

SUPPLEMENTAL MATERIAL

Weight loss and heart failure: a nationwide study of gastric bypass surgery versus intensive lifestyle treatment

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Supplemental Methods

Weight-loss program

The VLCD treatment was a liquid-based formula diet of 500kcal/day for 3-10 weeks (125kcal/sachet, 4 sachets/day, approved as sole source VLCD by the Swedish National Food Agency) followed by 2-8 weeks gradual introduction of normal food. Early introduction of normal food occurred if patients were satisfied with the achieved weight loss or reached BMI<25. In June, 2009, the program was changed to 600kcal/day for 3 weeks followed by 800kcal/day for up to 9 weeks.

The LCD treatment included 2 calorie-restricted normal food meals and 2 formula-diet meal replacement sachets per day providing a total caloric intake of about 1200-1500kcal. After the weight-loss phase, patients entered a 9-month weight maintenance program of exercise (circuit training at the center 2-3 times/week for 30-45 minutes, and pedometer use to encourage walking), dietary advice, and behavioral therapy (a structured program of 20 1-hour group sessions, initiated during the weight-loss phase). There were also face-to-face counselling sessions throughout the program.

Statistical methods

Variables included in the propensity score analysis were baseline variables age, systolic blood pressure, smoking, previous myocardial infarction, previous atrial fibrillation, weight, BMI, educational level, marital status, income, sex, antihypertensive drugs, lipid-lowering drugs, antidiabetic drugs, previous substance abuse, previous valve disease, and treatment year, with non-linear modelling of some variables, and interaction terms for several variables including BMI.

Supplemental Table 1. Variable sources and definitions

Variables obtained from nationwide health registries		Source
Atrial fibrillation	ICD-10: I48.9, diagnosed in ambulatory or in-patient care	National Patient Register
Myocardial infarction	ICD-10: I21, diagnosed in in-patient care	
Valve disease	ICD-10: I34, I35, I36, I37, diagnosed in in-patient care	
Heart failure	ICD-10: I50, diagnosed in in-patient care, only as main cause of hospitalization	
Substance abuse	ICD-10: F10-F19, diagnosed in ambulatory or in-patient care	
Lipid-lowering drug treatment	ATC: C10	Prescribed Drug Register (dispensed prescriptions)
Antidiabetic drug treatment	ATC: A10	
Aspirin treatment	ATC: B01AC06	
Thyroid hormone treatment	ATC: H03A	
Antihypertensive drug treatment	ATC: C02, C03A, C03B, C03EA01, C07 except C07AA07, C08C, C09	
Beta-receptor blocker treatment	ATC: C07 except C07AA07	
Calcium antagonist treatment	ATC: C08C	
RAAS blocker treatment	ATC: C09	
Thiazide diuretic treatment	ATC: C03A, C03B, C03EA01	
Loop diuretic treatment	ATC: C03C	
Income level	Mean of previous 2 calendar years from income & taxation register	Income and Taxation Register
Education level		Education Register
Age		Total Population Register
Sex		
Marital status		
Emigration date		
Death date		Causes of Death Register
Variables obtained in the SOReg or Itrim registries		
Baseline weight, waist circumference & body-mass index	Screening weight was used for the SOReg participants, since almost all are treated with VLCD in the months before surgery. Weight at start of intervention was used for Itrim participants.	SOReg Itrim
Intervention date	Date of first visit in Itrim. Date of surgery in SOReg.	
Systolic blood pressure	According to the Itrim protocol, coffee and smoking should be avoided 30 minutes before the measurement. Blood pressures were measured in the left upper arm using an Omron 1240 oscillometric device with the cuff at heart level, in the sitting position with the back against the backrest and without crossed legs, after 5 minutes' rest. If the first recording was elevated (SBP \geq 140 mmHg or DBP \geq 90 mmHg), a second measurement was obtained; the mean of those two measurements recorded. Registered in the SOReg protocol, without further instructions.	
Smoking	Structured questionnaire in Itrim and SOReg.	
Weight & waist circumference during follow-up	Structured protocol in Itrim and SOReg.	
Percent body fat during follow-up	Structured protocol in Itrim, using a Tanita body impedance meter.	

Supplemental Table 2. Baseline characteristics in persons with complete data vs those with any missing data

	Complete data (n= 23,700)	Any missing data (n=15,805)	Difference complete – missing
Age (years)	41.4 (41.2 to 41.5)	41.3 (41.1 to 41.5)	0.1 (-0.2 to 0.3)
Male sex	23.3 (22.7 to 23.8)	23.7 (23.0 to 24.4)	-0.4 (-1.3 to 0.5)
Weight (kg)	118.7 (118.5 to 118.9)	119.8 (119.5 to 120.1)	-1.1 (-1.5 to -0.7)
Baseline body-mass index (kg/m ²)	41.4 (41.3 to 41.4)	41.6 (41.5 to 41.6)	-0.2 (-0.3 to -0.1)
Systolic blood pressure (mmHg)	134.4 (134.2 to 134.6)	135.7 (134.7 to 136.7)	-1.3 (-2.3 to -0.3)
Married (%)	43.7 (43.1 to 44.3)	43.3 (42.5 to 44.1)	0.4 (-0.6 to 1.4)
Current smoker (%)	16.5 (16.0 to 16.9)	17.5 (15.9 to 19.1)	-1.1 (-2.7 to 0.6)
Prior myocardial infarction (%)	0.9 (0.7 to 1.0)	1.2 (1.0 to 1.3)	-0.3 (-0.5 to -0.1)
Prior atrial fibrillation (%)	0.9 (0.8 to 1.0)	1.1 (0.9 to 1.3)	-0.2 (-0.4 to -0.0)
Prior valve disease (%)	0.1 (0.0 to 0.1)	0.2 (0.1 to 0.3)	-0.1 (-0.2 to -0.0)
Prior substance abuse (%)	0.9 (0.8 to 1.0)	0.8 (0.6 to 0.9)	0.1 (-0.1 to 0.3)
Lipid-lowering drugs (%)	12.3 (11.9 to 12.7)	13.4 (12.9 to 14.0)	-1.2 (-1.9 to -0.5)
Antidiabetic drugs (%)	12.4 (12.0 to 12.8)	14.2 (13.7 to 14.8)	-1.9 (-2.6 to -1.2)
Antihypertensive drugs (%)	28.4 (27.9 to 29.0)	29.5 (28.7 to 30.2)	-1.0 (-1.9 to -0.1)
Education			
<10 years (%)	16.3 (15.8 to 16.7)	17.2 (16.7 to 17.8)	-1.0 (-1.6 to -0.4)
10 to 12 years (%)	60.5 (60.0 to 61.0)	60.7 (60.2 to 61.2)	-0.3 (-0.4 to -0.1)
>12 years (%)	23.3 (22.8 to 23.8)	22.0 (21.4 to 22.6)	1.2 (0.5 to 1.9)
Income (1000 USD/year)	31.1 (30.9 to 31.4)	30.9 (30.6 to 31.2)	0.2 (-0.2 to 0.6)

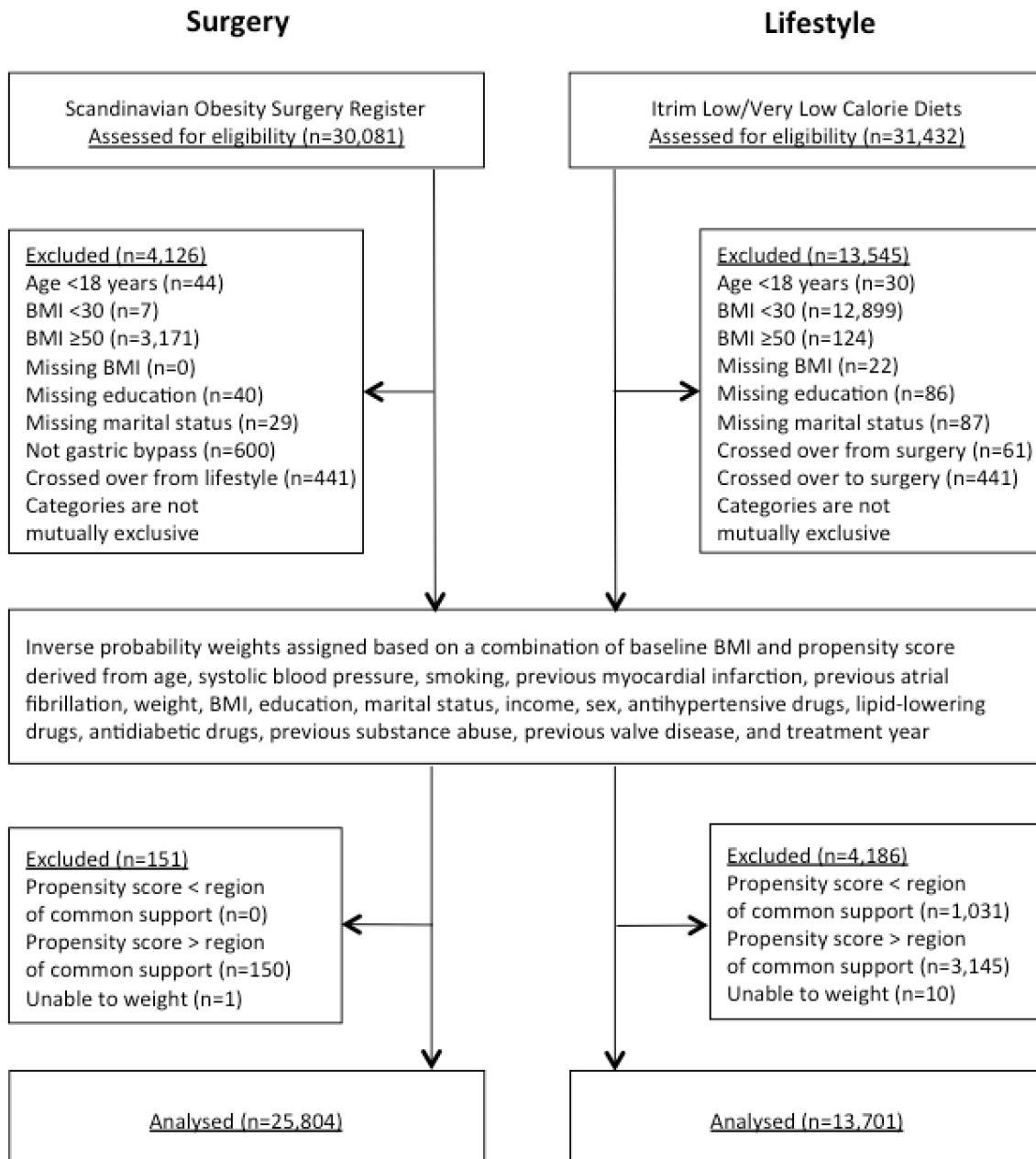
Data are means or percent and difference between persons with complete data on all variables and those with any missing data (95% confidence intervals) from an inverse probability-weighted sample.

Supplemental Table 3. Baseline characteristics of sample re-weighted also by one-year BMI

	Surgery (n=22,694)	Lifestyle (n=8,653)	Difference surgery – lifestyle
Age (years)	41.5 (41.4 to 41.7)	40.4 (40.2 to 40.6)	1.1 (0.9 to 1.4)
Male sex	25.2 (24.6 to 25.8)	20.8 (20.1 to 21.5)	4.4 (3.5 to 5.3)
Weight (kg)	119.5 (119.2 to 119.7)	119.7 (119.4 to 120.0)	-0.2 (-0.7 to 0.2)
Baseline body-mass index (kg/m ²)	41.4 (41.4 to 41.5)	41.3 (41.3 to 41.4)	0.1 (0.1 to 0.2)
One-year body-mass index (kg/m ²)	29.2 (29.1 to 29.2)	29.7 (29.6 to 29.8)	-0.5 (-0.6 to -0.4)
Systolic blood pressure (mmHg)	135.0 (134.7 to 135.3)	133.1 (132.8 to 133.4)	1.9 (1.4 to 2.3)
Married (%)	43.0 (42.4 to 43.7)	45.7 (44.8 to 46.5)	-2.6 (-3.7 to -1.5)
Current smoker (%)	15.5 (14.9 to 16.1)	16.5 (15.8 to 17.2)	-1.0 (-2.0 to -0.04)
Prior myocardial infarction (%)	1.0 (0.9 to 1.2)	0.7 (0.6 to 0.9)	0.3 (0.1 to 0.5)
Prior atrial fibrillation (%)	1.0 (0.9 to 1.1)	0.4 (0.3 to 0.5)	0.6 (0.4 to 0.8)
Prior valve disease (%)	0.2 (0.1 to 0.2)	0.0 (-0.0 to 0.01)	0.1 (0.1 to 0.2)
Prior substance abuse (%)	0.8 (0.6 to 0.9)	0.6 (0.5 to 0.8)	0.1 (-0.1 to 0.3)
Lipid-lowering drugs (%)	13.7 (13.2 to 14.1)	8.2 (7.7 to 8.7)	5.5 (4.8 to 6.2)
Antidiabetic drugs (%)	14.0 (13.6 to 14.5)	7.7 (7.2 to 8.1)	6.4 (5.7 to 7.0)
Antihypertensive drugs (%)	30.3 (29.7 to 30.9)	23.0 (22.2 to 23.7)	7.3 (6.4 to 8.3)
Education			
<10 years (%)	16.8 (16.3 to 17.3)	14.4 (13.9 to 14.9)	2.4 (1.8 to 3.0)
10 to 12 years (%)	61.8 (61.3 to 62.3)	61.0 (60.5 to 61.6)	0.8 (0.6 to 1.0)
>12 years (%)	21.4 (20.8 to 21.9)	24.6 (23.9 to 25.3)	-3.2 (-4.0 to -2.4)
Income (1000 USD/year)	30.6 (30.4 to 30.9)	30.7 (30.3 to 40.0)	-0.02 (-0.4 to 0.4)

Data are means or percent and difference between surgery and lifestyle groups (95% confidence intervals) from an inverse probability-weighted sample.

Supplemental Figure 1.



Supplemental Figure titles and legends

Supplemental Figure 1. Flow chart for definition of the study sample

Intervention years 2006-2013. BMI, body-mass index.