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Effect of bariatric surgery on employment status—a 7 years controlled nationwide registry study

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ABSTRACT

Background Severe obesity is associated with a reduced ability to work. Bariatric surgery is the most effective method to achieve a sustained weight loss. Previous studies have reported conflicting results regarding the effect of bariatric surgery on employment status. To address this, we investigated the effect of bariatric surgery on employment status in the Danish population.

Methods In this nationwide study, we identified 5450 subjects who underwent bariatric surgery and 10 900 control subjects matched for age, sex and municipality. From accessible registries, we extracted data regarding employment, absenteeism, sick leave and pension. Using a multistate model, we compared time in occupational states and transitions between these states to determine the effect of bariatric surgery on employment status.

Findings Before surgery, cases had an absolute risk increase (95% CI)(ARI (CI)) and a relative risk (RR (CI)) of being in full-time employment of −0.12 (−0.14 to −0.10) and 0.84 (0.82 to 0.86) and were more often unemployed or in a subsidised job than the background population. Taking into account the employment status before surgery, the bariatric surgery group increased their probability of being in full-time employment 1–3 years after bariatric surgery. However, this positive effect was not present with a longer duration of follow-up. Being male, above 50 years of age, or employed as a craftsman or office worker were associated with a sustained positive effect of being in full-time employment (ARI (CI) and RR (CI) 0.05 (0.04 to 0.05) and 1.05 (1.04 to 1.06), 0.06 (0.06 to 0.07) and 1.08 (1.07 to 1.09) and 0.05 (0.05 to 0.06) and 1.05 (1.05 to 1.06), respectively).

Interpretation Compared with a matched control group, those undergoing bariatric surgery did not improve their employment status in the long term. Certain subgroups had a more sustained positive effect.

Strengths and limitations of this study

- This is the largest and most long-term study performed to investigate the effect of bariatric surgery on the ability to work.
- Data were collated from several well-established registries with high data completeness.
- A control group was established matched by sex, age and municipality.
- The control group was not matched for body weight.
- The assumption of peoples type of work was based om union membership, and not all people were union members.

INTRODUCTION

Severe obesity is associated with a reduced ability to work under ordinary working conditions. People with obesity class III (BMI >35 kg/m^2) have a higher rate of both unemployment and sickness absence, compared with normal weight individuals with ORs of 1.42 and 1.53, respectively.[1] Furthermore, those with obesity and eligible for bariatric surgery, miss 5.1 more working days per year, compared with their non-obese colleagues.[2]

A number of causes can be suggested to explain the reduced ability to work because of severe obesity. Type 2 diabetes, sleep apnoea, osteoarthritis and coronary heart disease are all more common in people with obesity and are associated with increased sick leave.[3 4] Severe obesity may be a barrier for certain types of manual work, requiring a certain level of physical fitness, although this is not supported by literature.[5] Also employers may discriminate on the basis of weight by perceiving an obese person, who has all of the required qualifications to perform their job, to be a less attractive representative for their company, than a non-obese individual. Furthermore, obese individuals may have less self-esteem and not be comfortable being at the frontline, having face-to-face contact with clients. Unsurprisingly, as many as 38% individuals classified as obese class III declare that they have experienced weight-based discrimination.[6] All in all severe obesity increases absenteeism and reduces work productivity.[7] Whether unemployment increases the risk of obesity by reducing occupational energy expenditure lacks compelling evidence.[8]

Bariatric surgery is the most effective treatment for severe obesity. Surgically induced

weight loss reduces the prevalence and the severity of a wide range of obesity-related diseases, such as type 2 diabetes mellitus, arterial hypertension, osteoarthritis and sleep apnoea—all with a potential to affect negatively an individual's ability to work.[9–11] Reducing obesity-related disease burden might subsequently increase the ability to work. The association between severe obesity and reduced ability to work is well established. However, we have less knowledge regarding the impact of surgical weight loss both on the probability of remaining employed and on returning to work after unemployment. Most studies, which have investigated surgical weight loss and employment contained small cohorts, were of relative short duration and lacked an appropriate control group. Furthermore, results have been conflicting, ranging from no effect to a superior effect shortly after bariatric surgery.[12–14] Knowledge of the effect of surgical weight loss on the ability to work will potentially affect both the individual approach to people seeking surgery and the national weight loss guidelines, and accordingly we find it relevant to elucidate this matter further.

Our aim was to conduct a nationwide registry-based study to evaluate the changes in long-term employment status for people undergoing bariatric surgery and to compare the employment trajectories of these people with controls from the general population.

METHODS

Study population

We gained access to the Danish database for operative procedures, the Danish Central Person Register (CRP) and the Danish Register for Evaluation of Marginalisation (DREAM). Danish researchers can achieve permission to access these registries for research purposes after appropriate applications.

In the Danish database for operative procedures, we identified individuals who had undergone laparoscopic gastric bypass surgery between 1 July 2008 and 30 June 2010. We excluded those under 18 or above 60 years of age at the time of operation and those classified as foreign residents.

We identified two controls for each gastric bypass operated person in the Danish CPR. Control subjects were matched pairwise to study subjects according to age, sex and municipality. The reason for matching municipality was to account for regional variations within Denmark, regarding occupational structure, degree of employment and prevalence of obesity.[15] Cases and controls in receipt of early retirement or disability pension at inclusion were excluded from the study population, since it is very unlikely that these individuals will return to work. For the cases, we did not include data from 1 month prior to the operation and 2 months after the operation to account for postoperative recovery and rehabilitation.

Data on employment status for cases and controls were extracted from the DREAM-register administered by the Danish National Labour Market Authority. DREAM merges data from the Ministry of Employment, Ministry of Social Affairs, Ministry of Education and Ministry of Integration, as well as data from the Danish tax authorities, Danish municipalities and Statistics Denmark. DREAM includes all persons with a Danish central person registry number. All welfare benefits or any other transfer of income is registered on a weekly basis, while information regarding paid employment is registered once a month. DREAM includes information about employment and those in receipt of public funds, such as sick leave and student grants and can be calculated for specific time periods. Therefore, if an individual has no data in DREAM, they have not received any public funds.

Individuals were grouped into the following categories: full-time employed, part-time employed (less than 50%), unemployed, flex-job (subsidised job defined as an individual whose capacity to work is permanently reduced due to health issues) and 'out' (disability pension, emigration or death after time of inclusion). For each case, employment status was retrieved from 2 years prior to and up to 10 years after bariatric surgery. For control subjects, employment status was retrieved for an identical period.

DREAM also contains data about membership of unemployment funds. Most Danish unemployment funds are associated with one or more unions. Traditionally, the unions accept members with specific occupations, although during the last 30 years, interdisciplinary unemployment funds have gained popularity with a market share of 15% (2010). Based on the information from unemployment funds, it is possible to categorise a large proportion of the subjects according to their level of vocational education. The subjects were classified as 'no or short education', 'craftsmen or office worker', 'bachelor or master's degree' and 'interdisciplinary'. About 8% (2010) are members of unemployment funds and are self-employed. Self-employed members are included in the interdisciplinary group. People leaving the unemployment fund during the observation period were classified according to their most current membership status. DREAM is widely used in registry research regarding employment and sickness absence in Denmark.

Statistics

To properly model long-term employment status and accommodate possible right censoring, we used a multistate model for time-to-event outcomes.[16] Long-term employment status was modelled using a multistate time-to-event model consisting of five states (full-time employed, part-time employed, flex-employed and 'out') and a set of possible transitions between these (figure 1). These five states are considered sufficiently diverse to capture the essential characteristics of interest and sufficiently broad to neglect details of limited interest. For simplification, the model only included transitions that were deemed realistic and of relevance to the research questions. The 'out' state is a so-called absorbing state, as it does not allow for transitions away from this state. Also transitions from flex to full-time employment and

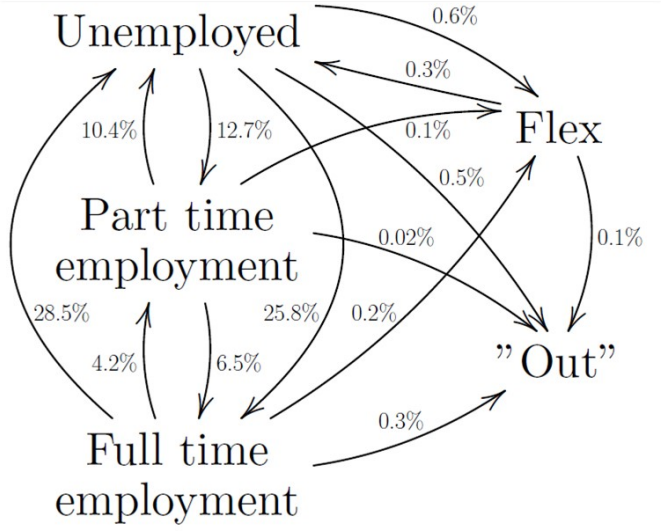

Figure 1 The figure illustrate the multistate model showing the five states categorising each person at any time point and the percentage of transitions. A person can move back and forth between all states during the observational period, except then entering the 'Out' state. 'Out' included emigration, retirement and death and was considered and absorptive state. Also transitions from flex to part-time employment and from flex to full-time employment are left out of the model (see text for further details).

from flex to part-time employment are excluded from the model, as a flex-job position is a permanent allowance.

Individual transitions between the specific states after inclusion in the study are modelled using Cox proportional hazard models, adjusting for sex, age group and education as well as stratifying on cases and controls. Overall and covariate-specific transition intensities can subsequently be transformed into so-called occupancy probabilities. The occupancy probabilities represent the estimated proportions of the population, with a given configuration of the covariates that 'occupy' each state over time. We used the occupancy probabilities for comparing cases and controls by means of relative risk (RR) at specific time-points. Differences in employment status between cases and controls were described in terms of the absolute difference and the relative difference in state occupational probabilities at given time points, corresponding to an absolute risk increase (ARI) and the RR between groups.[17] CIs were calculated using bootstrapping based on the occupancy probabilities. Estimation was done by use of the R package mstate.[18 19]

RESULTS

We identified 5450 individuals who underwent gastric bypass surgery and 10900 control subjects matched for age, sex and municipality. After exclusion of subjects who received early retirement or disability pension at baseline, the population consisted of 5008 cases and 10148 control subjects for further analysis. Seventy-eight percent were females. Approximately 60% of all subjects were between the ages of 30 and 50 years and cases were slightly older than control subjects. Among the cases, a significant proportion were classified as unskilled or held a short education, while fewer cases held a bachelor or a master's degree compared with the controls. The number of subjects who were not union members or were members of a non-specific union were almost equal in both groups (table 1). The minimum and the average follow-up times were 6.2 and 6.9 years, respectively.

Prior to surgery, the cases had an ARI (CI) and RR (CI) of being in full-time employment of −0.12 (−0.14 to −0.10) and 0.84 (0.82 to 0.86), respectively, and the increased risk of not being in full-time employment was

Table 1 Baseline characteristics of the study population after exclusion of study subjects who were pensioned at baseline

Population	Cases (operated subjects)	Control subjects	Difference
Total	5008	10148	NR
Grouped by sex			
Female (percent within group)	3921 (78.3)	7974 (78.6)	NS
Male (percent within group)	1087 (21.7)	2174 (21.4)	
Grouped by age group			
(18–30) years (percent within group)	943 (18.8)	1785 (17.6)	p=0.048
(30–40) years (percent within group)	1900 (37.9)	3765 (37.1)	
(40–50) years (percent within group)	1553 (31.0)	3239 (31.9)	
(50–60) years (percent within group)	612 (12.2)	1359 (13.4)	
Grouped by education			
Short education or unskilled (percent of group)	1673 (36.4)	2247 (23.9)	$p<1^{-10}$
Craftsmen or office (percent of group)	1084 (23.6)	2513 (26.8)	
Bachelor or master degree (percent of group)	677 (14.7)	2345 (25.0)	
Interdisciplinary (percent of group)	1163 (25.3)	2279 (24.3)	

The study population is grouped by sex, age group and vocational education.
NR, not relevant; NS, not significant.

most pronounced among craftsmen, office workers and those with a bachelor or master's degree. A significant proportion of the cases were unemployed or in a flex-job position and this tendency was robust across subgroups (table 2).

Taking into account the status of employment at baseline, the cases were more likely to be in full-time employment one to 3 years after bariatric surgery compared with the control subjects. However with a longer duration of follow-up, there was no difference and after six to 7 years there was a slightly negative effect. Some subgroups appeared to have a more sustained positive effect of bariatric surgery. Thus the male cases (ARI (CI): 0.05 (0.04 to 0.05) and (RR (CI) 1.05 (1.04 to 1.06)) and the elderly cases above 50 years of age (ARI (CI): 0.06 (0.06 to 0.07) and RR (CI) 1.08 (1.07 to 1.09)) continued to have a significant positive effect of surgery in being employed full-time as compared with controls. Also the craftsmen and office group (ARI (CI): 0.05 (0.05 to 0.06) and RR (CI) 1.05 (1.05 to 1.06)) had a sustained positive effect of bariatric surgery, while the higher education group holding a bachelor or master's degree had a sustained lower RR of being full-time employed up to 7 years after the operation (table 3).

Overall, in the 7-year follow-up period, those who underwent bariatric surgery had an increased risk of being in a flex-job position compared with the control subjects. The probability of being employed part-time or unemployed was reduced, while the probability of being in the outstate remained almost unchanged (figure 2 and online supplemental tables 1–4).

DISCUSSION

Our study shows that candidates for bariatric surgery are employed significantly less than the background population. This is consistent across sex, age and education groups and confirmed by previous findings.[20] We found a significant positive, but modest, effect on employment status the first years after surgery, but this was not sustained after 7 years of follow-up. Male sex and a short education are factors that are associated with a more positive outcome.

Prolonged lifespan, better health, improved quality of life, including enhanced self-esteem and for women obesity-related infertility, are the dominant motivational factors for seeking bariatric surgery.[21 22] Although employment contributes significantly to the quality of life, also for obese people seeking bariatric surgery,[23] few studies have specifically assessed the ability to work as a motivational factor. In a recent study, employment was ranked as the lowest of seven possible motivations being the prime factor for less than one percent.[24] To the best of our knowledge, no studies have systematically assessed severe obesity as a perceived hindrance to employment.

The effect of bariatric surgery on the ability to work has been investigated in several studies, but no clear conclusion has been made. A French and Norwegian study assessed employment rates by questionnaires among people, who had undergone bariatric surgery and concluded that there was no effect of surgery, during their follow-up of 6 months to 6 years.[13 25] Another French study found contradictory results indicating that the unemployment rate was approximately halved just 2 years after surgery.[12] The populations of these two studies were similar and comparable to ours with respect to age, sex and preoperative employment rates. Although they did not report educational level, this is unlikely to account for the entire difference.

We found a time dependency in the outcome, which to our knowledge has not previously been described. Thus, a slightly positive effect was identified initially, but not sustained over time. No obvious cause for this can be identified from our data. Late complications from bariatric surgery could impede the ability to work. It is, however, unlikely to explain our findings since these complications rarely occur years after bariatric surgery. Our study was conducted during a period with increasing unemployment. As mentioned earlier, individuals with obesity may be more prone to unemployment due to discrimination. It is thus conceivable that prejudgement of this group increases the risk of marginalisation in a period of recession even though it is not based on work-related issues.[26] This could offset a possible positive impact of weight loss surgery.

Prespecified subgroup analyses were performed for sex, age and different levels of education. We found a slightly more positive and sustained effect among males and in the older age groups. The degree of obesity and the magnitude of workload synergistically increase the risk of receiving disability benefits, and the presence of musculoskeletal disease increase this risk further.[27] Since males with a lower education are more often employed in physical demanding jobs, we expect a greater effect of weight loss, compared with those in more sedentary employment. In agreement with this, Gripeteg and colleagues found that bariatric surgery reduced the number claiming disability pension up to 19 years postoperatively in men, while there was no effect in women.[28] Likewise, in the older age groups, musculoskeletal diseases will be a frequent cause for leaving work, and accordingly a relief of pain and physical limitations due to weight loss may cause individuals to remain in employment. Therefore, our results are in agreement with Narbro and colleagues who found a reduction in sick leave and disability pension as a result of bariatric surgery, particularly in subjects aged 47–60 years.[29]

The finding that individuals with a higher education tend to have an increasingly negative outcome after bariatric surgery has not previously been described and requires further investigation.

Our findings have at least two important implications. First, our study demonstrates no clear evidence for long-term improvement in employment after bariatric surgery. This is in line with two recent reviews indicating that bariatric surgery had a positive impact on sick leave, but

Table 2 Baseline absolute risk increase (ARI) and relative risk (RR) of a case vs a control subject with 95% CI being in any of the occupational states in the multistate model

	Full-time employed		Part-time employed		Unemployed		'Flex'	
Population	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**
Total	−0.12 (−0.14 to −0.10)	0.84 (0.82 to 0.86)	0.01 (−0.03 to 0.04)	1.35 (1.08 to 1.68)	0.09 (0.06 to 0.12)	1.43 (1.35 to 1.52)	0.03 (−0.01 to 0.06)	2.58 (2.10 to 3.18)
Grouped by sex								
Female	−0.12 (−0.14 to −0.10)	0.82 (0.80 to 0.85)	0.01 (−0.03 to 0.04)	1.34 (1.06 to 1.69)	0.09 (0.06 to 0.12)	1.44 (1.35,1.54)	0.03 (−0.01 to 0.06)	2.32 (1.85 to 2.91)
Male	−0.12 (−0.14 to −0.10)	0.90 (0.86 to 0.93)	0.01 (−0.03 to 0.04)	1.47 (0.72 to 2.98)	0.09 (0.06 to 0.12)	1.41 (1.18 to 1.69)	0.03 (−0.01 to 0.06)	4.49 (2.63 to 7.68)
Grouped by age								
(18–30) years	−0.07 (−0.13 to −0.02)	0.88 (0.82 to 0.95)	0.01 (−0.07 to 0.09)	1.86 (0.96 to 3.60)	0.06 (0.00 to 0.12)	1.16 (1.05 to 1.28)	0.00 (−0.08 to 0.09)	7.89 (0.88 to 70.5)
(30–40) years	−0.15 (−0.19 to −0.12)	0.80 (0.77 to 0.84)	0.01 (−0.05 to 0.06)	1.34 (0.93 to 1.93)	0.13 (0.08 to 0.17)	1.64 (1.49 to 1.81)	0.02 (−0.04 to 0.08)	2.82 (1.87 to 4.24)
(40–50) years	−0.12 (−0.15 to −0.09)	0.85 (0.82 to 0.89)	−0.01 (−0.05 to 0.07)	1.47 (1.02 to 2.10)	0.07 (0.01 to 0.13)	1.54 (1.34 to 1.77)	0.04 (−0.02 to 0.10)	2.54 (1.87 to 3.45)
(50–60) years	−0.08 (−0.13 to −0.03)	0.90 (0.85 to 0.96)	0.00 (−0.10 to 0.10)	0.91 (0.59 to 1.65)	0.02 (−0.07 to 0.12)	1.19 (0.92 to 1.53)	0.06 (−0.04 to 0.15)	2.55 (1.73 to 3.75)
Grouped by education								
Short education or unskilled	−0.09 (−0.13 to −0.05)	0.88 (0.84 to 0.92)	0.00 (−0.07 to 0.06)	0.96 (0.66 to 1.39)	0.07 (0.01 to 0.12)	1.34 (1.19 to 1.52)	0.03 (−0.04 to 0.09)	1.82 (1.33 to 2.48)
Craftsmen or office	−0.15 (−0.19 to −0.11)	0.82 (0.79 to 0.86)	0.01 (−0.06 to 0.09)	1.69 (1.05 to 2.71)	0.11 (0.04 to 0.18)	1.79 (1.54 to 2.08)	0.02 (−0.05 to 0.10)	2.52 (1.62 to 3.91)
Bachelor or master degree	−0.08 (−0.13 to −0.03)	0.89 (0.84 to 0.95)	0.01 (−0.08 to 0.10)	1.35 (0.80 to 2.26)	0.07 (−0.01 to 0.15)	1.33 (1.15 to 1.55)	0.00 (−0.09 to 0.09)	1.63 (0.62 to 4.28)
Interdisciplinary	−0.11 (−0.15 to −0.08)	0.86 (0.82 to 0.90)	0.01 (−0.06 to 0.09)	1.63 (1.04 to 2.61)	0.09 (0.02 to 0.15)	1.57 (1.36 to 1.82)	0.01 (−0.06 to 0.09)	2.18 (1.24 to 3.81)

Relative risk is given for the full study group and stratified by sex, age group and vocational education.

Table 3 Absolute risk increase (ARI) and relative risk (RR) with 95% CI of a case vs a control subject being full-time employed from 1 year to 7 years after bariatric surgery

	Year 1		Year 2		Year 3		Year 4	
Population	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**
Total	0.02 (0.02 to 0.02)	1.10 (1.09 to 1.10)	0.01 (0.01 to 0.01)	1.04 (1.04 to 1.05)	0.00 (0.00 to 0.00)	1.03 (1.03 to 1.04)	0.00 (0.00 to 0.00)	1.02 (1.02 to 1.03)
Grouped by sex								
Female	0.01 (0.01 to 0.01)	1.09 (1.09 to 1.10)	0.00 (0.00 to 0.01)	1.03 (1.03 to 1.03)	−0.01 (−0.01 to −0.01)	1.02 (1.02 to 1.03)	−0.01 (−0.01 to −0.01)	1.01 (1.01 to 1.02)
Male	0.05 (0.04 to 0.05)	1.10 (1.10 to 1.11)	0.04 (0.04 to 0.04)	1.09 (1.08 to 1.10)	0.04 (0.03 to 0.04)	1.07 (1.06 to 1.08)	0.04 (0.04 to 0.05)	1.06 (1.05 to 1.07)
Grouped by age								
(18–30) years	0.00 (0.00 to 0.01)	1.06 (1.04 to 1.09)	−0.01 (−0.01 to 0.00)	1.01 (1.00 to 1.02)	−0.02 (−0.03 to −0.02)	1.01 (1.01 to 1.02)	−0.03 (−0.03 to −0.02)	1.01 (1.00 to 1.02)
(30–40) years	0.01 (0.01 to 0.02)	1.09 (1.09 to 1.10)	0.01 (0.01 to 0.02)	1.03 (1.02 to 1.03)	0.00 (−0.01 to 0.00)	1.01 (1.01 to 1.02)	0.00 (0.00 to 0.01)	1.02 (1.01 to 1.02)
(40–50) years	0.02 (0.02 to 0.03)	1.10 (1.09 to 1.11)	0.00 (0.00 to 0.00)	1.07 (1.06 to 1.07)	−0.02 (−0.02 to −0.01)	1.05 (1.04 to 1.06)	−0.03 (−0.04 to −0.03)	1.03 (1.02 to 1.04)
(50–60) years	0.05 (0.04 to 0.05)	1.11 (1.11 to 1.11)	0.05 (0.05 to 0.06)	1.06 (1.06 to 1.07)	0.06 (0.05 to 0.06)	1.08 (1.08 to 1.09)	0.07 (0.07 to 0.08)	1.05 (1.05 to 1.06)
Grouped by education								
Short education or unskilled	0.05 (0.05 to 0.05)	1.10 (1.10 to 1.11)	0.03 (0.02 to 0.03)	1.08 (1.08 to 1.08)	0.03 (0.02 to 0.03)	1.07 (1.07 to 1.07)	0.02 (0.02 to 0.03)	1.07 (1.06 to 1.07)
Craftsmen or office	0.05 (0.04 to 0.05)	1.13 (1.13 to 1.14)	0.06 (0.05 to 0.06)	1.07 (1.07 to 1.08)	0.04 (0.04 to 0.04)	1.07 (1.07 to 1.08)	0.04 (0.04 to 0.05)	1.06 (1.05 to 1.07)
Bachelor or master degree	−0.03 (−0.03 to −0.02)	1.04 (1.03 to 1.05)	−0.03 (−0.03 to −0.03)	0.98 (0.98 to 0.99)	−0.05 (−0.05 to −0.05)	0.97 (0.96 to 0.97)	−0.05 (−0.05 to −0.04)	0.97 (0.96 to 0.96)
Interdisciplinary	0.01 (0.01 to 0.02)	1.06 (1.05 to 1.07)	0.00 (−0.01 to 0.00)	1.02 (1.01 to 1.02)	−0.03 (−0.04 to −0.02)	1.01 (1.00 to 1.02)	−0.02 (−0.03 to −0.02)	1.01 (1.00 to 1.02)
	Year 5		**Year 6**		**Year 7**			
Population	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**		
Total	0.06 (0.06 to 0.06)	1.01 (1.01 to 1.02)	0.03 (0.03 to 0.03)	0.99 (0.98 to 0.99)	0.02 (0.02 to 0.03)	0.99 (0.98 to 0.99)		
Grouped by sex								
Female	0.06 (0.05 to 0.06)	1.00 (1.00 to 1.00)	0.02 (0.02 to 0.02)	0.97 (0.97 to 0.97)	0.02 (0.01 to 0.02)	0.97 (0.97 to 0.98)		

Continued

Table 3 Continued

	Year 1		Year 2		Year 3		Year 4	
Population	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**	**ARI (CI)**	**RR (CI)**
Male	0.07 (0.07 to 0.08)	1.05 (1.04 to 1.06)	0.06 (0.05 to 0.07)	1.05 (1.04 to 1.05)	0.05 (0.04 to 0.05)	1.05 (1.04 to 1.06)		
Grouped by age								
(18–30) years	0.02 (0.01 to 0.04)	0.99 (0.98 to 1.00)	0.00 (0.00 to 0.01)	0.96 (0.95 to 0.97)	0.01 (0.01 to 0.01)	0.97 (0.96 to 0.97)		
(30–40) years	0.06 (0.05 to 0.06)	1.01 (1.01 to 1.02)	0.02 (0.02 to 0.02)	0.99 (0.99 to 0.99)	0.01 (0.01 to 0.01)	1.00 (0.99 to 1.01)		
(40–50) years	0.07 (0.07 to 0.08)	1.00 (0.99 to 1.00)	0.05 (0.04 to 0.05)	0.97 (0.96 to 0.98)	0.03 (0.03 to 0.04)	0.95 (0.94 to 0.96)		
(50–60) years	0.07 (0.07 to 0.08)	1.06 (1.05 to 1.07)	0.04 (0.04 to 0.05)	1.05 (1.05 to 1.06)	0.06 (0.06 to 0.07)	1.08 (1.07 to 1.09)		
Grouped by education								
Short education or unskilled	0.07 (0.06 to 0.07)	1.03 (1.02 to 1.04)	0.05 (0.05 to 0.06)	1.03 (1.02 to 1.04)	0.05 (0.05 to 0.05)	1.02 (1.02 to 1.03)		
Craftsmen or office	0.09 (0.08 to 0.10)	1.07 (1.07 to 1.08)	0.05 (0.05 to 0.06)	1.05 (1.04 to 1.05)	0.05 (0.05 to 0.06)	1.05 (1.05 to 1.06)		
Bachelor or master degree	0.03 (0.02 to 0.03)	0.96 (0.96 to 0.96)	−0.01 (−0.02 to −0.01)	0.93 (0.93 to 0.94)	−0.03 (−0.03 to −0.02)	0.94 (0.93 to 0.94)		
Interdisciplinary	0.04 (0.04 to 0.05)	0.99 (0.98 to 1.00)	0.01 (0.01 to 0.02)	0.94 (0.94 to 0.95)	0.01 (0.01 to 0.02)	0.95 (0.94 to 0.96)		

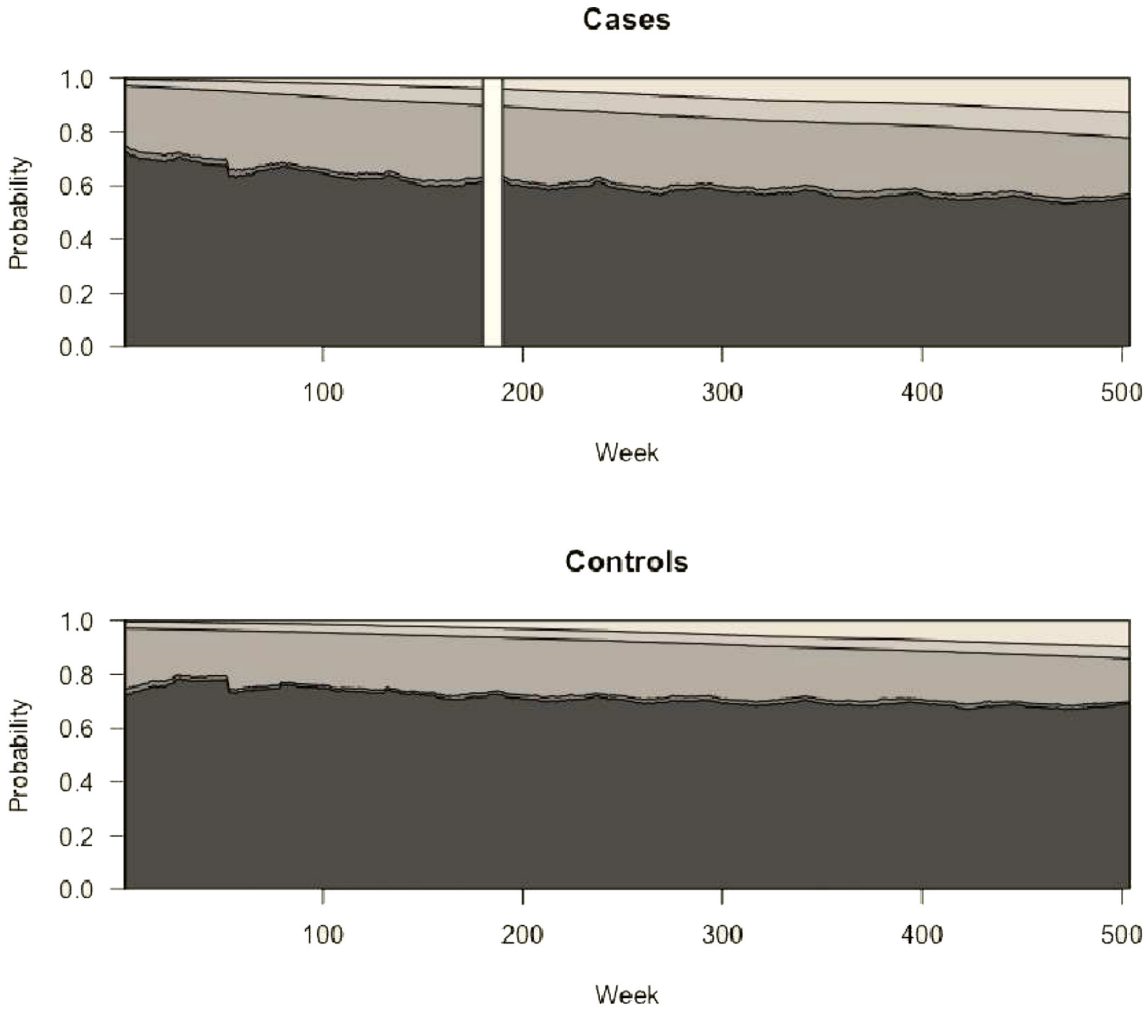

Figure 2 Graphic presentation of the probability of a subject being in any state of the multistate model from 2 years before to 10 years after bariatric surgery. The case and the control population are separated according to each state of the model. From bottom with decreasing shades of grey: full-time employed, part-time employed, unemployed, flex and 'Out'. The upper panel shows the cases censored perioperatively as indicated by the white area, while the lower panel shows the control subjects. X-axis displays weeks after inclusion.

no effect on employment status.[30 31] However, previous studies have had a relatively short duration of follow-up. Few studies present data between start and endpoint and potential temporary effects will remain undetected. In addition, most studies did not include a non-operated control group. Therefore, effects of confounding factors, such as economic growth or recession during the observation period may erroneously be ascribed to bariatric surgery. Our study indicates that if we aim to bring individuals back to work by offering bariatric surgery, we may need to specifically target individual challenges and implement policies that stimulate work participation.[20]

Another implication of our results relates to health economy. Several health economic evaluations of bariatric surgery have been performed and concluded that bariatric surgery is cost-effective, with a reasonable price for achieved quality adjusted life years.[32] While it may be reasonable to include reduced absenteeism of individuals at work in health economic calculations, return to work of unemployed people should probably not be accounted for.

Our study has several strengths. This is the largest and most long-term study to date investigating the effect of bariatric surgery on the ability to work. The data were collated from several well-established registries with high data completeness and allows for a nationwide study. Thus, regional variations and local procedures will not influence the data significantly. A control group was established matched by sex, age and municipality, which revealed a large diversity regarding educational level allowing us to draw conclusions also for subgroups.

Our study has limitations as well. The generalisability of our results to other countries may be limited. From cross-national studies, we know that, for example, workplace intervention policies and differences in social welfare systems partly explain differences in return to work from sick leave due to low back disorder.[33]

Also obesity-related diseases likely affect reduced ability to work differently, and for example, obstructive sleep apnoea and joint pain are more likely to affect employability than other diseases. We were not able to retrieve individual data regarding obesity-related diseases but from the yearly national obesity surgery report, we know that 41%–44% of people who undergo bariatric surgery suffer from moderate to severe pain in the joints and 18%–19% are diagnosed with obstructive sleep apnoea.

Finally, we were unable to match groups for body weight and this may be seen as a restraint for a valid comparison between the study groups. On the other hand, a weight matched group not seeking bariatric surgery will likely differ from the operated group, either because they do not qualify for bariatric surgery according to national criteria, or because they do not want a surgical intervention. As we assumed that the control group was representative weight-wise for the overall population, almost half of the subjects had a body mass index (BMI) above 25 kg/m^2 and more than 15% had a BMI above 30 kg/m^2.[15] Thus, even among the control subjects, weight will exert a negative impact on the ability to work, and the calculated 0.84 RR of being in full-time employment at baseline may therefore underestimate the overall effect of obesity on the ability to work.

CONCLUSION

Severe obesity is a significant burden resulting in comorbidities and reduced ability to work. We confirmed that candidates for bariatric surgery deliver significantly and substantially less work in contrast to the background population. While bariatric surgery has a major impact on comorbidities, it does not have a lasting effect on employment. This knowledge should be integrated in our individual counselling to people seeking bariatric surgery and in healthcare planning.

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Contributors CBJ developed the idea for the study, contributed to retrieve data, wrote data analysis plan, contributed to data analysis and interpretation of results, wrote first draft to manuscript and approved final draft of manuscript. RH contributed to retrieve data, contributed to data analysis plan, was mainly responsible for data analysis, contributed to and approved final draft of manuscript. LHM and CS contributed to retrieve data, contributed to data analysis plan and interpretation of results, contributed to and approved final draft of manuscript. JMG contributed to retrieve data, contributed to data analysis plan, contributed to data analysis and interpretation of results, contributed to and approved final draft of manuscript. GFT retrieved data, contributed to data analysis plan, contributed to data analysis and interpretation of results, contributed to and approved final draft of manuscript.

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Competing interests None declared.

Patient and public involvement statement People with severe obesity referred for bariatric surgery are routinely asked about their ability to work and about possible impacts of their obesity to stay working active. We followed up on this issue at subsequent visits. The observation that some people regained ability to work, while others did not constituted the basis of the study. Participants were not further involved in the study design. When the study is published, dissemination of study results will be discussed in our standing board of people with obesity. The Danish Health Data Authority: 6-8011-919/1, Danish Data Protection Agency: 2013-41-1795.

Patient consent for publication Not required.

Ethics approval We did not obtain ethical approval. According to Danish laws, a study like ours, which is solely based on registry data, ethical approval is not required, and the Regional Ethical Committee of South Denmark does not process protocols on this type of studies.

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Data availability statement Data are available upon reasonable request. All relevant data are provided in the manuscript. Sharing of original data is not permitted within the achieved permissions.

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