

EXPLORING SEX DIFFERENCES IN ADULT OBESITY CANDIDATES FOR BARIATRIC SURGERY

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SUMMARY

Introduction: Obesity represents a global health crisis and results from complex interactions between psychological, environmental, and genetic factors. Any therapeutic approach should consider the social, personal, and psychological characteristics of the obese subject, as well as possible medical complications. This study investigates sex differences in candidates for bariatric surgery.

Subjects and methods: This is a cross-sectional study including subjects who underwent psychiatric pre-surgical evaluation. The evaluation comprised a clinical interview and the administration of self-report questionnaires that assessed socio-demographic and clinical aspects. Descriptive and bivariate analyses and a multivariate logistic regression model were performed to evaluate variables significantly associated with sex in bariatric surgery candidates.

Results: The sample consisted of 173 subjects, of which 71.1% were women. Significant differences between men and women were detected in employment status, birth nationality, psychopathological history, organic comorbidities, and BMI value. There were no significant differences in clinical aspects.

Conclusion: Obesity has a significant impact on global health. Women and men who are considering bariatric surgery represent two different populations in demographic, personal, and social characteristics. Therefore, a sex-tailored approach is essential to guarantee adequate support in the management of the various aspects of obesity.

Key words: overweight – obesity - bariatric surgery - socio-demographic characteristics - sex differences

Abbreviations: BMI - Body Mass Index; DSM-5 - Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; ED - Eating Disorder; EU - European Union; N - Number (used to denote the sample size); SCID-5-CV - Structured Clinical Interview for DSM-5, Clinician Version; SCID-5-PD - Structured Clinical Interview for DSM-5, Personality Disorders; BES - Binge Eating Scale; BSQ - Body Shape Questionnaire; BULIT-R - Bulimia Test Revised; SPSS - Statistical Package for the Social Sciences; χ^2 - Chi-squared; CI - Confidence Interval; OQ - Obesity Questionnaire; NCD - Non-Communicable Diseases; t-test – Student's t-test

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INTRODUCTION

Obesity is defined by the World Health Organization as an excessive fat accumulation that represents a major risk to human health (WHO 2017). Being overweight and obesity are increasingly widespread problems, representing a threat to public health. In 2014, the prevalence of obesity reached 14.9% in women and 10.8% in men, with the average body mass index (BMI) of adults rising from 22 kg/m² in 1975 to 24 kg/m² (NCD Risk Factor Collaboration 2016, Semlitsch et al. 2019). The guidelines classify obesity based on BMI: a BMI of 25-29.9 kg/m² defines the condition of being overweight, while obesity is determined by a BMI \geq 30 kg/m² (Cornier 2022).

Like other chronic diseases, obesity also falls within the biopsychosocial framework of health (Engel 1977). A model is needed that considers the multiplicity of etiological factors, biological aspects, and the social and psychological factors in each clinical situation. This is

to keep the individual at the center rather than focusing exclusively on the disease. Indeed, obesity is the result of complex interactions between psychological, environmental, and genetic factors (Cheng et al. 2020). Several aspects of psychological functioning are involved in BMI (Sutin et al. 2011, Tambelli et al. 2017). Many obese people have a high incidence of comorbidity with many psychopathological disorders, such as mood and anxiety disorders (Amiri et al. 2019, Hryhorczuk et al. 2013, Luppino et al. 2010).

The therapeutic approach to obesity is multidisciplinary and can include dietary modifications, physical activity, psychological interventions, pharmacological treatment, and bariatric surgery (Mazzeschi et al. 2014, Semlitsch et al. 2019). The decision to offer surgery follows a comprehensive multidisciplinary assessment, including a psychiatric evaluation. Indeed, patients who undergo bariatric surgery often receive a psychiatric diagnosis during the pre-surgery evaluation (Zebi et al. 2023). The psychiatric evaluation for

patients suffering from obesity who are candidates for bariatric surgery requires an integrated network that operates according to a multidimensional and multi-professional model that integrates psychiatric/psychological/psychotherapeutic approaches with nutritional ones (Welbourn et al. 2018).

Several studies have considered that interindividual differences in susceptibility to the disease depend on personal characteristics (Chu et al. 2019, van Hout et al. 2004). Therefore, besides the factors mentioned above, weight could also be influenced by individuals' social and personal characteristics (Shaikh et al. 2015).

Regarding sex differences, obesity is more prevalent in women than men in most countries. Women are more likely to be diagnosed with obesity and seek and obtain obesity treatments, including bariatric surgery (Cooper et al. 2021). Nevertheless, men suffer from more severity and risk factors, due to their greater tendency to accumulate visceral adipose tissue and to produce pro-inflammatory substances (Muscogiuri et al. 2024). While women are more likely to seek and obtain obesity treatments (including bariatric surgery), men tend to have greater absolute weight loss (Cooper et al. 2021).

There are differences in the prevalence of obesity among various socioeconomic, ethnic, and sex groups (Singh et al. 2011, Wang et al. 2007).

Much of the literature focuses on the study of symptoms and interpersonal functioning of obese patients, while fewer studies have analyzed aspects of patients' life contexts and socio-demographic factors. Gender medicine aims to clarify these differences in men and women suffering from obesity and further research is needed to investigate the mechanisms underlying sex/gender differences in prevalence, comorbidities, and treatment (Cooper et al. 2021).

This study investigates differences between men's and women's medical and personal histories in individuals affected by obesity who are candidates for bariatric surgery. We evaluate the clinical and diagnostic features of the sample, underlining eventual disparities between men and women. We hypothesize that the social demographic characteristics differ in terms of the medical and personal histories of the sexes.

SUBJECTS AND METHODS

The study is based on a cross-sectional design, in which subjects underwent a psychiatric evaluation process between January 2016 and January 2024. The subjects attended an evaluation at the Division of Psychiatry, Clinical Psychology, and Psychiatric Rehabilitation of the General Hospital of Perugia. The evaluation included a clinical interview and the administration of self-report questionnaires in which socio-demographic and symptomatic aspects were assessed. We used the Obesity Questionnaire (OQ) to evaluate the socio-demographic aspects. This custom-

built tool includes a section to collect personal and demographic data, including sex, educational level, relationship status, past work conditions, country of birth, psychopathological diagnosis (including Eating Disorders - ED), other possible medical conditions, and BMI. A battery of self- and clinician-administered tests were used, including the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), clinician version (SCID-5-CV) (First et al. 2017a), the Structured Clinical Interview for DSM-5 personality disorders (SCID-5-PD), (First et al. 2017b), the Binge Eating Scale (BES) (Gormally et al. 1982), the Body Shape Questionnaire (BSQ) (Cooper et al. 1987) and the Bulimia Test-Revised (BULIT-R) (Welch Get et al. 1993).

All subjects were at least 18 years old, had a good knowledge of the Italian language, and had signed consent to participate in the study.

A descriptive analysis of the sample was performed to evaluate the distribution of socio-demographic, clinical, and diagnostic variables. Additionally, the Student's t-test (hereafter, t-test) and chi-squared test (χ^2) were conducted to evaluate significant differences between the sexes (women and men).

A multivariate logistic regression model was performed to evaluate variables significantly associated with the male sex. The independent variables included in the model were those found to be statistically significant during the bivariate Pearson chi-squared analysis with 95% confidence intervals (CI) and significance of $p=0.05$, namely educational level, relationship status, past work conditions, country of birth, psychopathological diagnosis (including ED), other possible medical conditions, and BMI. All tolerance values were > 0.1 and all variance inflation factors were < 10 , confirming that the assumption of multicollinearity was not violated in the regression analysis.

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS: IBM version 22). Statistical significance was considered for p values < 0.05 .

RESULTS

The sample consisted of 173 subjects, of which 71.1% were women ($N=123$). The average age was 47.10 ± 10.4 , while the average BMI of the subjects was 42.82 ± 6.4 .

Most of the subjects (89.5%, $N=145$) did not achieve an educational level higher than a secondary school diploma. Fifty-three percent ($N=88$) of the subjects were unmarried and 34.6% had never worked ($N=56$).

In the overall sample, 78.6% of patients were born in Italy ($N=132$). Additionally, 52.4% of the subjects ($N=87$) had a personal history of psychiatric disorders and 66.5% ($N=111$) reported medical comorbidities.

Table 1. Contingency table of the variables of employment status, birth nationality, psychopathological diagnosis, organic pathologies, BMI in relation to sex

Socio-demographic feature	Women (%)		Men (%)	
	Yes	No	Yes	No
Employment status	59.1	40.9	80.9	19.1
Birth nationality	71.4	28.6	95.9	4.1
Psychopathological history/diagnosis	58.5	41.6	37.5	62.5
Organic pathologies	61.0	39.0	79.6	20.4
BMI > 40	79.5	20.5	93.8	6.3

Table 2. Descriptive analysis of the contingency table and χ^2 test for the variables of employment status, birth nationality, psychopathological diagnosis, organic pathologies, and BMI concerning sex

Socio-demographic feature	Women (%)	Men (%)	χ^2 (df = 1)	p
Employment status	59.1	80.9	6.959	0.008
Birth nationality	71.4	95.9	12.364	<0.001
Psychopathological history/diagnosis	58.5	37.5	6.018	0.014
Organic pathologies	61.0	79.6	5.360	0.021
BMI > 40	79.5	93.8	5.059	0.024

*Women (%): Percentage of women; Men (%): Percentage of men; χ^2 (df = 1); χ^2 statistic with degrees of freedom indicated; p: p-value indicating statistical significance

Table 3. Logistic regression model of socio-demographic and clinical variables associated with the male sex in patients who were candidates for bariatric surgery

Variables in equation	Wald	p-value	OR (95% CI)
Employment status	4.523	0.030	2.699 (1.081-6.739)
Birth nationality (Italy)	5.898	0.015	6.562 (1.438-29.953)
Positive psychiatric history (including EDs)	0.719	0.396	0.606 (0.190-1.930)
Medical comorbidities related to obesity	3.220	0.073	2.219 (0.929-5.299)
BMI > 40	4.224	0.040	5.072 (1.078-23.862)

* χ^2 : 28.741; df: 5; p < 0.001; Notes: BMI = Body Mass Index; ED = Eating Disorders

There were no significant differences between the sexes regarding education level, relationship status, or age. However, there were significant differences in employment status, birth nationality, psychopathological history (including ED), medical conditions related to obesity, and BMI.

In particular, the results showed significant differences between the groups regarding the socio-demographic variable of employment status, since women were more likely to have always been unemployed throughout their lives (women= 59.1% vs men= 80.9%, p=0.008).

Statistically significant differences emerged between the two groups regarding the variable of being born in Italy (M = 95.9% vs F = 71.4%, p<0.001).

Pearson's χ^2 test showed significant differences between the groups regarding the variable for the presence of a psychiatric history (including EDs) (F=58.5% vs M = 37.5%, p=0.014).

In terms of medical comorbidities related to obesity, the results indicated a higher prevalence of comorbidities in men (M = 79.6% vs F = 61.0%, p=0.021).

There was a significant difference between the sexes for the presence of BMI at first started collecting data, T0 > 40 (M = 93.8% vs F = 79.5%, p=0.024).

There were no statistically significant differences in the BES, BSQ, and BULIT-R scores between men and women. Besides, men and women did not significantly differ in the prevalence of single psychiatric comorbidities, including ED.

The contingency tables and Pearson's χ^2 are described in Tables 1 and 2.

In the multivariable logistic regression analysis, the model considered the male sex as the dependent variable (χ^2 =28.741, df = 5, p<0.001), explaining between 17.5% (Cox & Snell's R square) and 25% (Nagelkerke R square). Of the five independent variables, employment status, country of birth, and BMI > 40 at T0 were significant in the univariate analyses (see Table 3).

DISCUSSION

Our findings focused on the identification of sex differences in obese subjects who were candidates for bariatric surgery, to highlight contextual socioeconomic factors associated with the sexes, helping our understanding of the problem and tailoring public health interventions.

There were no significant differences between women and men regarding post-high school qualifications

and relationship status. Concerning education, most studies in developed countries report conflicting results. Our results partially agree with a previous study in Spain which reported that the obesity rate was higher among people with only a primary education (Gutierrez-Fisac et al. 2002). However, other studies show that education is more negatively associated with the risk of obesity in women (e.g., Sobal & Stunkard 1989, Tchicaya & Lorentz 2012). Regarding relationship status, our results differ from other studies that underline how relationship status affects obesity differently for men and women (Gortmaker et al. 1993, Tchicaya & Lorentz 2012). For instance, a study conducted by the National Longitudinal Survey of Youth indicates that obese women in the United States were less likely to be married than non-obese women, while this was not the case for obese men (Gortmaker et al. 1993). This suggests that obesity may have a different impact on relationship status based on sex, at least in specific contexts. The divergence in our findings may be due to cultural, temporal, or sampling variations between studies. For example, social and cultural norms surrounding marriage and obesity may have changed in recent decades, influencing outcomes differently. Further investigations are needed to understand the associations between obesity, educational outcomes, and relationship status.

Our results show significant differences between women and men in the sociodemographic variable of employment. Women were more likely to have never been employed.

In general, the employment situation of workers in Italy presents a gender gap (Carta et al. 2023). Women tend to become homemakers due to family and social pressure, with a sex gap that is the second highest among EU countries (Carta et al. 2023). The expectations and roles that society attributes to women can lead them to conform to these traditional roles, limiting their work opportunities.

Our hypothesis confirms that employment differs by gender, negatively influencing women's professional success. This data agrees with the literature showing that obese women are less likely to be employed, as observed in other countries such as England, Canada, and China (Dou et al. 2020, Morris 2006, Sari & Osman 2018). Obese women are less present in work contexts, particularly in those where a high level of social interaction is required, and physical appearance and body shape are highly valued (Bartels & Nordstrom 2013). These findings can be explained by considering the prejudice and stigma that is often associated with obesity.

If obesity is related to higher employment for men, this suggests that the impact of obesity and employment may vary significantly between the sexes and in different socio-economic contexts.

In our study, most men were born in Italy. The interpretation of this data is unclear and may be linked

to socio-economic factors and women's greater search for healthcare regardless of their social background.

Our results show significant differences concerning psychiatric history, highlighting that women with obesity are more likely to have a personal history of psychiatric conditions than men. This agrees with the literature showing that obesity has significant repercussions on mental health, reporting comorbidities with anxiety and mood disorders (Duarte-Guerra et al. 2014, Zebi et al. 2023). The prevalence of psychopathological diagnoses among obese patients who are candidates for bariatric surgery is higher than in the general population (Malik et al. 2014). Furthermore, it is interesting to underline how there are no statistically significant differences in the diagnoses at the end of the evaluation, showing how obese women are more often "help-seekers" than men (Cooper et al. 2021). In addition, there is a significant difference between the sexes regarding the presence of organic pathologies and BMI. Men have more medical comorbidities and a BMI > 40, showing how men arrive at bariatric surgery at a more advanced stage. Sex hormones appear to contribute to the development of EDs. Subcutaneous and visceral adipose tissue can play different roles in eating regulation. Visceral adipose tissue accumulation results in increased immune cell infiltration and secretion of vasoconstrictor mediators, which are at a higher level than subcutaneous fat inflammation mediators (Koenen et al. 2021, Muscogiuri et al. 2024). Sex steroid hormones participate in the metabolism, accumulation, and distribution of adipose tissues. Men have high fat in the abdominal area, women tend to distribute a larger proportion of their fat in the lower body. Abdominal body fat represents an important cardiovascular disease risk factor, contributing to sex-based differences in cardiovascular risk (Elmaleh-Sachs et al. 2023, Muscogiuri et al. 2024, Singh et al. 2021). These data are in line with our findings that men are more inclined to have a more severe level of obesity at the first evaluation than women.

Our study has some limitations. The observational nature and limited number of patients do not allow for generalization of the results. Furthermore, there was no control group of obese subjects who followed alternative methods to bariatric surgery to lose weight. Further studies are necessary to further analyze our preliminary results.

CONCLUSIONS

Men and women have distinctive characteristics from a demographic, social, and psychopathological point of view, and treatment must be tailored to the needs of each individual. The health conditions of obese patients start from different levels of severity and characteristics based on sex. This suggests the need for pathways that consider the complexity and sex differentiation, which can be associated with different disease courses.

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Contribution of individual authors:

Veronica Raspa: methodology, writing original draft preparation, review and editing, project administration.

Giulia Menculini: study design, methodology, review and editing.

Leonardo Zebi: data curation, writing original draft preparation, review and editing.

Patrizia Moretti: study design, review and editing.

Laura Dalla Ragione & Alfonso Tortorella: supervision.

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