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Country of origin and bariatric surgery in Sweden during 2001–2010

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Abstract

Background—The prevalence of obesity, as well as use of bariatric surgery, has increased worldwide. The aim of the present study was to investigate the potential differences in the use of bariatric surgery among Swedes and immigrants in Sweden and whether the hypothesized differences remain after adjustment for socioeconomic factors.

Methods—A closed cohort of all individuals aged 20–64 years was followed during 2001–2010. Further analyses were performed in 2 periods separately (2001–2005 and 2006–2010). Age-standardized cumulative incidence rates (CR) of bariatric surgery were compared between Swedes and immigrants considering individual variables. Cox proportional hazards models were used in univariate and multivariate models for males and females.

Results—A total of 12,791 Swedes and 2060 immigrants underwent bariatric surgery. The lowest rates of bariatric surgery were found in immigrant men. The largest difference in CR between Swedes and immigrants was observed among low-income individuals (3.4 and 2.3 per 1000 individuals, respectively). Adjusted hazard ratios (HRs) were lower for all immigrants compared with Swedes in the second period. The highest HRs were observed among immigrants from Chile and Lebanon and the lowest among immigrants from Bosnia. Except for Nordic countries, immigrants from all other European countries had a lower HR compared with Swedes.

Conclusions—Men in general and some immigrant groups had a lower HR of bariatric surgery. Moreover, the difference between Swedes and immigrants was more pronounced in individuals with low socioeconomic status (income). It is unclear if underlying barriers to receive bariatric surgery are due to patients' preferences/lack of knowledge or healthcare structures. Future studies are needed to examine potential causes behind these differences.

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Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.soard.2015.03.014>.

Keywords

Obesity; Bariatric surgery; Country of origin; Immigrants; Socioeconomic status

Similar to many other Western European countries, there has been an increase in immigration to Sweden during the last decades. In 1990, 11.3% of the total population were first-generation immigrants compared with 14.7% in 2010 [1]. During the 1950s and 1960s, the majority of immigrants came from Italy, Finland, Greece, and the former Yugoslavia to meet an increasing need for industrial labor, whereas immigrants during the 1970s and 1980s were mainly political refugees from Poland, Turkey, Latin America, the Middle East, Asia, Africa, and the former Yugoslavia [2]. Thus, immigrants in Sweden are very heterogeneous regarding reason for emigration, educational level, social class, and health status. In general, immigrants have a higher risk for health problems compared with the majority population [2,3]. Decline of the psychosocial status [4] and changes in lifestyle might be possible explanations. Changes in lifestyle may include unhealthy dietary patterns, which might explain why many immigrant groups in Sweden have higher rates of obesity [5–7].

The prevalence of obesity, defined as body mass index (BMI) ≥ 30 kg/m², has doubled in Sweden over the past 20 years [8,9]. Obesity is associated with higher mortality, decreased quality of life, and greater overall costs to the healthcare system due to its numerous co-morbidities, such as diabetes, hypertension, cardiovascular disease, sleep apnea syndrome, and degenerative skeletal diseases [10,11]. Morbid obesity (BMI ≥ 40 kg/m²) is generally refractory to diet, exercise, and drug therapies [12,13]. Bariatric surgery often results in substantial weight loss, resolution and/or improvement of obesity-related co-morbidities, reduced mortality, and improved quality of life [14–16]. In Sweden, individuals with BMI ≥ 40 kg/m² or those with BMI ≥ 35 kg/m² plus obesity-associated comorbidity are eligible for bariatric surgery [17]. Studies from countries with private healthcare insurance systems have found that although obesity is more prevalent among economically disadvantaged and ethnic minorities, these patients undergo bariatric surgery less than expected [18–20]. Sweden has universal healthcare insurance, which means that financial reasons should not be a major obstacle in the probability of receiving bariatric surgery. However, earlier studies found that individuals with the lowest socioeconomic status undergo bariatric surgery at a lower rate [21]. In addition, immigrants in general have a higher risk for many health problems [2,3]. The authors' hypothesis was that there are, despite medical eligibility, still differences associated with country of origin and the rate of bariatric surgery in Sweden. The primary aim of the present study was to investigate the potential differences in the use of bariatric surgery by country of origin and gender in Sweden during 2001–2010. The secondary aim was to investigate whether the hypothesized differences in bariatric surgery remain after adjustment for socioeconomic factors. To the authors' knowledge, this is the first nationwide study that compares differences in bariatric surgery rates between Swedes and immigrants.

Materials and methods

Data used in this study incorporated 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 [22] 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 to provide anonymity.

The follow-up period started on January 1, 2001, and proceeded until first hospitalization for bariatric surgery, death, emigration, or the end of the study period on December 31, 2010. Further analyses were done in 2 periods separately (i.e., 2001–2005 and 2006–2010) as there was a large increase in the number of surgeries during the second period. Because the analyses were done as closed cohorts, the total number of operated cases for the period 2001–2010 was not the same as the sum of the number of cases for 2001–2005 and 2006–2010.

Outcome variable

The outcome variable was bariatric surgery. The Swedish Inpatient Register was used to identify main diagnoses of obesity and operation in the study population during the study period. The *International Classification of Diseases*, Tenth Revision (ICD-10), was used to identify patients with a diagnosis of obesity (ICD-10, E66) [23]. The Swedish Classification of Operations and Major Procedures was used to identify patients undergoing bariatric surgery: operation codes JDF00-JDF01, JDF10-JDF11, and JDF20-JDF21. The subtypes of bariatric surgery were defined as gastropasty (JDF00-JDF01), gastric bypass (JDF10-JDF11), and gastric banding (JDF20-JDF21). All the operated cases (events) had both an ICD code for obesity and an ICD code for bariatric surgery.

Individual variables

The individual variables were defined at the initial year for each study period:

Gender: Male or female.

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

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. For example, 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 [24]. The final variable was calculated as empirical quartiles from the distribution [25] and classified as low, middle-low, middle-

high, and high. Family's consumption weight was calculated as follows: 1.00 for the first adult, .51 for the second adult, .62 for the third adult, .52 for the first child (0–19 yr), and .42 for child number 2 or more (0–19 yr). For example, a family that consists of 1 adult and 2 children has a total consumption weight of 1.00 (adult) + .52 (first child) + .42 (second child) = 1.94.

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

Employment: Defined as yes (including part-time employment) or no.

Predictor variable

The predictor variable was country of birth, defined as Swedish-born and foreign-born, the latter subdivided further as described below.

The data set included people from 64 countries and regions of birth (Supplementary Table 1). In the present study, countries were combined into 12 regions (Nordic countries, Southern Europe, Western Europe, Eastern Europe, Baltic countries, Central Europe, Africa, North America, Latin America, Asia, Russia and countries belonging to the southern part of the Soviet Union, and Other countries). Countries/country groups with more than 10 cases of obesity surgery were analyzed separately. These countries included Denmark, Finland, Norway, Greece, Italy, other Southern European countries, Great Britain/Ireland, Germany, Bosnia, former Yugoslavia, Romania, Poland, Hungary, Chile, Turkey, Lebanon, Iran, and Iraq.

Statistical analysis

Age-standardized cumulative incidence rates (CR) of bariatric surgery were compared between Swedes and immigrants considering individual variables. *P* values were calculated using Z-test calculators. A *P* value of <.05 was considered statistically significant. To compensate for multiple comparisons, estimates also were calculated based on a 99% confidence interval (CI). Individuals aged 20–64 years at the start of follow-up were included. Age was standardized according to the age in the study population. The associations between the individual variables and bariatric surgery were analyzed with Cox proportional hazards models. An advantage with this model is that individuals who are censored contribute to the analysis with their time under risk in the study. Firstly, univariate Cox regression was performed for each variable. Secondly, a multivariate Cox regression model including all variables was calculated. Separate analyses were performed for the periods 2001–2005 and 2006–2010. All analyses were performed using the SAS version 9.2 (SAS Institute, Cary, NC) [26].

Ethical considerations

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

Results

In the closed cohort between 2001 and 2010, a total number of 14,851 individuals (12,791 Swedes and 2060 immigrants) underwent bariatric surgery in Sweden. In Table 1A, the

distribution of the population and cumulative rates of bariatric surgery per 1000 individuals are shown. Overall, the lowest rates for bariatric surgery were found in immigrants who were male and those aged 50–64 years. Age-standardized cumulative incidence rate (CR) for immigrants was slightly lower (2.7 per 1000 individuals [95% CI: 2.6–2.9]) compared with Swedes (2.9 per 1000 individuals [95% CI: 2.9–3.0]) (although the difference was not statistically significant, $P = .3125$), with predominance for women in both groups (4.3 and 4.5 per 1000 individuals respectively). The age group with the highest CR was age group 30–39 years (both Swedes and immigrants). Fifteen percent of the Swedes had a low family income compared with 34.0% of the immigrants. The difference was statistically significant, $P < .05$. For the variable income, the lowest CRs were found among those with highest income in both Swedes and immigrants (1.9 and 2.0, respectively), whereas the highest CRs were among those in middle-low income groups (3.6 and 3.4, respectively). The largest difference in CR between Swedes and immigrants, with respect to income group, was among low-income individuals (3.4 and 2.3, respectively; the difference was statistically significant, $P < .001$). For marital status, the highest CR in Swedes was found in individuals who were married/cohabiting (3.6), whereas for immigrants there was no difference in CR among the 2 groups (2.8). For employment status, the highest CR for Swedes was among those with no employment, whereas for immigrants it was among those with employment (4.4 and 2.9, respectively).

Because Table 1A shows a closed cohort during a 10-year period, many of the variables, including marital status, employment, and family income, might change over time. For this reason, the 10-year period was divided into 2 periods, 2001–2005 and 2006–2010, to capture the differences between these 2 periods. These results are shown in Table 1B and 1C. The results are relatively similar to those in Table 1A except for the following.

The rates of bariatric surgery were higher in the second period (i.e., 2006–2010). In this period (Table 1C), the highest CR by age group was found in Swedes aged 30–39 years and in immigrants aged 40–49 years. The lowest CRs in Swedes and immigrants were in age groups 50–64 years and 20–29 years, respectively. For income, the highest CR in the second period was among Swedes with the lowest income, whereas in the first period the highest CR was among Swedes with a middle-low income. For immigrants, the highest CR was among those with middle-low income in both periods. The CRs for employment status in immigrants differed in the first and second period compared with the whole period 2001–2010. During the whole period, the CR was highest for those with employment, whereas in the 2 periods 2001–2005 and 2006–2010, there was no difference between employed and unemployed individuals.

Table 2 and 3 show hazard ratios (HRs) for bariatric surgery by different regions and countries of origin compared with Swedish-born, in men and women, respectively. HRs of bariatric surgery were analyzed in 2 different models (i.e., a crude model and a fully adjusted model). In the fully adjusted model, there was no significant difference in bariatric surgery between female immigrants and Swedes. However, male immigrants had a lower HR for bariatric surgery compared with Swedes.

In Table 2, the highest HR in men in the full model was among immigrants from Chile (HR 2.40 [95% CI: 1.76–3.29]) and Lebanon (HR 2.34 [95% CI: 1.65–3.31]). The lowest HRs were found in men from Bosnia (HR .11 [95% CI: .04–.33]) and Turkey (HR .43 [95% CI: .22–.83]). Immigrant men from Nordic countries (Denmark, Finland, and Norway) had higher HRs than Swedes.

In Table 3, the HRs for women were very similar to the HRs for men. In the full model, the highest HR in women was among immigrants from Chile (HR 3.77 [95% CI: 3.28–4.33]), Lebanon (HR 1.65 [95% CI: 1.31–2.07]), and Iran (HR 1.53 [95% CI: 1.31–1.80]). The lowest HRs were found in women born in Bosnia (HR .29 [95% CI: .20–.41]) Great Britain/Ireland (HR .49 [95% CI: .24–.98]), and Germany (HR .54 [95% CI: .35–.83]). Among females from the Nordic countries, only those from Finland and Norway had a significantly higher HRs than Swedes.

Results from the 2 periods 2001–2005 and 2006–2010 (men and women analyzed together), are shown in Table 4. In the first period, the HRs of bariatric surgery were not significantly different comparing Swedes and all immigrants, whereas in the second period the HR was lower for immigrants (.74 [95% CI: .71–.78]). The highest HRs in both periods were for immigrants from Chile followed by Lebanon. The lowest HRs in both periods were found in immigrants from Bosnia followed by Germany in the first period and Great Britain/Ireland in the second period. Immigrants from the Nordic countries, especially Finland, had higher HRs compared with Swedes in both periods.

Discussion

To the authors' knowledge, no previous nationwide study has compared bariatric surgery rates in Sweden among Swedish-born individuals and immigrants. Despite Sweden's public health insurance, differences were found in rates of bariatric surgery in different sociodemographic and country groups. In the present study, the rates of bariatric surgery were lowest among those who were middle-aged and unemployed male immigrants. An American study from 2013 reported that fewer black than white males underwent bariatric surgery [27]. The highest probability to undergo bariatric surgery was found in immigrants from Chile (adjusted HR 3.77 in women and 2.40 in men) followed by Lebanon, whereas the lowest probability was found in immigrants from Bosnia (HR .11 for men and .29 for women), compared with Swedes.

Several American studies have suggested that the procedure is used inequitably according to ethnicity and socioeconomic status [18,28,29]. Because the rate of morbid obesity is much higher in the lowest socioeconomic status (SES) groups [19,30], one might expect that the rate of bariatric surgery would be highest in this group. The present study found, however, that the highest bariatric surgery rate belonged to middle-low income group in both Swedes and immigrants.

In the present study, there was no significant difference in the HR for bariatric surgery in females from Sweden and females from other countries. In contrast, male immigrants had a lower HR for bariatric surgery compared with Swedes. However, there were significant

differences between the different countries of origin. The overall result indicated that among European immigrants, those from Nordic countries had higher HRs for bariatric surgery compared with Swedes, whereas immigrants from every other country in Europe had a lower HR. Among immigrants from countries outside Europe, Chile and Lebanon had higher HRs compared with Swedes. These differences sometimes reflect the rates of obesity in certain immigrant groups but not always. In a Swedish cross-sectional study [31], the prevalence ratio (PR) of obesity for women from Chile was markedly increased, corresponding to the high HR for bariatric surgery in the present study. A more recent study from Sweden [5] reported, however, that immigrants from the Middle East had significantly higher odds (almost 3 times higher) for obesity. The present study found different results for Middle Eastern countries: For example, Lebanon had higher HRs for bariatric surgery, whereas Iraq had similar or even lower HRs (second period) than Swedes. Although obesity rates in most other OECD Countries are higher compared with Sweden [32], the HRs for bariatric surgery were lower for almost all other OECD countries included in the present study except for Nordic countries and Chile. Among the Nordic countries, Norway has a lower obesity rate compared with Sweden and still the HR for bariatric surgery for both men and women were higher for immigrants from Norway compared with Swedes.

The process of migration involves major challenges in an individual's life such as social, familial, occupational, and economic disruption, which might lead to stress and unhealthy behaviors like physical inactivity and obesity [4,33]. Former studies show that many immigrant groups in Sweden have higher rates of obesity [5–7,31]. As found in this study and some other studies [6,7], unemployment rates are higher among immigrants. Employment status differed between Swedes and immigrants and during the first and second period. Among Swedes who had been operated, the rate of unemployment was higher compared with immigrants. It has been suggested that unemployment is also related to reduced levels of activity, which would contribute to a more sedentary lifestyle.

In countries with private insurance settings, socioeconomic factors may exert a significant influence on the probability of individuals undergoing bariatric surgery [18]. In Sweden, a country with a universal health insurance, the costs of surgery should not be a primary barrier to receiving surgery. There are other factors that should influence the selection of individuals for bariatric surgery, such as medical eligibility—that is, rates of morbid obesity and its co-morbidity in different groups. Significant differences might exist between different ethnic and socioeconomic groups in the perception of obesity and bariatric surgery, which might lead to differences in seeking bariatric surgery. The referral patterns of primary care providers might be biased by the patient's ethnicity and other factors, which may lead to altered patterns for seeking and receiving surgical intervention. Low referral rates for ethnic minorities were reported in an American study from 2007 [34]. Another study reported that blacks and men were less likely to have been recommended bariatric surgery by their doctors [35]. In addition, several American studies have found less weight loss among nonwhite patients after bariatric surgery [36,37].

Previous work suggests that ethnic minorities are less likely to undergo bariatric surgery [38]. This was also shown for the whole immigrant population in the present study. On the other hand, there were large variations between different immigrant groups. The factors

underlying such large variations in the use of bariatric surgery in different immigrants group are unclear. Differences in obesity rates among different ethnical groups could probably influence the rate of bariatric surgery. Another explanation is that obesity is culturally, socially, and economically more stigmatizing for some immigrants than others who have a more positive body image and larger social acceptance for obesity, which may lead to lower weight loss goals. Some cultures may have higher ideal weights and desire less weight loss than others. Thus, the motivation to seek potentially risky weight loss treatments such as bariatric surgery may differ among different subgroups of immigrants. These cultural differences could be more prevalent among low SES immigrants and could therefore be a potential explanation behind our findings. An American study found that quality of life was higher among black compared with Caucasian patients with obesity [35] and that patients seeking weight loss treatment tended to have poorer quality of life than obese persons in the community [39]. It is also possible that some individuals with very low SES do not even have the knowledge about alternative weight loss procedures and thus not demanding them. Another possible explanation is that lower rates of bariatric surgery among low SES immigrants might reflect cultural differences in preferences regarding surgical treatment in general. An American study from 2007 found negative patient perceptions of bariatric surgery among black women [40]. Furthermore, some immigrants may choose to undergo bariatric surgery in their country of origin instead of in Sweden. Healthy migration bias (i.e., those who chose to migrate are healthier individuals compared with those who do not migrate [41]), might be another reason for lower rates of bariatric surgery among some immigrant groups.

Previous study results, regarding ethnicity and inequalities in access to healthcare, indicate underlying socioeconomic diversity and differences in healthcare delivery [42]. For this reason, unadjusted results among ethnic minorities have to be interpreted with caution. Santry et al. reported that ethnicity did not influence access to bariatric surgery and that surgeon decisions did not contribute to race and gender disparities in bariatric surgery. Patients' age, BMI, and social support were most influential [43]. This suggests that factors other than surgeon's discretion might result in race and gender disparities in bariatric surgery. Another study from the United Kingdom found that bariatric surgery is provided equally to ethnic minority groups [44].

Generally, obstacles in receiving bariatric surgery are complex and are a combination of individual evaluation of health and appearance, primary care physicians and surgeons selection, and healthcare structural factors.

This study shows social disparities in Sweden with a social gradient in obesity surgery, and it is likely that major mechanisms underlying these disparities are broadly similar across many Western countries. Moreover, around 26% of the population are first- or second-generation immigrants from all parts of the world. This has resulted in an ethnically and culturally diverse population, thereby increasing the generalizability of the results.

Limitations and strengths

The present results must be interpreted in the context of its limitations. First, BMI and other anthropometric parameters could not be included as variables, which made it impossible to

directly compare the rate of bariatric surgery and morbid obesity according to country of birth. Secondly, the study lacks comparable information about incidence rates of obesity and bariatric surgery in the country of origin. In addition, although income was included, educational level could not be included in the present study, because data on education were missing for many immigrants, especially those newly arrived. The limitations of the study are, however, balanced by its strengths. To the authors' knowledge, this is the first nationwide study that included all patients who underwent bariatric surgery in Sweden during a 10-year period. Another important strength of the present study is that it was based on hospitalization data and the Swedish Inpatient Register, which is complete and has been extensively validated in previous studies [45]. Thirdly, the analyses took several sociodemographic variables into account. Finally, both men and women were included and analyzed separately.

Conclusions

The results of the present study present interesting findings. Even in countries like Sweden, with universal health insurance, men, some immigrant groups, and individuals with low socioeconomic status are underrepresented among those who receive bariatric surgery. It is unclear if underlying barriers to receive bariatric surgery are due to patients' preferences/lack of knowledge or healthcare structures. Future studies, including qualitative studies, are needed to examine potential causes behind differences by sociodemographic factors, focusing on patients, doctors, and structural barriers. Public awareness about morbid obesity as a health problem rather than a cosmetic issue should also be increased. Healthcare providers should be aware of indications and benefits of bariatric surgery to refer medically eligible patients for bariatric surgery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1A

Distribution of population, number of obesity surgery events, and age-standardized cumulative rates (per 1000) of obesity surgery, 2001-2010

	Born in Sweden					Immigrants				
	Population		Events		P [*]	CR		Events		P
	No.	%	No.	%		CR	95% CI	No.	%	
Total population (%)	4,379,014		12,791			2.9	2.9 3.0	722,289	2060	
Gender										
Men	2,236,593	51.1	3199	25.0	1.4 1.5 <.001	1.4	1.4 1.5	353,925	49.0	423 20.5 1.1 1.0 1.3 <.001
Women	2,142,421	48.9	9592	75.0	4.5 4.4 4.6 -	4.5	4.4 4.6	368,364	51.0	1637 79.5 4.3 4.1 4.5 -
Age (years)										
20-29	919,931	21.0	3332	26.0	3.6 3.5 3.7 -	3.6	3.5 3.7	142,112	19.7	425 20.6 3.0 2.7 3.3 -
30-39	1,035,269	23.6	4917	38.4	4.7 4.6 4.9 <.001	4.7	4.6 4.9	195,823	27.1	721 35.0 3.7 3.4 4.0 .001
40-49	957,560	21.9	3106	24.3	3.2 3.1 3.4 <.001	3.2	3.1 3.4	181,245	25.1	623 30.2 3.4 3.2 3.7 .027
50-64	1,466,254	33.5	1436	11.2	1.0 .9 1.0 <.001	1.0	.9 1.0	203,109	28.1	291 14.1 1.4 1.3 1.6 <.001
Family income (quartiles) [†]										
Low income	482,322	11.0	1923	15.0	3.4 3.3 3.6 <.001	3.4	3.3 3.6	261,460	36.2	701 34.0 2.3 2.1 2.5 <.001
Middle-low income	1,258,896	28.7	5082	39.7	3.6 3.5 3.7 <.001	3.6	3.5 3.7	196,786	27.2	710 34.5 3.4 3.1 3.6 <.001
Middle-high income	1,311,858	30.0	3588	28.1	2.9 2.8 3.0 <.001	2.9	2.8 3.0	147,263	20.4	431 20.9 3.1 2.8 3.4 <.001
High income	1,325,938	30.3	2198	17.2	1.9 1.8 2.0 -	1.9	1.8 2.0	116,780	16.2	218 10.6 2.0 1.7 2.3 -
Marital status										
Married/cohabiting	1,894,071	43.3	4595	35.9	3.6 3.5 3.7 -	3.6	3.5 3.7	373,628	51.7	1034 50.2 2.8 2.6 3.0 -
Never married, widowed, or divorced	2,484,943	56.7	8196	64.1	3.0 3.0 3.1 <.001	3.0	3.0 3.1	348,661	48.3	1026 49.8 2.8 2.6 3.0 .164
Employment status										
No	927,820	21.2	3399	26.6	4.4 4.2 4.5 <.001	4.4	4.2 4.5	326,556	45.2	874 42.4 2.7 2.5 2.8 .011
Yes	3,451,194	78.8	9392	73.4	2.7 2.6 2.7 -	2.7	2.6 2.7	395,733	54.8	1186 57.6 2.9 2.7 3.1 -

No. = number; CR = cumulative incidence rates; CI = confidence interval.

^{*} P values are calculated according to reference group in each category (shown with "-"), for Swedes and immigrants separately.

[†] Annual family income in Swedish crowns: low income, 0-92,000; middle-low income, 92,001-121,500; middle-high income, 121,501-161,000; high income, > 161,000.

Table 1B

Distribution of population, number of obesity surgery events, and age-standardized cumulative rates (per 1000) of obesity surgery, 2001-2005

	Born in Sweden					Immigrants				
	Population		Events		P [*]	CR		Events		P
	No.	%	No.	%		No.	%	No.	%	
Total population (%)	4,379,014		2695			.6	.6	471		.7
Gender										
Men	2,236,593	51.1	625	23.2	.3	.3	.3	87	18.5	.2
Women	2,142,421	48.9	2070	76.8	1.0	.9	1.0	384	81.5	.9
Age (yr)										
20-29	919,931	21.0	529	19.6	.6	.5	.6	59	12.5	.4
30-39	1,035,269	23.6	1030	38.2	1.0	.9	1.1	153	32.5	.8
40-49	957,560	21.9	682	25.3	.7	.7	.8	155	32.9	.9
50-64	1,466,254	33.5	454	16.8	.3	.3	.3	104	22.1	.5
Family income (quartiles) [†]										
Low income	482,322	11.0	403	15.0	.7	.7	.8	140	29.7	.5
Middle-low income	1,258,896	28.7	1108	41.1	.8	.7	.8	177	37.6	.9
Middle-high income	1,311,858	30.0	778	28.9	.6	.6	.7	98	20.8	.7
High income	1,325,938	30.3	406	15.1	.3	.3	.4	56	11.9	.5
Marital status										
Married/cohabiting	1,894,071	43.3	1085	40.3	.8	.7	.8	244	51.8	.6
Never married, widowed, or divorced	2,484,943	56.7	1610	59.7	.6	.6	.7	227	48.2	.7
Employment status										
No	927,820	21.2	866	32.1	1.1	1.1	1.2	224	47.6	.7
Yes	3,451,194	78.8	1829	67.9	.5	.5	.5	247	52.4	.6

No. = number; CR = cumulative incidence rates; CI = confidence interval.

^{*} P values are calculated according to reference group in each category (shown with "-"), for Swedes and immigrants separately.[†] Annual family income in Swedish crowns: low income, 0-92,000; middle-low income, 92,001-121,500; middle-high income, 121,501-161,000; high income, > 161,000.

Table 1C

Distribution of population, number of obesity surgery events, and age-standardized cumulative rates (per 1000) of obesity surgery, 2006-2010

	Born in Sweden				Immigrants											
	Population		Events		CR		P *		Population		Events		CR		P	
	No.	%	No.	%	CR	95% CI	CR	95% CI	No.	%	No.	%	CR	95% CI	CR	95% CI
Total population (%)	4,373,452		10,769		2.5	2.4	2.5		835,443		1776		2.1	2.0	2.2	
Gender																
Men	2,237,855	51.2	2,695	25.0	1.2	1.2	1.3	<.001	409,283	49.0	370	20.8	.9	.8	1.0	<.001
Women	2,135,597	48.8	8,074	75.0	3.8	3.7	3.9	-	426,160	51.0	1406	79.2	3.2	3.1	3.4	-
Age (yr)																
20-29	880,059	20.1	1,793	16.6	2.0	1.9	2.1	-	184,386	22.1	260	14.6	1.4	1.2	1.6	-
30-39	976,909	22.3	3,698	34.3	3.8	3.7	3.9	<.001	215,699	25.8	548	30.9	2.5	2.3	2.8	<.001
40-49	991,420	22.7	3,293	30.6	3.3	3.2	3.4	<.001	207,932	24.9	573	32.3	2.8	2.5	3.0	<.001
50-64	1,525,064	34.9	1,985	18.4	1.3	1.2	1.4	<.001	227,426	27.2	395	22.2	1.7	1.6	1.9	.009
Family income (quartiles) [†]																
Low income	913,344	20.9	3,402	31.6	3.3	3.2	3.4	<.001	389,845	46.7	800	45.0	2.1	1.9	2.2	<.001
Middle-low income	1,110,900	25.4	3,379	31.4	3.1	3.0	3.2	<.001	192,884	23.1	529	29.8	2.7	2.5	2.9	<.001
Middle-high income	1,158,073	26.5	2,487	23.1	2.1	2.1	2.2	<.001	143,114	17.1	292	16.4	2.0	1.7	2.2	<.001
High income	1,191,135	27.2	1,501	13.9	1.3	1.2	1.4	-	109,600	13.1	155	8.7	1.4	1.2	1.6	-
Marital status																
Married/cohabiting	1,796,063	41.1	4,173	38.8	3.0	2.9	3.1	-	420,449	50.3	914	51.5	2.1	1.9	2.2	-
Never married, Widowed, or divorced	2,577,389	58.9	6,596	61.2	2.6	2.5	2.6	<.001	414,994	49.7	862	48.5	2.1	2.0	2.3	.338
Employment status																
No	853,303	19.5	3,025	28.1	4.4	4.3	4.6	<.001	380,233	45.5	779	43.9	2.1	2.0	2.3	.163
Yes	3,520,149	80.5	7,744	71.9	2.2	2.1	2.2	-	455,210	54.5	997	56.1	2.1	2.0	2.2	-

No. = number; CR = cumulative incidence rates; CI = confidence interval.

* P values are calculated according to reference group in each category (shown with "-"), for Swedes and immigrants separately.

[†] Annual family income in Swedish crowns: low income, 0-92,000; middle-low income, 92,001-121,500; middle-high income, 121,501-161,000; high income, > 161,000.

Table 2

Hazard ratios of bariatric surgery in male immigrants

Birth country	Crude					Adjusted model [*]		
	Population	Cases	HR	95 % CI		HR	95 % CI	
Swedish	2,236,593	3199	ref.			Ref.		
Nordic countries	82,847	138	<u>1.32</u>	<u>1.11</u>	<u>1.56</u>	<u>1.46</u>	<u>1.23</u>	<u>1.73</u>
Denmark	12,353	22	1.45	.95	2.20	<u>1.56</u>	<u>1.03</u>	<u>2.38</u>
Finland	58,123	91	1.21	.98	1.49	<u>1.37</u>	<u>1.11</u>	<u>1.69</u>
Norway	11,072	21	<u>1.61</u>	<u>1.05</u>	<u>2.48</u>	<u>1.65</u>	<u>1.08</u>	<u>2.54</u>
Southern Europe	15,422	11	.61	.34	1.10	.62	.34	1.12
Greece	4,968	1	.17	.02	1.18	.18	.03	1.28
Italy	3,080	4	1.08	.40	2.87	1.16	.44	3.10
Other Southern European countries	2,155	3	1.13	.36	3.49	1.10	.36	3.43
Western Europe	25,585	18	<u>.57</u>	<u>.36</u>	<u>.91</u>	<u>.61</u>	<u>.39</u>	<u>.97</u>
Great Britain, Ireland	8,980	6	.57	.25	1.26	.55	.25	1.24
Germany	11,205	9	.63	.33	1.21	.73	.38	1.40
Eastern Europe	53,488	24	<u>.32</u>	<u>.22</u>	<u>.48</u>	<u>.31</u>	<u>.21</u>	<u>.47</u>
Bosnia	18,326	3	<u>.12</u>	<u>.04</u>	<u>.36</u>	<u>.11</u>	<u>.04</u>	<u>.33</u>
Yugoslavia	26,147	18	<u>.49</u>	<u>.31</u>	<u>.78</u>	<u>.49</u>	<u>.31</u>	<u>.78</u>
Romania	4,067	3	.54	.18	1.68	.52	.17	1.63
Baltic countries	2,100	2	.78	.20	3.12	.92	.23	3.69
Central Europe	12,540	16	.95	.58	1.55	.94	.57	1.53
Poland	10,220	14	1.01	.60	1.70	.97	.58	1.64
Hungary	4,826	4	.62	.23	1.66	.71	.27	1.90
Africa	25,243	11	<u>.35</u>	<u>.19</u>	<u>.62</u>	<u>.31</u>	<u>.17</u>	<u>.56</u>
North America	6,092	5	.76	.32	1.83	.72	.30	1.73
Latin America	18,470	50	<u>2.02</u>	<u>1.53</u>	<u>2.67</u>	<u>1.76</u>	<u>1.33</u>	<u>2.33</u>
Chile	10,827	40	<u>2.71</u>	<u>1.98</u>	<u>3.70</u>	<u>2.40</u>	<u>1.76</u>	<u>3.29</u>
Asia	98,931	135	1.01	.85	1.19	.90	.75	1.08
Turkey	13,957	9	<u>.46</u>	<u>.24</u>	<u>.89</u>	<u>.43</u>	<u>.22</u>	<u>.83</u>
Lebanon	9,025	33	<u>2.66</u>	<u>1.89</u>	<u>3.75</u>	<u>2.34</u>	<u>1.65</u>	<u>3.31</u>
Iran	22,972	31	.99	.70	1.41	.91	.64	1.30
Iraq	22,065	39	1.27	.93	1.75	1.13	.82	1.56
Russia	3,505	3	.68	.22	2.12	.63	.20	1.94
Others	4,876	6	1.03	.46	2.30	.88	.39	1.96
All immigrants	353,925	423	.91	.83	1.01	<u>.90</u>	<u>.81</u>	<u>.99</u>

HR = hazard ratios; CI = confidence interval.

Bold type indicates that 95% CI does not include 1.00. Underline indicates that 99% CI does not include 1.00.

* Adjusted for age, marital status, family income, and employment status.

Table 3

Hazard ratios of bariatric surgery in female immigrants

Birth country	Crude				Adjusted model [*]		
	Population	Cases	HR	95 % CI	HR	95 % CI	
Swedish	2,142,421	9592	ref.		ref.		
Nordic countries	100,827	450	1.07	.97 1.17	1.32	1.20	1.45
Denmark	10,611	40	.93	.68 1.27	1.05	.77	1.43
Finland	75,490	339	1.05	.95 1.18	1.37	1.23	1.53
Norway	13,436	69	1.30	1.03 1.65	1.40	1.10	1.77
Southern Europe	9390	37	1.05	.76 1.45	1.01	.73	1.39
Greece	3,166	13	1.09	.63 1.87	1.10	.64	1.90
Italy	1,372	6	1.13	.51 2.51	1.15	.51	2.55
Other Southern European countries	1,487	11	1.85	1.02 3.34	1.70	.94	3.06
Western Europe	18,949	36	.48	.35 .66	.53	.38	.74
Great Britain, Ireland	4,346	8	.50	.25 .99	.49	.24	.98
Germany	10,772	20	.45	.29 .70	.54	.35	.83
Eastern Europe	52,714	137	.59	.50 .70	.49	.41	.58
Bosnia	18,276	30	.37	.26 .53	.29	.20	.41
Yugoslavia	24,603	82	.75	.61 .94	.65	.53	.81
Romania	4,908	17	.81	.50 1.30	.71	.44	1.14
Baltic countries	3,453	8	.56	.28 1.13	.54	.27	1.08
Central Europe	23,806	56	.54	.42 .70	.55	.42	.71
Poland	20,858	50	.55	.42 .73	.55	.42	.73
Hungary	4,801	18	.88	.55 1.40	.99	.62	1.57
Africa	19,948	49	.61	.46 .81	.44	.33	.58
North America	4,953	26	1.55	1.05 2.27	1.41	.96	2.07
Latin America	19,131	261	3.25	2.88 3.68	2.61	2.31	2.95
Chile	10,427	207	4.64	4.04 5.33	3.77	3.28	4.33
Asia	98,002	510	1.21	1.11 1.33	.88	.80	.96
Turkey	12,229	68	1.26	.99 1.60	.93	.73	1.18
Lebanon	7,084	75	2.45	1.95 3.08	1.65	1.31	2.07
Iran	18,591	156	1.97	1.68 2.30	1.53	1.31	1.80
Iraq	16,110	110	1.57	1.30 1.89	1.07	.89	1.30
Russia	8,391	31	.87	.61 1.24	.73	.51	1.03
Others	3,999	18	1.18	.74 1.87	.91	.57	1.44
All immigrants	368,364	1637	1.06	1.00 1.11	.96	.91	1.01

HR = hazard ratios; CI = confidence interval.

Bold type indicates that 95% CI does not include 1.00. Underline indicates that 99% CI does not include 1.00.

^{*} Adjusted for age, marital status, family income, and employment status.

Table 4

Hazard ratios of bariatric surgery in immigrants, 2001-2005 and 2006-2010

Birth country	2001-2005				2006-2010			
	Population	Cases	HR *	95% CI	Population	Cases	HR *	95% CI
Swedish	4,379,014	2695	ref.		4,373,452	10,769	ref.	
Nordic countries	183,674	135	1.21	1.02	1.44	462	1.18	1.07
Denmark	22,964	10	.76	.41	1.41	52	.81	.61
Finland	133,613	100	1.24	1.01	1.52	329	1.28	1.14
Norway	24,508	23	1.46	.97	2.20	78	1.24	.99
Southern Europe	24,812	11	.76	.42	1.38	24,947	41	.70
Greece	8,134	2	.41	.10	1.63	13	.77	.45
Italy	4,452	2	.91	.23	3.64	8	.89	.45
Other Southern European countries	3,642	4	1.76	.66	4.69	13	1.26	.73
Western Europe	44,534	12	.49	.28	.87	46	.43	.32
Great Britain, Ireland	13,326	3	.45	.14	1.39	12	.39	.22
Germany	21,977	4	.32	.12	.85	28	.51	.36
Eastern Europe	106,202	40	.50	.36	.68	137	.38	.32
Bosnia	36,602	5	.17	.07	.42	32	.26	.18
Yugoslavia	50,750	29	.77	.54	1.12	76	.44	.35
Romania	8,975	5	.75	.31	1.79	19	.63	.40
Baltic countries	5,553	0			7,658	13	.50	.29
Central Europe	36,346	23	.81	.54	1.22	54	.39	.30
Poland	31,078	20	.80	.52	1.25	50	.40	.30
Hungary	9,627	8	1.35	.67	2.70	15	.68	.41
Africa	45,191	8	.24	.12	.47	60	.32	.25
North America	11,045	11	1.60	.89	2.90	27	.90	.62
Latin America	37,601	68	2.39	1.88	3.05	278	2.16	1.91
Chile	21,254	59	3.76	2.90	4.87	209	3.30	2.87
Asia	196,933	144	.89	.75	1.07	589	.69	.63
Turkey	26,186	17	.82	.51	1.33	60	.64	.49
Lebanon	16,109	26	2.00	1.35	2.96	87	1.43	1.16

Birth country	2001-2005				2006-2010			
	Population	Cases	HR *	95% CI	Population	Cases	HR *	95% CI
Iran	41,563	53	<u>1.71</u>	<u>1.30</u>	48,470	161	1.15	.99 1.35
Iraq	38,175	32	1.04	.73 1.48	60,667	154	<u>.79</u>	<u>.67</u> <u>.92</u>
Russia	11,896	7	.63	.30 1.32	20,107	33	<u>.45</u>	<u>.32</u> <u>.63</u>
Others	8,875	4	.64	.24 1.70	11,052	21	.69	.45 1.05
All immigrants	722,289	471	.92	.83 1.02	835,443	1776	<u>.74</u>	<u>.71</u> <u>.78</u>

HR = hazard ratios; CI = confidence interval.

Bold type indicates that 95% CI does not include 1.00. Underline indicates that 99% CI does not include 1.00.

* Adjusted for age, gender, marital status, family income, and employment status.