 1 shows the total number of bariatric surgeries for each year between 1990 and 2010. Except for a small peak in 1994, there was a substantial increase in the number of surgeries after 2006. Figure 2 shows the rates of surgery, by the different surgical methods. Gastric bypass was the dominating surgical method during the whole period (69.4 %), and after 2007, it contributed to 97.5 % of all bariatric surgery procedures in Sweden [24].

Discussion

This study showed, for the first time, that there is a potential impact of sociodemographic factors on the rate of bariatric surgery in Sweden, despite its universal health insurance system, which provides equal access to health care to all population groups irrespective of individual income. The HRs for bariatric surgery were highest for individuals with intermediate educational level and intermediate-low income in both periods.

Furthermore, the study investigated time trends in terms of incidence and choice of surgical methods during the two time periods 1990–2005 and 2006–2010.

Socioeconomic Factors

In countries with private insurance settings, socioeconomic factors may exert a significant influence on selection of the individuals that undergo bariatric surgery [16]. However, studies of the impact of socioeconomic factors on the probability of undergoing bariatric surgery are scarce. In Sweden, the costs of surgery should not be the primary limitation to receive surgery. However, the results of the present study are similar to a study from Canada [25], a country with a universal health insurance system similar to Sweden. The Canadian study showed low-income patients were less likely to be recommended for bariatric surgery.

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The factors that might influence the rate of bariatric surgery include rates of obesity in different socioeconomic group, referral patterns, individuals' awareness and demand, and surgeons' elimination criteria.

It is already known from multiple studies that obesity is distributed along a socioeconomic gradient with higher prevalence rates in low socioeconomic groups [26]. Furthermore, obesity-related comorbidities are more common in patients with lower incomes [25]. Despite the established fact that obesity is more common in low-income groups, our study showed that the likelihood of surgery was highest in the intermediate income and educational group. The highest socioeconomic groups underwent surgery less often which might reflect the lower rate of obesity in this group [26, 27] and a better lifestyle, i.e., a healthy diet and physical activity [28].

Although our study did not have access to individual-level data on behavior, there are some possible explanations to our findings that individuals in the lowest socioeconomic groups were less likely to undergo surgery. These individuals may be less likely to demonstrate a commitment to preoperative programs, a major precondition for surgical approval [25]. Successful maintenance of weight loss after bariatric surgery relies on patient compliance with postoperative medical and dietary management. Some of the patients eligible for these operations may have difficulties following the necessary postoperative management schemes because of educational or financial limitations [29]. Another limiting factor may be the referral patterns of care providers, leading to a decreased representation of lower socioeconomic groups [16]. Additionally, previous research indicates that obese patients in lower socioeconomic strata may experience a greater social acceptance of excess body weight [30].

Time Trends

The results of the time trend analyses showed an almost fivefold increase in bariatric surgery in Sweden during the study period. This might be not only due to an increasing incidence of morbid obesity in Sweden [2, 31] but also due to an altered view of obesity as a disease, necessitating treatment. Moreover, the awareness among patients about surgical options may have changed [17]. Additionally, the utilization of bariatric procedures has increased throughout the world in concordance with the expanding evidence base of the beneficial effects of surgery [32]. Most importantly, in Sweden, the increase was presumably in response to the publication of the Swedish obese subjects study [11] which most likely had an impact on rate of surgery and referral practice. The small peak in 1994 coincides with the incidence peak of restrictive procedures, such as gastric banding [17], due to the simplicity of the surgical technique and reversibility but the rate subsided later due to reports of complications of the method [33]. There are some similarities and some differences between the two studied time periods. The main differences were that in the second period, surgery was more common in individuals that were single and unemployed, in contrast to the first period. These differences might be due to the fact that in the first period, the number of surgeries was limited, resulting in a more restricted selection of patients.

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Gender

In this study, like many other studies [16, 34], women were overrepresented among operated individuals (76.3 %). This overrepresentation may be due to sociocultural norms about body size [35] encouraging women to seek bariatric surgery more often than men. Additionally, women underwent surgery at a younger age (30–39 years old) compared to men (40–49 years old), indicating that the cosmetic aspect of obesity might have been more important to women whereas men might have been less aware of the possibilities of surgical treatment.

Limitations and Strengths

This study had potential limitations. We were not able to include BMI or other anthropometric parameters as variables. Thus, we were unable to assess whether BMI affected the likelihood of undergoing bariatric surgery. Residual confounding is most likely present. For example, the socioeconomic variables cannot fully measure socioeconomic status. The limitations of the study are somewhat balanced by its strengths. To our knowledge, this is the first nationwide study, which included all patients that underwent bariatric surgery in Sweden during a 20-year period. Another important strength of our study is that it was based on Swedish hospitalization data that is highly complete [19].

Conclusion

The present nationwide study has contributed to novel findings of associations between socioeconomic factors and bariatric surgery. Even in a country like Sweden with a universal health-care insurance system, those in the lowest socioeconomic groups were less likely to undergo bariatric surgery, which may have a negative effect on individuals with largest need for weight loss. Further studies are needed to examine the potential barriers to bariatric surgery among individuals in the lowest socioeconomic strata.

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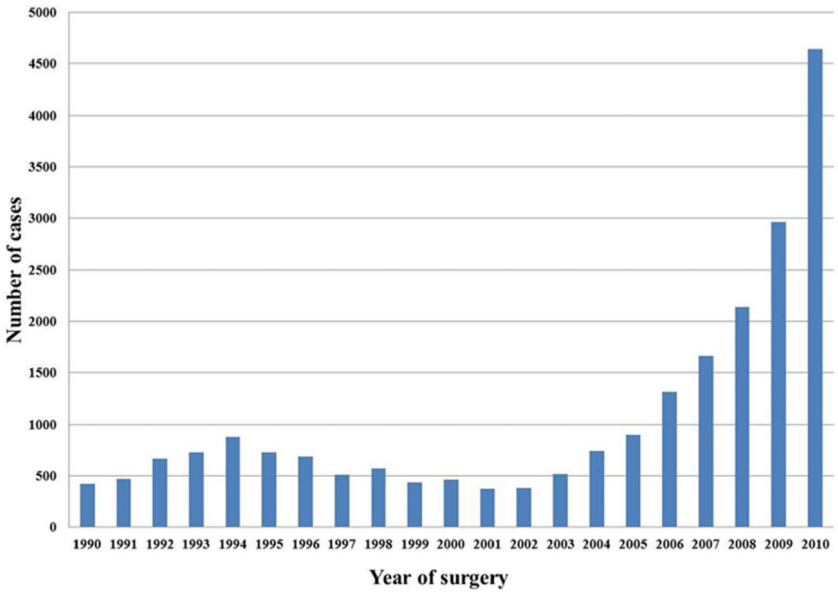

Fig. 1.

Number of cases of bariatric surgery, ages 20 to 64 years in Sweden, 1990–2010

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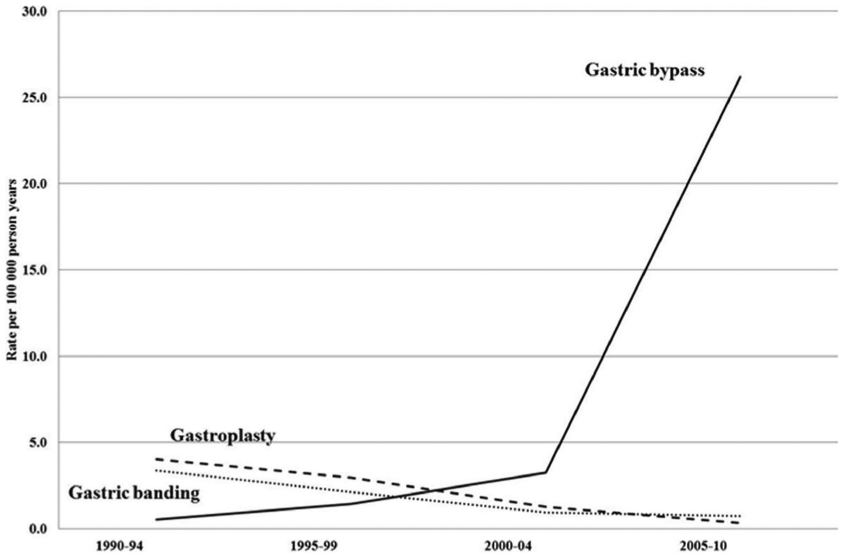

Fig. 2.

Age-adjusted incidence rates (per 100,000 person-years) of bariatric surgery, 1990–2010

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Table 1

Distribution of population, number of bariatric surgery events, and age-standardized incidence rates (IR) (per 100,000 person-years) of bariatric surgery, 1990–2010, open cohort

	Men (*N*=6,082,206)					Women (*N*=6,092,368)				
	No.	**%**	**IR**	**95 % CI**		**No.**	**%**	**IR**	**95 % CI**	
Total bariatric surgery events	5,258		5.6	5.5	5.8	16,940		18.5	18.2	18.8
Gastroplasty	801	15.2	0.8	0.8	0.9	2,891	17.1	3.1	3.0	3.2
Gastric bypass	3,754	71.4	3.9	3.7	4.0	11,651	68.8	12.5	12.2	12.7
Gastric banding	703	13.4	0.7	0.7	0.8	2,398	14.2	2.6	2.5	2.7
Age (years) at surgery										
20–29	640	12.2	5.1	4.7	5.5	2,721	16.1	22.7	21.9	23.6
30–39	1,383	26.3	10.2	9.7	10.7	5,460	32.2	42.0	40.9	43.1
40–49	1,803	34.3	13.1	12.5	13.7	5,153	30.4	38.6	37.6	39.7
50–64	1,432	27.2	7.9	7.5	8.3	3,606	21.3	20.2	19.6	20.9
Period										
1990–1994	726	13.8	3.6	3.3	3.9	2,439	14.4	12.5	12.0	13.0
1995–1999	614	11.7	2.7	2.4	2.9	2,327	13.7	10.5	10.1	11.0
2000–2004	580	11.0	2.5	2.3	2.7	1,896	11.2	8.6	8.2	9.0
2005–2010	3,338	63.5	13.0	12.6	13.5	10,278	60.7	42.0	41.2	42.8

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Table 2

Population, bariatric surgery events, and age-adjusted cumulative rates (per 1,000 individuals) by individual characteristics, closed cohorts

	Period 1990–2005					Period 2006–2010				
	Population	**Events**	**Rate**	**95 % CI**		**Population**	**Events**	**Rate**	**95 % CI**	
Total population	5,517,045	8,350	1.51	1.48	1.55	6,061,363	12,533	2.07	2.03	2.10
Gender										
Men	2,804,513	1,903	0.68	0.65	0.71	3,090,682	3,125	1.01	0.98	1.05
Women	2,712,532	6,447	2.38	2.32	2.43	2,970,681	9,408	3.17	3.10	3.23
Age at baseline (years)										
20–29	1,407,140	2,940	2.09	2.01	2.16	1,266,894	2,121	1.67	1.60	1.75
30–39	1,299,787	2,548	1.96	1.88	2.04	1,410,042	4,279	3.03	2.94	3.13
40–49	1,396,672	2,156	1.54	1.48	1.61	1,387,489	3,812	2.75	2.66	2.83
50–64	1,413,446	706	0.50	0.46	0.54	1,996,938	2,321	1.16	1.11	1.21
Family income (quartiles)										
Low	1,332,555	1,543	1.02	0.97	1.07	1,517,062	2,535	1.51	1.45	1.57
Intermediate-low	1,408,640	2,872	1.91	1.84	1.98	1,514,053	4,678	3.02	2.93	3.10
Intermediate-high	1,380,609	2,260	1.70	1.63	1.77	1,515,775	3,397	2.24	2.17	2.32
High	1,395,241	1,675	1.31	1.25	1.37	1,514,473	1,923	1.31	1.25	1.36
Marital status										
Married/cohabiting	2,637,039	3,938	1.97	1.91	2.03	2,300,169	5,022	2.52	2.45	2.59
Never married, widowed/divorced	2,880,006	4,412	1.42	1.38	1.46	3,761,194	7,511	1.99	1.94	2.03
Educational attainment										
Low	2,149,491	2,860	1.52	1.47	1.58	1,652,415	2,434	1.56	1.49	1.62
Intermediate	1,672,815	3,969	2.20	2.14	2.27	1,422,141	4,729	3.56	3.46	3.66
High	1,694,739	1,521	0.86	0.81	0.90	2,986,807	5,370	1.76	1.71	1.80
Employment status										
Employment	4,160,163	6,889	1.64	1.60	1.68	4,108,665	8,698	2.08	2.03	2.12
Unemployment	1,356,882	1,461	1.13	1.07	1.19	1,952,698	3,835	2.08	2.02	2.15

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Table 3

Hazard ratios (HR) of bariatric surgery by individual characteristics, Cox regression analysis

	Period 1990–2005						Period 2006–2010					
	Univariate model			Multivariate model			Univariate model			Multivariate model		
	HR	95 % CI		HR	95 % CI		HR	95 % CI		HR	95 % CI	
Gender												
Men	1.00			1.00			1.00			1.00		
Women	3.45	3.28	3.63	3.49	3.32	3.68	3.11	2.99	3.24	3.08	2.95	3.21
Age at baseline (years)												
20–29	1.00			1.00			1.00			1.00		
30–39	0.91	0.86	0.96	0.90	0.85	0.95	1.74	1.65	1.83	1.73	1.64	1.83
40–49	0.70	0.67	0.74	0.66	0.62	0.70	1.54	1.46	1.63	1.41	1.33	1.50
50–64	0.24	0.22	0.26	0.20	0.18	0.22	0.65	0.61	0.69	0.57	0.53	0.61
Family income (quartiles)												
Low income	1.08	1.01	1.16	0.65	0.60	0.70	1.49	1.40	1.58	1.32	1.24	1.41
Intermediate-low income	1.69	1.59	1.80	1.01	0.95	1.08	2.44	2.31	2.57	1.41	1.33	1.50
Intermediate-high income	1.36	1.28	1.45	0.97	0.91	1.04	1.77	1.67	1.87	1.27	1.20	1.36
High income	1.00			1.00			1.00			1.00		
Marital status												
Married/cohabiting	1.00			1.00			1.00			1.00		
Never married, widowed/divorced	1.08	1.04	1.13	0.91	0.87	0.96	0.96	0.92	0.99	1.11	1.07	1.15
Educational attainment												
Low	1.60	1.50	1.70	2.38	2.23	2.54	0.91	0.87	0.95	1.67	1.59	1.76
Intermediate	2.62	2.47	2.78	2.52	2.37	2.68	1.84	1.77	1.92	2.01	1.93	2.10
High	1.00			1.00			1.00			1.00		
Employment status												
Employment	1.00			1.00			1.00			1.00		
Unemployment	0.76	0.71	0.80	0.88	0.82	0.94	1.03	0.99	1.07	1.37	1.31	1.43

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