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Sleep disordered breathing in morbidly obese patients prior to bariatric surgery - a retrospective analysis of a single centre cohort

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Background

Obstructive sleep apnea (OSA) is a common disease in the general population. Obesity is a strong risk factor of OSA and its prevalence is continuously increasing with an estimated number of 1.1 billion obese individuals (BMI>30 kg/m2) by 2030. Bariatric surgery is an intervention that produces substantial and sustained weight loss in adults. Due to the increased peri- and postoperative risk in these patients an assessment for sleep apnoea prior to bariatric surgery is recommended.

Study objective

The aim of this retrospective cohort study was to investigate prevalence and independent predictive factors of OSA (AHI>5/h) in obese patients prior to bariatric surgery in a single university centre.

Material and Methods

We analysed data of all morbidly obese patients (BMI>35 kg/m2) who underwent a home respiratory polygraphy prior to bariatric surgery between January 2012 to July 2015. Additional demographic data, laboratory values, pulmonary function testing and data from sleep questionnaires (STOPBang, Epworth Sleepiness Scale, Fatigue Severity Scale) were analysed.

Statistics

All data are reported descriptively using median together with interquartile range. Sensitivity, specifity, negative and positive predictive values were inferred using confusion matrix analyses.

Results

	AHI				Univariate p-value			Multivariate p-value		
Variables	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30	≥5/h	≥15/h	≥30h
Age	36 (26-44)	43 (33-53)	46 (38-54)	46 (41-58)	**p<0.001**	**p<0.001**	**p<0.001**	**p<0.05**	p>0.05	**p<0.005**
Female gender (%)	86	76	59	37	p>0.05	**p<0.001**	**p<0.001**	p>0.05	p>0.05	p>0.05
BMI	41.26 (37.76-44.99)	42.71 (39.08-45.39)	46.19 (39.56-51.65)	45.11 (14.50-49.70)	p>0.05	**p<0.005**	**p<0.001**	p>0.05	p>0.05	p>0.05
Neck circumference (cm)	40.0 (37.3-42.0)	41.0 (40.0-45.0)	45.0 (41.5-47.5)	46.2 (43.8-48.0)	**p<0.005**	**p<0.001**	**p<0.001**	**p<0.05**	p>0.05	p>0.05
FEV1 (l)	3.07 (2.74 -3.51)	2.98 (2.64-3.37)	2.83 (2.36-3.44)	3.00 (2.48-3.74)	p>0.05	p>0.05	p>0.05			
FVC(l)	3.83 (3.44-4.48)	3.76 (3.30-4.13)	3.58 (3.11-4.30)	4.02 (3.31-4.80)	p>0.05	p>0.05	p>0.05			
STOPBANG	3 (2-3)	3 (3-4)	4 (3-5)	5 (4-6)	**p<0.001**	**p<0.001**	**p<0.001**	p>0.05	p>0.05	p>0.05
ESS	6 (4-9)	6 (4-10)	7 (4-9)	11 (7-14)	p>0.05	p>0.05	p>0.05			
FSS	3.11 (2.22-4.39)	4.00 (2.56-5.00)	3.33 (2.33-4.11)	4.89 (2.83-5.45)	p>0.05	p>0.05	**p<0.05**			
VAS (1-10)	5 (2-6)	3 (2-5)	4.0 (1.5-5.0)	5 (3-6)	p>0.05	p>0.05	p>0.05			
ODI (4%)	2.2 (1.0-3.9)	10.1 (6.9-12.9)	25.8 (20.2-29.8)	47.8 (41.6-74.2)	**p<0.001**	**p<0.001**	**p<0.001**			
SPO2 mean (%)	93.8 (93.0-94.9)	92.85 (91.80-94.00)	92.4 (90.3-93.5)	86.9 (89.3-91.1)	**p<0.05**	**p<0.001**	**p<0.001**			
SPO2<90% (min)	2.15 (0.30-16.55)	15.7 (5.1-42.2)	33.4 (18.2-165.2)	185.8 (89.8-260.5)	p>0.05	**p<0.001**	**p<0.001**			
AHI supine position	1.4 (0.3-3.3)	9.5 (5.2-15.1)	22.5 (14.2-37.5)	53.2 (24.4-66.9)	**p<0.001**	**p<0.001**	**p<0.001**			
PH	7.43 (7.42-7.45)	7.44 (7.42-7.45)	7.43 (7.42-7.45)	7.45 (7.43-7.45)	p>0.05	p>0.05	p>0.05			
PACO2 (mm Hg)	35 (32-37)	36.5 (34.5-38.0)	37 (34-39)	36 (34-39)	**p<0.05**	**p<0.05**	p>0.05			
HCO3- (mm Hg)	24.0 (23.0-24.8)	24.7 (23.8-25.4)	25.1 (24.2-25.9)	25.0 (23.1-26.4)	**p<0.001**	**p<0.005**	**p<0.005**	p>0.05	p>0.05	p>0.05
PAO2 (mm Hg)	85.0 (79.1-92.0)	79.5 (71.5-86.5)	76.0 (70.0-86.0)	69.0 (63.0-75.5)	**p<0.001**	**p<0.001**	**p<0.001**	p>0.05	p>0.05	p>0.05
Cholesterine	4.85 (4.16-5.60)	4.95 (4.32-5.63)	5.15 (4.50-5.71)	5.10 (4.27-5.64)	p>0.05	p>0.05	p>0.05			
HDL	1.27 (1.08-1.50)	1.20 (0.96-1.39)	1.22 (1.14-1.46)	1.13 (1.01-1.25)	**p<0.05**	p>0.05	**p<0.05**			
LDL	2.90 (2.34-3.59)	3.04 (2.49-3.68)	3.11 (2.50-3.65)	2.91 (2.49-3.52)	p>0.05	p>0.05	p>0.05			
Triglicyeride	1.24 (0.93-1.65)	1.45 (1.02-2.01)	1.47 (1.08-1.81)	1.70 (1.26-2.28)	p>0.05	**p<0.05**	**p<0.001**			
TSH	2.03 (1.44-2.97)	1.86 (1.34-2.69)	1.97 (1.63-2.85)	2.31 (1.93-3.12)	p>0.05	p>0.05	p>0.05			
Cortisol	284 (208-408)	298 (230-396)	374 (292-474)	346 (272-436)	p>0.05	**p<0.05**	p>0.05			
Oestradiol	162 (95-340)	108 (69-190)	104 (52-119)	108 (79-187)	**p<0.05**	**p<0.05**	p>0.05			
LH	5.6 (3.5-8.2)	7.1 (4.2-19.1)	6.6 (4.8-11.9)	5.2 (3.7-7.3)	**p<0.05**	p>0.05	p>0.05			
FSH	5.10 (3.55-7.45)	7.10 (3.80-25.00)	7.80 (4.10-19.80)	5.80 (5.00-9.00)	**p<0.001**	p>0.05	p>0.05			
HbA1c	5.55 (5.30-5.80)	5.80 (5.50-6.50)	5.90 (5.55-6.60)	6.30 (5.90-7.95)	**p<0.01**	**p<0.05**	**p<0.001**	p>0.05	p>0.05	p>0.05
Arterial hypertension (n)	45	28	13	17	p>0.05	p>0.05	**p<0.005**			
Coronary artery disease (n)	0	2	0	0	p>0.05	p>0.05	p>0.05			
Cardiac arrythmia (n)	1	0	2	1	p>0.05	p>0.05	p>0.05			
Diabetes mellitus (n)	14	15	11	11	**p<0.005**	**p<0.005**	**p<0.001**			
COPD/Asthma (n)	14	3	5	6	p>0.05	p>0.05	p>0.05			
Cerebrovascular disease (n)	6	1	1	4	p>0.05	p>0.05	p>0.05			
Gastroesophageal reflux disease (n)	46	10	9	7	p>0.05	p>0.05	p>0.05			
Dyslipidemia (n)	30	27	13	8	**p<0.01**	**p<0.001**	p>0.05			
Psychiatric disease (n)	55	18	8	9	p>0.05	p>0.05	p>0.05			
Smoker (n)	28	17	5	3	p>0.05	p>0.05	p>0.05			
Former smoker (n)	12	6	2	4	p>0.05	p>0.05	p>0.05			

Table 1: Patient demographics, AHI and factors predictive for OSA

Results

	AHI				Univariate p-value			Multivariate p-value		
Variables	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30	≥5/h	≥15/h	
Age	36 (26-44)	42 (31-54)	50 (38-55)	47 (43-49)	**p<0.005**	**p<0.001**	**p<0.005**	p>0.05	p>0.05	
BMI	41.26 (38.03-44.90)	42.64 (39.15-45.10)	45.91 (39.56-48.61)	48.62 (42.10-54.36)	p>0.05	p>0.05	**p<0.001**	p>0.05	p>0.05	
Neck circumference (cm)	39 (37-41)	40 (39-41)	43 (41-44.5)	43.5 (43-44.0)	p>0.05	**p<0.001**	**p<0.001**	p>0.05	p>0.05	
FEV1 (l)	3.01 (2.64-3.38)	2.78 (2.49-3.10)	2.46 (2.35-2.86)	2.74 (2.27-2.89)	**p<0.01**	**p<0.001**	p>0.05	p>0.05	p>0.05	
FVC(l)	3.74 (3.36-4.25)	3.53 (3.10-3.94)	3.19 (2.58-3.58)	3.28 (3.05-3.67)	**p<0.01**	**p<0.001**	**p<0.05**	p>0.05	p>0.05	
STOPBANG	2 (2-3)	3 (2-4)	4 (2-5)	5 (4-5)	**p<0.005**	**p<0.001**	**p<0.001**	p>0.05	p>0.05	
ESS	6 (4-9)	6 (4-10)	6 (2.5-9)	7 (6-12)	p>0.05	p>0.05	p>0.05			
FSS	3.11 (2.22-4.39)	4 (1.95-4.56)	3.33 (2.33-4.33)	5.06 (1.78-6.11)	p>0.05	p>0.05	p>0.05			
VAS (1-10)	5 (2-6)	2.5 (2-5)	4 (1.3-5)	5 (5-6)	p>0.05	p>0.05	p>0.05			
ODI (4%)	2 (1-4)	10 (7-14)	23 (18-28)	58 (36-83)	p>0.05	**p<0.001**	**p<0.001**			
SPO2 mean (%)	93.8 (93.0-94.9)	92.9 (91.8-94.0)	92.4 (90.3-93.5)	89.3 (86.9-91.1)	**p<0.001**	**p<0.005**	**p<0.001**			
SPO2<90% (min)	2 (1-17)	16 (5-42)	33 (18-165)	186 (90-260)	**p<0.001**	**p<0.001**	**p<0.001**			
AHI supine position	1.4 (0.3-3.4)	9.6 (5.3-15.4)	26.9 (16.9-29.8)	42.8 (29.2-72.1)	**p<0.001**	**p<0.001**	**p<0.001**			
PH	7.44 (7.42-7.46)	7.44 (7.43-7.45)	7.44 (7.42-7.45)	7.46 (7.45-7.46)	p>0.05	p>0.05	p>0.05			
PACO2 (mm Hg)	34 (32-36)	36 (34-36)	36 (34-38)	35 (34-36)	p>0.05	**p<0.05**	p>0.05			
HCO3- (mm Hg)	23.80 (22.90-24.65)	24.70 (23.80-26.60)	25.10 (24.1-25.90)	25.10 (22.50-26.20)	**p<0.001**	**p<0.01**	p>0.05	p>0.05	p>0.05	
PAO2 (mm Hg)	86 (81-92)	80 (74-88)	80 (75-87)	70 (64-72)	**p<0.001**	**p<0.05**	**p<0.001**	p>0.05	p>0.05	
Cholesterine	4.84 (4.11-5.61)	4.95 (4.37-5.59)	4.96 (4.50-5.78)	5.10 (4.32-5.47)	p>0.05	p>0.05	p>0.05			
HDL	1.30 (1.11-1.56)	1.20 (0.98-1.37)	1.26 (1.22-1.49)	1.22 (1.05-1.49)	**p<0.01**	p>0.05	p>0.05			
LDL	2.87 (2.32-3.54)	3.05 (2.62-3.56)	3-07 (2.46-3.48)	2.98 (2.78-3.57)	p>0.05	p>0.05	p>0.05			
Triglicyeride	1.22 (0.86-1.54)	1.44 (1.01-1.84)	1.46 (1.07-1.72)	1.42 (1.15-1.70)	p>0.05	**p<0.01**	p>0.05			
TSH	2.02 (1.45-2.98)	1.86 (1.33-2.71)	2.16 (1.65-2.60)	2.86 (1.93-3.59)	p>0.05	p>0.05	p>0.05			
Cortisol	286 (212-423)	284 (223-399)	400 (257-628)	321 (218-422)	p>0.05	**p<0.05**	p>0.05			
Oestradiol	199 (107-357)	92 (66-183)	400 (44-149)	124 (80-211)	p>0.05	p>0.05	p>0.05			
LH	5.70 (3.15-9.55)	11.7 (4.7-20.6)	8.9 (4.8-21.3)	5.05 (3.70-7.90)	**p<0.01**	p>0.05	p>0.05			
FSH	5.3 (3.7-7.5)	8.0 (5.4-36.6)	9.55 (4.05-38.7)	9.0 (4.6-11.1)	**p<0.001**	**p<0.05**	p>0.05	p>0.05	p>0.05	
HbA1c	5.5 (5.3-5.8)	5.70 (5.50-6.15)	6.00 (5.65-7.05)	6.25 (6.00-6.80)	**p<0.01**	**p<0.001**	**p<0.001**	p>0.05	p>0.05	
Arterial hypertension (n)	33	21	5	7	**p<0.001**	p>0.05	**p<0.001**			
Coronary artery disease (n)	0	1	0	0	p>0.05	p>0.05	p>0.05			
Cardiac arrythmia (n)	1	0	1	0	p>0.05	p>0.05	p>0.05			
Diabetes mellitus (n)	11	3	4	1	p>0.05	p>0.05	p>0.05			
COPD/Asthma (n)	11	3	4	1	p>0.05	p>0.05	p>0.05			
Cerebrovascular disease (n)	5	1	1	0	p>0.05	p>0.05	p>0.05			
Gastroesophageal reflux disease (n)	36	7	4	3	p>0.05	p>0.05	p>0.05			
Dyslipidemia (n)	26	18	7	3	**p<0.01**	p>0.05	p>0.05			
Psychiatric disease (n)	49	14	7	4	p>0.05	p>0.05	p>0.05			
Smoker (n)	23	10	1	0	p>0.05	p>0.05	p>0.05			
Former smoker (n)	11	4	1	1	p>0.05	p>0.05	p>0.05			

Table 2: Demographics, AHI and factors predictive for OSA in women

	AHI				Univariate p-value			Multivariate p-value		
Variables	0-4.9	5-14.9	15-29.9	≥30	5-14.9	15-29.9	≥30	≥5	≥15	≥30
Age	36 (25-43)	43 (40-50)	43 (38-49)	46 (37-58)	p>0.05	p>0.05	**p<0.001**	p>0.05	p>0.05	p>0.05
BMI	40.62 (36.54-45.98)	43.42 (39.08-48.84)	46.73 (39.68-52.64)	42.52 (41.03-48.44)	p>0.05	p>0.05	p>0.05			
Neck circumference (cm)	45.5 (43-49)	45.8 (44-50)	48 (46-50)	47 (46.3-49)	p>0.05	p>0.05	p>0.05			
FEV1 (l)	3.90 (3.06-4.25)	3.49 (3.28-3.97)	3.67 (2.97-4.03)	3.46 (2.81-3.96)	p>0.05	p>0.05	p>0.05			
FVC(l)	4.83 (4.17-5.63)	4.51 (4.10-4.88)	4.65 (3.93-5.49)	4.58 (3.71-5.06)	p>0.05	p>0.05	p>0.05			
STOPBANG	5 (4-6)	4 (4-6)	5 (3.5-5)	4 (5-6)	p>0.05	p>0.05	p>0.05			
ESS	6 (5-8)	8 (5-14)	8.5 (7-9)	11.5 (7-14)	p>0.05	p>0.05	**p<0.005**	p>0.05	p>0.05	p>0.05
FSS	3.84 (2.56-4.56)	4.67 (3.45-5.45)	3.33 (2.39-3.78)	4.86 (3.22-5.33)	p>0.05	p>0.05	p>0.05			
VAS (1-10)	3 (3-5)	5 (2.5-6.5)	4 (1.5-5)	5 (2-6)	p>0.05	p>0.05	p>0.05			
SPO2 mean (%)	93.8 (92.6-94.5)	93.0 (91.9-94.9)	92.01 (89.3-93.1)	89.4 (86.8-91)	p>0.05	p>0.05	**p<0.001**			
SPO2<90% (min)	5 (1-34)	16 (3-22)	39 (25-185)	166 (73-266)	p>0.05	p>0.05	**p<0.001**			
AHI supine position	2.4 (0.9-3.3)	9.2 (3.2-13.9)	20.7 (11.0-43)	56 (9.1-65.5)	p>0.05	**p<0.005**	**p<0.001**			
PH	7.43 (7.42-7.45)	7.42 (7.41-7.43)	7.43 (7.42-7.45)	7.44 (7.42-7.45)	**p<0.05**	p>0.05	p>0.05			
PACO2 (mm Hg)	37 (37-39)	38 (36-41)	38 (35-39)	37 (34-40)	p>0.05	p>0.05	p>0.05			
HCO3- (mm Hg)	24.55 (23.9-24.45)	24.5 (23.6-25.4)	25.05 (24.35-25.75)	26 (23.6-26.6)	p>0.05	p>0.05	p>0.05			
PAO2 (mm Hg)	78 (70-89)	75 (69-79)	71 (65-78)	66 (60-78)	p>0.05	p>0.05	**p<0.05**			
Cholesterine	5.26 (4.30-5.54)	4.95 (4.23-5.63)	5.24 (4.63-5.59)	5.04 (4.22-5.79)	p>0.05	p>0.05	p>0.05			
HDL	1.07 (0.97-1.24)	1.07 (0.83-1.38)	1.20 (1-1.38)	1.11 (0.96-1.17)	p>0.05	p>0.05	p>0.05			
LDL	3.16 (2.58-3.76)	2.89 (2.42-4.30)	3.47 (2.87-3.65)	2.86 (2.44-.50)	p>0.05	p>0.05	p>0.05			
Triglicyeride	1.59 (1.14-2.89)	1.46 (1.15-2.61)	1.54 (1.16-2.02)	2.22 (1.27-2.51)	p>0.05	p>0.05	p>0.05			
TSH	2.05 (1.38-2.28)	1.86 (1.37-2.52)	1.80 (1.61-3.18)	2.30 (1.89-2.78)	p>0.05	p>0.05	p>0.05			
Cortisol	280 (193-160)	328 (288-364)	371 (316-424)	356 (331-476)	p>0.05	p>0.05	**p<0.05**	p>0.05	p>0.05	p>0.05
Oestradiol	103 (82-134)	123 (85-176)	104 (84-109)	94 (78-177)	p>0.05	p>0.05	p>0.05			
LH	5.25 (4.40-6.15)	4.2 0(2.70-6.60)	6.20 (4.75-7.95)	5.20 (3.70-6.70)	p>0.05	p>0.05	p>0.05			
FSH	4.05 (2.90-6.90)	3.7 (2.4-5.3)	5.50 (3.55-10.10)	5.50 (5.0-6.3)	p>0.05	p>0.05	p>0.05			
HbA1c	5.55 (5.30-5.80)	5.80 (5.5-6.5)	5.90 (5.55-6.60)	6.30 (5.90-7.95)	p>0.05	p>0.05	p>0.05			
Arterial hypertension (n)	12	7	8	10	p>0.05	p>0.05	p>0.05			
Coronary artery disease (n)	0	1	0	0	p>0.05	p>0.05	p>0.05			
Cardiac arrythmia (n)	0	0	1	1	p>0.05	p>0.05	p>0.05			
Diabetes mellitus (n)	6	6	2	6	p>0.05	p>0.05	p>0.05			
COPD/Asthma (n)	3	0	1	5	p>0.05	p>0.05	p>0.05			
Cerebrovascular disease (n)	1	0	0	4	p>0.05	p>0.05	p>0.05			
Gastroesophageal reflux disease (n)	10	3	5	4	p>0.05	p>0.05	p>0.05			
Dyslipidemia (n)	4	9	6	5	**p<0.05**	p>0.05	p>0.05			
Psychiatric disease (n)	6	4	1	5	p>0.05	p>0.05	p>0.05			
Smoker (n)	5	7	4	3	p>0.05	p>0.05	p>0.05			
Former smoker (n)	1	2	1	3	p>0.05	p>0.05	p>0.05			

Table 3: Demographics, AHI and factors predictive for OSA in men

	Cutoff	Sensitivity	Specifity	PPV	NPV
AHI>5/h					
Age (y) overall	40	0,63	0,63	0,56	0,69
Age (y) Female	40	0,59	0,62	0,46	0,74
Age (y) Male	41	0,67	0,75	0,85	0,52
Neck Circumference (cm) overall	40	0,86	0,47	0,55	0,82
Neck Circumference (cm) Female	40,2	0,57	0,63	0,44	0,74
Neck Circumference (cm) Male	46,5	0,63	0,61	0,78	0,42
BMI overall	42,41	0,58	0,62	0,53	0,66
BMI Female	40	0,78	0,54	0,47	0,82
BMI Male	41,67	0,65	0,60	0,78	0,44
STOPBANG overall	4	0,63	0,77	0,68	0,73
STOPBANG Female	4	0,46	0,84	0,62	0,73
STOPBANG Male	5	0,60	0,36	0,70	0,26
ESS overall	9	0,42	0,73	0,55	0,62
ESS Female	7	0,42	0,53	0,33	0,62
ESS Male	8	0,66	0,69	0,85	0,43
FSS overall	3,44	0,58	0,56	0,50	0,64
FSS Female	3,33	0,60	0,54	0,41	0,72
FSS Male	4,11	0,52	0,50	0,73	0,29
AHI>15/h					
Age (y) overall	43	0,64	0,64	0,32	0,87
Age (y) Female	43	0,70	0,64	0,23	0,93
Age (y) Male	42	0,62	0,59	0,56	0,65
Neck Circumference (cm) overall	43	0,82	0,73	0,45	0,94
Neck Circumference (cm) Female	42,41	0,63	0,85	0,38	0,94
Neck Circumference (cm) Male	45,28	0,88	0,50	0,59	0,84
BMI overall	45,71	0,52	0,80	0,41	0,86
BMI Female	45,54	0,59	0,81	0,33	0,93
BMI Male	44,54	0,55	0,65	0,57	0,63
STOPBANG overall	4	0,79	0,70	0,42	0,92
STOPBANG Female	4	0,69	0,80	0,38	0,94
STOPBANG Male	5	0,73	0,48	0,53	0,68
ESS overall	7	0,62	0,54	0,26	0,84
ESS Female	7	0,44	0,54	0,14	0,86
ESS Male	7	0,82	0,50	0,58	0,76
FSS overall	3,44	0,53	0,50	0,21	0,81
FSS Female	3,33	0,60	0,51	0,15	0,90
FSS Male	4,11	0,45	0,43	0,41	0,48
AHI>5, STOPBANG≥ 3					
HCO3 overall	24,55	0,57	0,59	0,63	0,52
HCO3 Female	24,56	0,57	0,65	0,60	0,63
HCO3 Male	25,08	0,40	0,57	0,70	0,28
AHI>5 STOPBANG≥ 4					
HCO3 overall	24,7	0,59	0,54	0,73	0,38
HCO3 Female	24,56	0,57	0,65	0,60	0,63
HCO3 Male	24,37	0,60	0,51	0,34	0,75
AHI>15, STOPBANG≥3					
HCO3 overall	24,55	0,57	0,53	0,34	0,75
HCO3 Female	24,56	0,57	0,65	0,59	0,62
HCO3 Male	24,2	0,73	0,33	0,47	0,60
AHI>15 STOPBANG≥ 4					
HCO3 overall	24,8	0,53	0,55	0,47	0,61
HCO3 Female	25,8	0,85	0,39	0,68	0,64
HCO3 Male	24,04	0,70	0,38	0,48	0,60

Table 4: Receiver operator curves with cutoff values

Conclusion

- In our cohort the prevalence of OSA is relatively low compared to other studies, Probably due to the younger cohort and less severe obesity.
- Screening for OSA prior to bariatric surgery should be considered.
- Better screening algorithms are needed to identify patients at risk.