NIHR | Policy Research Unit in Obesity

OPRU Briefing Report: Quantifying the impact of Body Mass Index on employment: A brief report: Inclusion criteria, flow chart and tables of included studies

May 2024

Table 1 *Inclusion and exclusion criteria for intervention studies*

Inclusion criteria
Population: People with overweight or obesity
Intervention: Bariatric surgery or lifestyle/pharma intervention
Exposure: BMI change/BMI measured as a continuous variable
Outcome: Going from unemployment to employment or vice versa
Design: All relevant study designs
Exclusion criteria
Any other measure of obesity (categorical measures)
Measures of work productivity, sickness leave, work ability, number of working days, absenteeism, quality of life, days of unemployment

Table 2 *Inclusion and exclusion criteria for non-intervention longitudinal studies*

Inclusion criteria
Exposure: BMI change/BMI measured as a continuous variable/Change in BMI status
Outcome: Employment status/ Categories of employment (Employed/unemployed/ full time employment etc)
Design: Longitudinal observational studies
Exclusion criteria
Any other measure of obesity (e.g., categorical measures)
Measures of work productivity, sickness leave, work ability, number of working days, absenteeism, quality of life, days of unemployment

Figure 1 *Flowchart of the included studies*

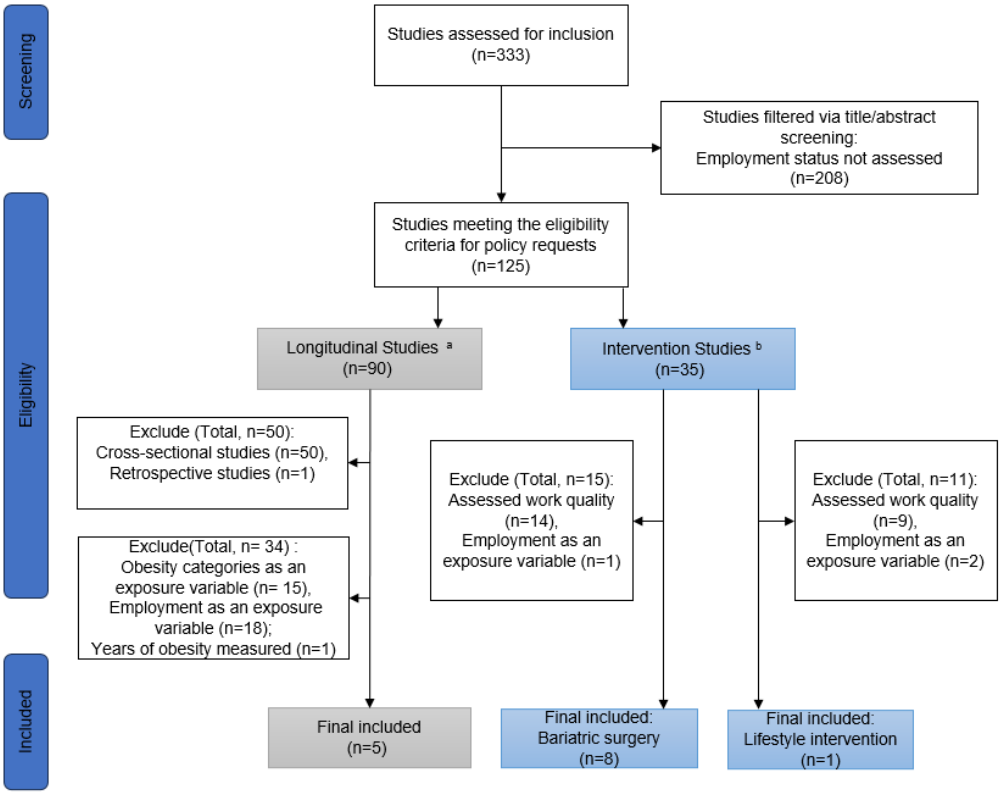

Table 1 *Characteristics and findings of intervention studies (bariatric surgery and weight management) (n=9)*

First author and year; country	Design	Sample Characteristics	BMI before & after mean (SD)	Findings	Limitations
Registry or cohort studies with controls					
Bramming et al., 2022 Denmark	Cohort Study	**Eligibility:** Patients who underwent bariatric surgery between January 1st, 2005, and December 31st, 2013 aged 18-60 years. A reference group was identified from Danish national health surveys conducted between 2005 and 2013, sample matched using propensity score methods. **Sample Size (surgery, control):** 19454 (9126, 10328) **Gender (F/M):** 13765/5689 **Mean Age (SD):** Surgery group: 41.7 (8.94) years, control group: 41.5 (10.4) years **Employment status:** 73.1% working, 17.3% unemployed, and 9.8% sickness absence	Surgery group: Before: 38.8 (3.57) After: not reported (nr) Control group: Before: 38.8 (4.96) After: nr	There was no significant difference in the risk of unemployment (relative to employment) at 1, 3 and 5 year follow-up overall. For women at 5 years bariatric surgery was associated with an increased risk of unemployment (RR 1.23. 1.05-1.44) and a lower risk for men (RR 0.71, 0.55-0.92).	No BMI before and after surgery given. No data about change in employment status before and after surgery given. Likely overlap with Juhl et al, 2021. Note bariatric surgery was associated with increased sickness absence during the follow-up period for both men and women, which suggests that the bariatric group were less healthy than the control group (or the surgery was harmful). This suggests the control group was healthier, and thus not a fair control.
Juhl et al., 2021 Denmark	Cohort study with matched controls	**Eligibility:** Patients who had undergone laparoscopic gastric bypass surgery between 1 July 2008 and 30 June 2010 aged 18-60 years. Excluded patients who had retired early or in receipt of sickness disability. **Sample Size (surgery, control):** 16350 (5450/10900) **Gender (F/M):** 11895/3261 **Mean Age (SD):** NR	Not reported	Before surgery, the 'cases' had a lower employment rate than the controls (12 percentage points), this difference was largely eliminated at 1 year, and during the follow-up period when there were either marginal or no significant differences in employment rate.	No BMI before and after surgery given. No data about change in employment status before and after surgery given. Controls not matched for BMI prior to surgery. No information on BMI of controls. Likely overlap with Bramming et al, 2022.
Turchiano et al., 2013 USA	Cohort study (retrospective review of unemployed patients)	**Eligibility:** Unemployed severely obese patients seen in an urban bariatric surgery programme over a 2-year period **Sample Size (surgery, control):** 193 (72, 121) **Gender (F/M):** 159/34 **Mean Age (SD):** Surgery group: 44.4 (11.7) years, Control group: 47.0 (13.7) years	Surgery group: Before: 43.9 (5.3) After: 34.6 (nr) Control group: Before: 47.3 (10.6) After: 46.5 (nr)	24.1% of the patients that underwent surgery and 9% of the controls had acquired full time employment at least 1year after surgery (p=0.043).	The control group had significantly higher BMI at baseline, compared to the surgical group. Employment status determined only for 38% of the control group and 82% of the surgical group. Most patients were of Hispanic or African American (minorities) origin. Time of recording of employment status relative to surgery unclear
Registry or cohort studies without controls					
Halvachizadeh et al., 2022 Switzerland	Cohort study	**Eligibility:** Patients who underwent bariatric metabolic surgery between 2011 and 2017 and had complete employment data at all follow up visits **Sample Size:** 623 **Gender (F/M):** 485/138 **Mean Age (SD):** 42.65 (10.11) years	**Before:** 42.4 kg/m^2 **After: 31.2 kg/m^2**	Unemployment fell after surgery from 61.6% (pre-surgery) to 32.4% at 24 months (p<0.001), but then rose again to 62.8% at 60 months post-surgery.	No control group. The unemployed group is ill-defined and presumably includes those with caring responsibilities and those retired.

Courtney et al., 2017 UK	Cohort study	**Eligibility:** Patients who underwent bariatric surgery between 29 May 2013 and 01 September 2016 and had an occupation status documented electronically within 30 months of their surgery **Sample Size:** 1011 **Gender (F/M):** 762/249 **Mean Age (SD):** 46 (nr) years	Before: 43 (nr) After: nr	Before surgery, 59.5% were employed, compared to 69.9% post-surgery (p<0.05). Before surgery, 36.6% were unemployed, compared to 21% post-surgery (p<0.05). Effects on unemployment persisted from within 6 months to 30 months.	No control group; conducted in one of the worst areas of employment deprivation in the UK (Sunderland); incomplete employment documentation (50-81% pre-surgery, 51-73% post-surgery).
Tarride et al., 2016 Canada	Cohort study	**Eligibility:** all Bariatric Registry participants who underwent bariatric surgery between 21st April 2010 and 31st March 2012, and who completed 1-year follow-up as of 31st March 2013. **Sample Size:** 340 **Gender (F/M):** 289/51 **Mean Age (SD):** 46 (9.4) years	**Before:** 49.7 (nr) **After:** 33.6 (nr)	No major changes in employment status at 1 year following bariatric surgery (no estimates given).	No control group. Low data completeness, of 304 individuals with one year data, only 138 (45%) had data on employment.
Hanvold et al, 2015 Norway	Cohort study	**Eligibility:** Patients that underwent laparoscopic RYGB surgery from January 2006 to July 2009 **Sample size:** 165 **Gender (F/M):** 123/42 **Mean Age (SD):** 44 (8.6) years	**Before:** 44.3 (5.1) **After:** 30.9 (4.9) P<0.001	Unemployment fell after surgery (37.7% before vs 33.3% after), but the differences were not significant (p=0.189) at 2 years after surgery.	No control group. The unemployed group is ill-defined and presumably includes those with caring responsibilities and those retired.
Andersen et al., 2015 Norway	Cohort study	**Eligibility:** Patients who underwent bariatric surgery between 2001 and 2008, aged>18 years. **Sample Size:** 224 (224) **Gender (F/M):** 136/88 **Mean Age (SD):** 40 (9) years	Before: 49 (8) After: 31.3 (5.5)	The employment rate increased 5 years after surgery (54% before vs 58% after), but the differences were not significant (p=0.34).	No control group.
Lifestyle interventions					
Reichert, 2014 Germany	RCT: participated to a weight loss intervention (control, €150 reward, €300 reward)	**Eligibility:** Patients of four rehabilitation clinics with BMI>30, aged 18-75. **Sample Size** 512 (control, 152; €150, 168, €300, 192) **Gender (F/M):** 168/344 **Mean Age (SD):** 48 (nr) years	Before: Women: 38.4 (6.6) Men: 37.2 (6.2) After: nr	Women with obesity who lost weight improve their likelihood of retaining employment if employed or gaining employment if unemployed; small and non-significant or nil effects reported for men. A one percentage point decrease in BMI (i.e. 0.4 kg/m^2) increases the probability of remaining employed by 2 percentage points (if employed) or of finding employment (if unemployed).	Robust study design, but study size is small and methods of estimating the effect size are not transparent, making it hard to assess bias. Timing (and method) of assessing employment status unclear. Methods for estimating effect size not transparent and appear large relative to other estimates.

BMI: body mass index, SD: standard deviation, F: female, M: male, NR: not reported, CI: confidence intervals

Table 4. *Longitudinal and Mendelian Randomisation studies of the association between BMI and employment status (n=5)*

Study	Sample characteristics	Follow-up time	Weight-related measures	Definition of employment	Main findings	Limitations
Katsaiti et al, 2016	Participants aged between 20 and 65 from the German Socio-Economic Panel survey (n= 82905; 48% female; amongst those with obesity: mean age 47.2 years, and employment =59%; those without obesity: mean age =45.2 years and employment = 79%). Average BMI in those without obesity was 24.4 kg/m2 while the average BMI among those with obesity was 33.7 kg/m2	2002 to 2012, with survey every two years.	BMI calculated based on self-reported height and weight.	Self-reported employment status as either employed or unemployed, unclear if sickness/disability or family/carer roles are incorporated within 'unemployment'.	Using instrumental variable analysis (father's BMI), higher BMI was significantly associated with lower likelihood of employment in women (β= -0.00333, $p < 0.05$), but not in men (β= -0.000256, $p < 0.10$), after adjusting for age, education, perceived health status, marital status, number of children in the household, job experience, nationality, region, and year.	Measurement error in self-reported BMI; Insufficient information on data collection points; Possible reverse causation
Larose, et al. 2016	Participants aged between 25 and 53 years from the Canadian National Population Health Survey (n=3993, 49.2% female, mean BMI =26.3 kg/m^2 for women and 27.9 kg/m^2 for men; labour participation 74.6% for women and 87.8% for men)	6 years	BMI calculated based on self-reported height and weight.	Self-reported employment status. It was estimated using a binary variable ("employed" in the past 12 months, and "unemployed or not working", measured at two year intervals up to six yeas after baseline.	Trend towards reduced likelihood of being employed with increase in BMI, but no significant association between BMI and employment status six years later in either men (OR: 0.992, SE:0.009, N.S) or women (OR: 0.985, SE: 0.013, N.S) after adjusting for demographic, socioeconomic factor, and time-invariant individual heterogeneity. Sample weighting to make results representative of Canadian population.	Measurement error in self-reported BMI. Used lagged BMI to account for reverse causality.
Han et al, 2017	Participants aged between 20 and 65 from the Korean Labor and Income Panel Study, 2005 to 2008, (n= 15180, 36.4% female; mean BMI 23.5 kg/m2 for females and 21.7 kg/m^2 for males; employment = 40.7% for women, and 58.4% for men)	3 years	BMI calculated based on self-reported height and weight for three years of the study (2005, 2007 and 2008)	Self-reported employment status, as salaried, self-employed, and unemployed from the three time points.	A unit increase in BMI for women was significantly associated with a higher likelihood of unemployment by 0.41 percentage points ($p<0.05$). A unit increase in BMI for men was significantly associated with a lower likelihood of unemployment by 0.56 percentage points ($p <0.01$). All analyses were controlled for age, residential areas of living, marital status, number of children, level of education, any health-related difficulties, current smoking and drinking status, risk preference and job sector.	Labour market very different to UK (lower employment particularly amongst women) and prevalence of overweight much lower than UK (10% for women and 23% for men). Short period of follow-up, making reverse causation more likely.
Lee et al, 2019	Participants were middle school students and high school seniors from Korean Education and Employment Panel study, enrolled when at school and followed up to first employment (n=8340, 43.4% female; BMI 20.2 kg/m^2 for females and 23.3 kg/m^2 for males; employment rate 71.7% for females and 55.1% for males).	Not stated	BMI calculated based on self-reported height and weight.	Employed (which includes those who help their family for >18 hrs/week) vs not-employed (which includes students and people enrolled in national service).	*Regression results:* No association between BMI at baseline and employment status at follow-up in both men (OR 0.99 95% CI: 0.97, 1.00) and women (OR 1.00, 95% CI: 0.97, 1.02) after adjusting for educational attainment, health behaviours, personal characteristics, experience of discrimination, and parents' socioeconomic position.	Labour market very different to UK (lower employment amongst men likely explained by national service) and prevalence of overweight/obesity much lower than UK. Also note that higher BMI amongst males associated with professional occupations.

Mendelian Randomisation (MR) Studies						
Campbell, et al.2021	Participants aged between 40 and 69 from the UK Biobank study (n= 230791; 45% female; mean age 52.9 years; mean BMI 27.4 kg/m^2 (SD 4.8); female employed =79.4%, unemployed 1.6%; male employed 71.8%, unemployed 2.8%). Analysis restricted to White British population.	N/A	BMI calculated from measured height and weight at baseline; polygenic score for BMI for each subject estimated (1 unit increase in score associated with 0.11 kg/m^2 increase in BMI)	Self-reported current employment status (at baseline) as 5 categories: employed, early retirement, family/carer, sick/disabled, unemployed. Had dichotomous variable of employed/not in paid employment (pooling the four not in employment other categories).	1kg/m^2 BMI associated with 1.076 (significant: 1.039-1.114) odds of being sick/disabled compared to the odds of being in paid employment, but not of being unemployed using MR. Increase in BMI also associated with reduced likelihood of being family/carer on MR. Overall no effect of BMI on not being in paid employment compared to being in paid employment, on MR. MR analyses adjusted for age, sex and genetic principal component, but not deprivation. No evidence of different causal effect of BMI on employment by gender.	Large UK sample, albeit with high employment rate/tendency to be healthier and wealthier than UK population as a whole; analysis restricted to White British population; whilst 'cross-sectional' used MR analyses which is a better causal test for an association. Whilst linear associations were modelled, analysis suggested relationship was non-linear at extremes of BMI.

BMI: Body Mass Index, OR: Odds Ratio, CI: Confidence Intervals, β: Beta coefficient, N.S: Not significant, SE: Standard Error

This study was funded by the UK National Institute for Health and Care Research Policy Research Programme (PR-PRU-0916-21001; grant number 174868). The views expressed in this Article are those of the authors and not necessarily those of the National Institute for Health and Care Research or the UK Department of Health and Social Care.