

# Bariatric Surgery Influences the Number and Quality of Oocytes in Patients Submitted to Assisted Reproduction Techniques

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**Objective:** To determine differences in follicle stimulation, oocyte retrieval, maturation, and fertilization among patients who underwent bariatric surgery, obese patients, and patients with  $18 < \text{BMI} < 30 \text{ kg/m}^2$  submitted to assisted reproduction techniques and check that these patients may have some impairment in ovarian response.

**Methods:** The study comprised three groups: GI: 29 patients who had undergone restrictive and/or mal-absorptive bariatric surgery; GII: 57 obese patients ( $\text{BMI} > 30 \text{ kg/m}^2$ ); and GIII: 94 patients ( $18 < \text{BMI} < 30 \text{ kg/m}^2$ ) with infertility due to a male factor. BMI, weight loss until oocyte retrieval, vitamin supplementation, and anemia were evaluated. Data were compared with the number of follicles observed, the number of oocytes retrieved, and the maturation status of these oocytes. Results were analyzed statistically.

**Results:** A statistically significant difference in the number of follicles observed by ultrasound ( $P < 0.01$ ), the number of oocytes retrieved ( $P = 0.013$ ), and the number of metaphase II oocytes ( $P < 0.01$ ) between the patients with prior bariatric surgery and both GII and GIII group was found.

**Conclusions:** The weight loss resulting from bariatric surgery can be very beneficial to the overall health of the woman, but the reproductive process can be impaired. Bariatric surgery appears to have an important impact on the formation of follicles and oocytes.

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## Introduction

Obesity is characterized by the excess of fat tissue, due to a chronic imbalance between energy intake and energy expenditure. Several factors have been associated with this energy imbalance, such as lifestyle (diet and physical activity) and neuroendocrine disorders, associated to the individual genetic background (1).

This condition has become a major health problem across the world. In the UK, obesity affects one-fifth of the female population, and 18.3% of the female population in the reproductive age group (16–44 years) are classified as obese (2). In Brazil, 16 million women are overweight, which corresponds to 38% of the female population (3).

The World Health Organization (WHO) classifies obesity based on the body mass index (BMI). By this method, the person's weight (in kilograms) is divided by the square of his or her height (in meters). This index defines the following groups: underweight ( $\text{BMI} < 18.5 \text{ kg/m}^2$ ),

adequate ( $\text{BMI} < 25 \text{ kg/m}^2$ ), overweight ( $\text{BMI} = 25\text{--}30 \text{ kg/m}^2$ ), and obese, subdivided into classes I, II, and III ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ,  $\geq 35 \text{ kg/m}^2$ , and  $\geq 40 \text{ kg/m}^2$ , respectively) (4).

Obese women generally present increased risk for infertility, miscarriage, gestational diabetes mellitus, gestational hypertension, pre-eclampsia, cesarean delivery, and anesthesia-related complications. Maternal obesity also puts the developing fetus at risk for congenital abnormalities, abnormal intrauterine growth, and may lead to life-long adverse effects, including obesity in the developing child (5).

Unfavorable responses to ovarian stimulation such as increased gonadotropin consumption, fewer selected follicles, and lower number of retrieved oocytes have been observed in obese women submitted to assisted reproduction techniques (ART) (6). Due to this fact and to the difficulties those women may face during gestation, in some countries there are severe restrictions to performing fertility

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**Author contributions:** Juliana Christofolini, Gustavo Santos and Denise Christofolini conceived study design. Juliana Christofolini and Gustavo Santos performed the data collection, Fernando Adami analysed data. Bianca Bianco, Denise Christofolini and Caio Parente Barbosa interpretation the data. All authors were involved in literature search, writing the paper and had final approval of the submitted and published versions.

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