RESEARCH ARTICLE

A Case-Control Study of Body Mass Index and Infertility in Algerian Women (Sidi Bel Abbes, West of Algeria)

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ABSTRACT

Introduction: The prevalence of obesity and female infertility in Algeria has increased in past decades, and recent study are showing a relationship between body mass index (BMI) and the risk of female infertility, suggesting that obesity is a risk factor for infertility. In order to evaluate the risk of infertility associated with BMI, we conducted a case-control study.

Materials and methods: The relationship between BMI and female infertility was investigated in a case-control study of 256 infertile cases and 326 fertile control subjects. The BMI of infertile women was compared with the BMI of the control fertile group. Odds ratios (ORs) was calculated as measures of relative risk of infertility associated with BMI.

Results: Multiple analyses showed significant association between various measures of BMI and female infertility in this population. An association between BMI and infertility was observed for the overweight (25.00–29.99 kg/m^2; odds ratio = 2.23; p = 0.021; 95% confidence interval, 1.52–3.25) and obese group (>30 kg/m^2; odds ratio = 3.26; p = 0.019; 95% confidence interval, 1.62–6.58) compared to the normal weight group. However, no association was found between underweight and infertility (BMI <20 Kg/m^2, odds ratio = 0.96; p = 0.063; 95% confidence interval, 0.57–1.63).

Conclusion: The present study confirms the results that the previously reported research have shown and affirm that an negative association exist between obesity and overweight with fertility, this association might be influenced by other factors, that's why larger and more research in the Algerian population are needed.

Keywords: Algeria, Body mass index, Female infertility, Obesity, Overweight.

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INTRODUCTION

Infertility is now considered to be a global health problem,[1] that can have a serious impact on the reproductive health of the couple.[2,3] It does not only affect the couples' life, it also affects the social environment and healthcare services.[4]

In developing countries, very few studies have investigated the potential effect of excess weight on infertility. In those low-income countries, genital tract infections and sexually transmitted diseases are the most important factors contributing to infertility.[5,6] However, in those countries a very limited number of studies have been conducted on the impact of body mass index (BMI) on female infertility.

In Algeria, which considered a developing country, the prevalence of obesity among women is high with a percentage of 30.1%.[7] Therefore, it is important to investigate the probable relation between BMI and female infertility in Algeria, especially knowing that up to now, only a few studies have been performed on that particular factor. The present study aims to evaluate the relationship between BMI and infertility, and in order to evaluate the risk of infertility associated with BMI, we conducted a case-control study.

MATERIALS AND METHODS

Participants

This study was a case-control study conducted in the region of Sidi Bel Abbes, West of Algeria. Case patients were women in infertile relationships; they were recruited from a private gynecological office, to be eligible for the study the women needed to be between 18 and 30 years old, and having had regular unprotected intercourse for one year or more with one regular partner without conception.

Control participants were fertile women; they were defined as women who recently delivered. Controls were recruited at the level of the Hospital Establishment Specializing in Obstetrics and Gynecology. To limit the effect of confounding factors control participants were

matched to case patients for age, we only included fertile women aged between 18 and 30 years. All control participants were women who conceived naturally.

A total of 582 women were recruited for the study with 256 infertile case participants and 326 fertile control participants. For data collection, participants were interviewed using a special questionnaire that included questions on sociodemographics characteristics, medical characteristics, fertility and other lifestyle factors. To add power to a study, we enroll more than one control for every case, that the reason the number of cases and controls for this study were not matched, plus we defined the number based on what other researches have done on the relationship between BMI and other factors, like BMI and lung cancer[8] or BMI and breast cancer.[9]

To calculate the BMI, the mathematical formula based on person's height and weight was used, with BMI equals weight in kilograms divided by height in square meters (BMI = kg/m²).[10] The BMI was divided into four categories as followed: <20 kg/m² was defined as underweight, 20 to 24.9 kg/m² as normal weight 25 to 29.9 kg/m² as overweight and >30 kg/m² as obese. The BMI of 20 to 24.9 kg/m² was chosen as the reference category for the statistical analysis.

STATISTICAL ANALYSIS

Data collected during the interviews were entered and analyzed using statview software version 5.0 (SAS Institute) and SPSS version 22 (IBM Corp.). Individual demographic and clinical characteristics were compared between cases and controls, the statistical significance was assessed at ($p < 0.05$) of the differences between groups using the Student's t-test and ANOVA for continuous variables and the Chi-square test for categorical variables. We assessed the impact of BMI on female infertility using the odds ratios (ORs) and used logistic regression model that adjusted for some confounding factors, such as employment status, level of education and age. This study and the study protocol was approved by local institutional review boards.

RESULTS

Table 1 shows the different characteristics of the cases and controls group. Even if the age range for this study was from 18 to 30 years, approximately 65% of the cases were aged between 27 and 30 against 54% of the control group in the same age range. The educational level showed some differences between the two groups, 36% of the cases had secondary education and 21% of them had university education, however, the percentages for those two categories were 19% for the controls group (χ^2 test p <0.0001). Eight percent of the fertile women were employed compared to a percentage of 36% in the

Table 1: Characteristics of the study population for cases (infertile patients) and controls (fertile subjects)
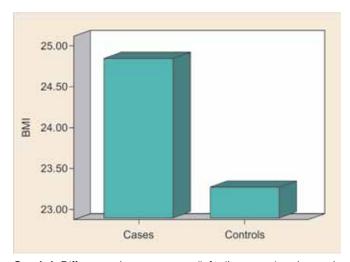
Characteristic	Cases n (%)	Control n (%)	p (χ^2)
Age			
18–21	23 (8.98)	41 (12.57)	0.38
22–26	88 (34.37)	106 (32.51)	
27–30	145 (65.64)	179 (54.90)	
Education level			
None	6 (2.34)	8 (2.45)	<0.0001
Primary education	25 (9.76)	46 (14.11)	
Average education	77 (30.07)	146 (44.78)	
Secondary education	94 (36.71)	62 (19.01)	
University education	54 (21.09)	64 (19.63)	
Occupation			
Employed	94 (36.71)	29 (8.89)	<0.0001
Unemployed	162 (63.28)	297 (91.10)	
BMI categories			
<20	29 (11.32)	53 (16.25)	<0.0001
20.00–24.99	95 (37.10)	172 (52.76)	
25.00–29.99	107 (41.79)	87 (26.68)	
>30	25 (9.76)	14 (4.29)	

infertile group. Results showed a statistically significance difference between the occupation status in the two group (χ^2 test p <0.0001).

Concerning the BMI, infertile women group had more percentage of overweight and obesity compared to the fertile group (41 *vs* 26% for overweight and 9 *vs* 4% for obesity) the difference between the BMI categories was statistically significant (χ^2 test p < 0.0001) (Graph 1).
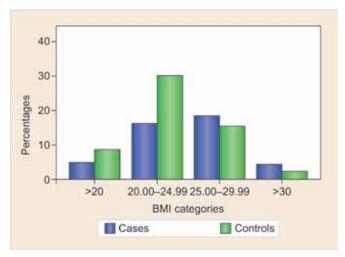
The difference between the two BMI mean among infertile case and fertile control group was statistically significant (p <0.0001), with higher BMI in the infertile groups compared to the fertile groups (Graph 2).

Table 2 shows the ORs and 95% confidence intervals (CIs) for the association of BMI with female infertility. The

Graph 1: Differences between cases (infertile women) and controls (fertile women) according to the BMI means, (p-value for anova test < 0.0001)

Graph 2: Body mass index categories histograms for cases (infertile women) and controls (fertile women). (p-value for Chi-square test < 0.0001)

Graph 3: Odds ratio of infertility by BMI categories. Bars represent 95% confidence intervals. Category 20.00 to 24.99 kg/m^2 is used as reference group

Table 2: Association of BMI with infertility

BMI categories	Case patients	Control subjects	Odd ratio	95% CI	p
20.00–24.99 (reference)	95	172	1.0 (Ref)	1.0 (Ref)	
< 20	29	53	0.96	0.57–1.63	0.0063
25.00–29.99	107	87	2.23	1.52–3.25	0.0021
> 30	25	14	3.26	1.62–6.58	0.0019

Table 3: Model adjusted for educational level, age and working status

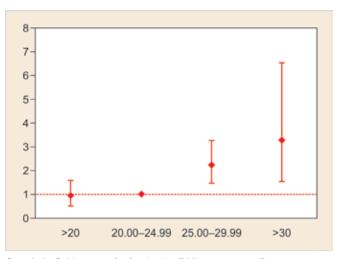| BMI categories	Case patients	Control subjects	Odd ratio	95% CI	p
20.00–24.99 (reference)	95	172	1.0 (Ref)	1.0 (Ref)	
< 20	29	53	1.01	0.57–1.78	0.9714
25.00–29.99	107	87	2.47	1.64–3.73	0.0001
> 30	25	14	3.30	1.50–7.26	0.0029

overweight group exhibited a two-fold higher rate than the normal BMI group (BMI = 25.00–29.99 kg/m^2 OR = 2.23; 95% CI, 1.52–3.25; p = 0.0021). A higher increase was noted for the obese group compared to the normal weight group (BMI > 30 kg/m^2 OR = 3.26; 95% CI, 1.62–6.58; p = 0.019), (Graph 3).

To test potential interaction with BMI and other factor, the model was further adjusted for age, educational level and working status (Table 3). The results showed a nonsignificant association, with no notable difference in ORs for the four BMI categories, in this study, the interaction term between BMI and the other factor was not significant.

DISCUSSION

The results of the study showed a high percentage of overweight and obese women in the infertile group respectively (41.79–9.76%) compared to the percentages found in the control fertile group (26.68–4.29%), the logistic regression analysis indicated a 3-fold increased risk of infertility for the obese group (OR = 3.26) compared to women with normal weight. Those results display an association of BMI with infertility risk.

This result is similar to those of most other studies, which found significant associations between the two factors.[11-13] It is now accepted that abnormal body weight reduces fertility for women with a BMI less than 19 and higher than 25.[12,13] And research is showing that obesity is a health problem that can lead to disease-induced infertility.[14]

In this study, obesity and overweight were more associated with female infertility than underweight, however, some other researches have also found an increase in the risk of infertility for very lean women.[15-17] In this study, this can be explained by the fact that the number of underweight women was low compared to the other groups.

One study found that 44% of women with BMI > 29.9 were infertile and suffered from sexual dysfunction,[18] thus establishing an association between obesity and overweight with sexual dysfunction in different research.

Additionally, other studies have found that physical appearance of women have an impact on their sexual interaction, and the ones who were dissatisfied with how they looked reported less confidence in their sexual interactions.[19,20] Other studies have also shown this relationship between obesity and sexual dysfunction in women.[21,22]

Some of the adverse effects obesity can have on the reproductive function include menstrual disorders and hormone imbalances,[23] imbalance of sex steroids, insulin and leptin, which, may affect the ovarian function, implantation and development of a clinical pregnancy.[24,25]

Studies have shown that obese women are at risk of condition that affect fertility such ovulation failure and polycystic ovary syndrome.[26,27] Obese women who suffer from polycystic ovary syndrome (PCOS) frequently develop infertility as a result of anovulation; they also have an increased risk for miscarriages and complications during pregnancy.[28]

Association between obesity and menstrual irregularities is now recognized. In a study, comparing women with menstrual irregularities with normally menstruating females obesity was present at a 4-fold higher rate in women with menstrual irregularities.[29]

In addition, recent studies concluded that obese women have poorer responses to the assisted reproductive treatment than non-obese patient.[14]

The negative impact of obesity on the results of assisted reproductive treatment cycles has been supported by many researches and has also been reviewed.[30] Several studies confirmed the adverse effect of obesity on *in vitro* fertilization IVF outcomes.[14-31] However, some other studies have found no differences between obese and normal weight women.[32,33]

The strength of this study is that it is one of the first case-control study focusing on the relation between BMI and female infertility in Algeria, however, there are some limitation to this research, the sample size was limited and the study had a lack of details and parameters like; type of infertility, duration of it, age of marriage, history of miscarriage and more importantly the different causes of infertility.

Future studies in our region should consider those parameters, also further studies are required to determine the effects of BMI on infertility in a larger Algerian population and investigate the relationship between BMI and sexual function in infertile and fertile women, and explore the effects that BMI can have on the assisted reproductive treatment in Algeria.

CONCLUSION

In conclusion, increased risk of infertility was observed in this study among women whose BMI was 25.00 to 29.99 kg/m^2 and >30 kg/m^2, thus the present study confirms the previously reported possibility that an association between BMI and risk of female infertility exists, and that overweight women may have difficulty conceiving compared to women of average weight.

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