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Association Between Body Mass Index and Reproductive Outcomes in IVF Cycles: A Retrospective Analysis from an Ecuadorian Cohort

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ABSTRACT

Objective: To study whether overweight is associated with lower pregnancy success in women undergoing conventional in vitro fertilization.

Design: Retrospective cross-sectional observational study.

Subjects: Thirty-seven women who underwent conventional in vitro fertilization at the PROVIDA Assisted Reproduction Centre in Latacunga, Ecuador, from January 2022 to June 2024.

Exposure: Body mass index category, comparing normal weight (<25 kg/m²) with overweight or obesity (≥25 kg/m²).

Main Outcome Measures: Pregnancy rate, number of oocytes retrieved, number of follicles, and number of day-5 blastocysts.

Results: Twenty-two women (59.5%) had body mass index ≥25 kg/m² and 15 (40.5%) had body mass index <25 kg/m². The overall pregnancy rate was 56.8%. Pregnancy rate differed significantly by body mass index category (p=0.002), with higher pregnancy rates in women with body mass index <25 kg/m² than in women with body mass index ≥25 kg/m². Body mass index was moderately and negatively correlated with the number of day-5 blastocysts (r=-0.367; p=0.026). The number of blastocysts was positively correlated with pregnancy rate (r=0.339; p=0.040).

Conclusion: Overweight and obesity were associated with lower pregnancy success and fewer day-5 blastocysts in women undergoing conventional in vitro fertilization. Preconception weight management may improve reproductive outcomes, although larger multicenter studies are needed..

Keywords: Overweight, body mass index, in vitro fertilization, pregnancy rate, blastocyst development.

INTRODUCTION

Obesity and its effects on the morbidity of diseases have been a global issue of concern in the past few decades (1). Recent statistics show that obesity is spreading rapidly in the world, with at least 2 billion individuals affected, and the prevalence and incidence of the disease is almost 30 per cent of the world population (2).

The prevalence rate of adult obesity, or the body mass index (BMI) over 30, is 13.10 on the global level and 28.60 in the Americas, which is a high-risk area in this case (3). The National Health and Nutrition Survey of the National Institute of Statistics and Census (INEC) (4) indicates that 64.68 per cent of adults aged 19-59 years in Ecuador are overweight, and there are various types of overweight and obese.

The impact of obesity on reproductive health is highly interesting and significant in the field of reproductive medicine. Since the obesity epidemic is rising in tandem with the trend towards delayed childbearing in urban populations, more and more couples facing difficulties conceiving are subjected to it, and the negative impact of obesity on pregnancy outcomes becomes more pronounced with the rise in BMI.

As an example, the study by Provost et al. (5) (2016) assessed the effect of BMI upon in vitro fertilisation (IVF) results in fresh autologous cycles using a sample of over 240,000 fresh IVF cycles. The findings indicated that the success rates, the probability with the 95% significance level, were positive and improved steadily with the shrinking of the BMI, inversely with the increasing BMI.

A subsequent study, which was released in 2011 by Shah et al. (6), estimated the influence of BMI on morphologic parameters, the amount of oocytes gathered, the amount of embryos that were subsequently advanced to the blastocyst phase, and the outcome of cycles in women with IVF.

Anthropometric risk A retrospective cohort of 1,721 women was compared, and the normally fertilised oocytes and the levels of oestradiol were lower in women with class 2 obesity (BMI 35 to 39.90) and class 3 obesity (BMI 40 and above). Lastly, women with normal weight had a reduced chance of childbirth and live birth by half compared to the women with class III obesity.

With the current obesity epidemic concurrently rising across the globe, there has been a necessity to further study the effects of being overweight and obese on the success of treatment in the treatment of infertility. In this regard, the primary objective of the study was to assess the impact of being overweight on the success of pregnancy in women undergoing the traditional IVF. Besides that, it was intended to analyse the number of oocytes retrieved and the number of blastocysts retrieved on day 5, comparing overweight women with women with normal BMI..

Methodology

Study design and population

It was a cross-sectional, retrospective, quantitative and descriptive study. The secondary data gathered included information in the form of medical records in an assisted reproduction centre found in the city of Latacunga, Ecuador. The overall sample was that of patients who had been treated at the centre in the period between January 2022 and June 2024. Then a non-random convenience sample was chosen; this was done on the condition that the patients fulfilled the inclusion and exclusion criteria.

The inclusion criteria have identified the patients who have been subjected to conventional IVF and treated at PROVIDA. The excluded patients included individuals that had incomplete medical records, previous failures of IVF, severe endocrine conditions that might have affected fertility, previous comorbid conditions and male infertility.

Variables

The patients were categorised as obese and overweight (7). Normal weight was set to a BMI range of 18.50- 24.99 and the range of 25.00-29.90 was termed as overweight. Pregnancy rate was considered to be a qualitative variable having two categories, No or Yes, according to the chance of pregnancy visualisation in the form of foetal heartbeat in transvaginal ultrasound. Besides, pregnancy was determined by a level of human chorionic gonadotropin (hCG) of at least 5 mIU/mL.

Similar to the pregnancy rate, implantation failure was a Yes and No category and was determined as no pregnancy following embryo transfer during an assisted cycle. Also included and classified as agonists or antagonists were medications that are acting on the hypothalamic-pituitary hormonal axis that regulates ovulation. Lastly, the number of follicles, the number of oocytes, and the number of blastocysts were determined to date 5.

Procedure

The study syllabus was presented to the Human Research Ethics Committee of Universidad San Francisco de Quito to be

evaluated and approved. After its approval it was forwarded to the authorities of the PROVIDA Assisted Reproduction Centre to get permission to access information in medical records.

Once the respective permission was granted, data gathering was performed using the medical records of patients who satisfied the set inclusion and exclusion criteria. The collection of data was done in the afternoon at the hospital unit. The data were entered into a data collection sheet in electronic form designed to be used in this case.

It is also worth noting that the information gathered was stored in portable USB storage in the sole possession of the people who were responsible for the study. Only the responsible investigators could access this device with a password and did not disclose the data to the third party until the deletion of the data. This was then exported to a personal computer that also had a password, and the SPSS version 27.0 statistical package was installed, and statistical analysis was performed using the same. The data was stored for six months and subsequently allowed to be deleted, as it is required by the Organic Law on Personal Data Protection (8).

Also, it was determined that the data obtained, together with the findings of this research, would be utilised purely on academic grounds and presentation of research projects, without violating patient privacy and confidentiality.

Data analysis

Upon gathering the required information, the investigators conducted a review and validation exercise to make sure that the data was consistent and accurate. After validation of data, the data were coded and inputted in SPSS version 27.0 to be processed and analysed.

The statistical process had two stages. Percentage distribution of qualitative variables was determined in the first, descriptive stage, and measures of central tendency and dispersion were determined in quantitative variables. The analysis of the normality was conducted with the help of the Shapiro-Wilk test. A non-normal distribution was assumed in the event that the resultant figure was below 0.05, and the median and interquartile range were presented. Otherwise, the mean and standard deviation were put across.

The second step was related to the inferential analysis, the goal of which was to find statistical relationships between qualitative variables with the help of the chi-square test, whose level of significance was 95% ($p \leq 0.05$). In case a significant relationship was identified, the risk associated with it and its confidence interval were obtained through a binary logistic regression model.

Moreover, correlation tests were used to compare quantitative and quantitative variables or quantitative and qualitative variables in order to perform the inferential analysis, based on the data distribution. In case the variable was normally distributed, the Pearson test was applied, but in the absence of normality, the Spearman rho test was used.

Ethical and Gender Considerations

The concepts of bioethics, such as beneficence, non-maleficence, justice, and respect of the autonomy of the participants, were factored in this study. The study outcomes were reflected by beneficence, as they had benefits for both PROVIDA medical staff and patients by assisting in determining the correlation between overweight and the percentage of pregnancies among patients subjected to conventional IVF. The non-maleficence was ensured by the introduction of procedures that ensured that the participants were not exposed to harm, whether physical, psychological or social, and the risks involved in the study were minimised.

In terms of the principle of justice, the overall sample selection was encouraged without any bias on gender, age or ethnicity, and all the patients had equal chances to be involved in the research and enjoy the results. The autonomy was respected, as the study was founded on the examination of the anonymised database that was shared previously.

Besides this, the research adhered to the existing national and international ethical principles, among them being the Declaration of Helsinki (9), particularly the clause requiring medical research with human subjects to be conducted by someone with the right scientific and ethical training under the guidance of a physician or any other qualified researcher.

The international ethical principles of health-related research involving Human beings of the Council of International Organizations of medical Sciences (CIOMS) (10) were also used, which include more elaborate ethical principles of conducting medical research, especially in developing nations. These guidelines deal with the following issues: informed consent, vulnerable populations, independent ethical review, risk-benefit assessment and transparency in data management, and to ensure that the study meets the international standards concerning human rights, scientific integrity and equity.

The guidelines of the Human Research Ethics Committee of Universidad San Francisco de Quito were also factored in. They are aimed at ensuring dignity, rights and wellbeing of individuals involved in biomedical research. The project was assessed, monitored, and passed by this committee using ethical, scientific, and legal standards as per the regulations of the Ministry of Public Health of Ecuador, the Organic Health Law (11), the Regulations of Research in Human Beings (12), and the principles of good clinical practice (13).

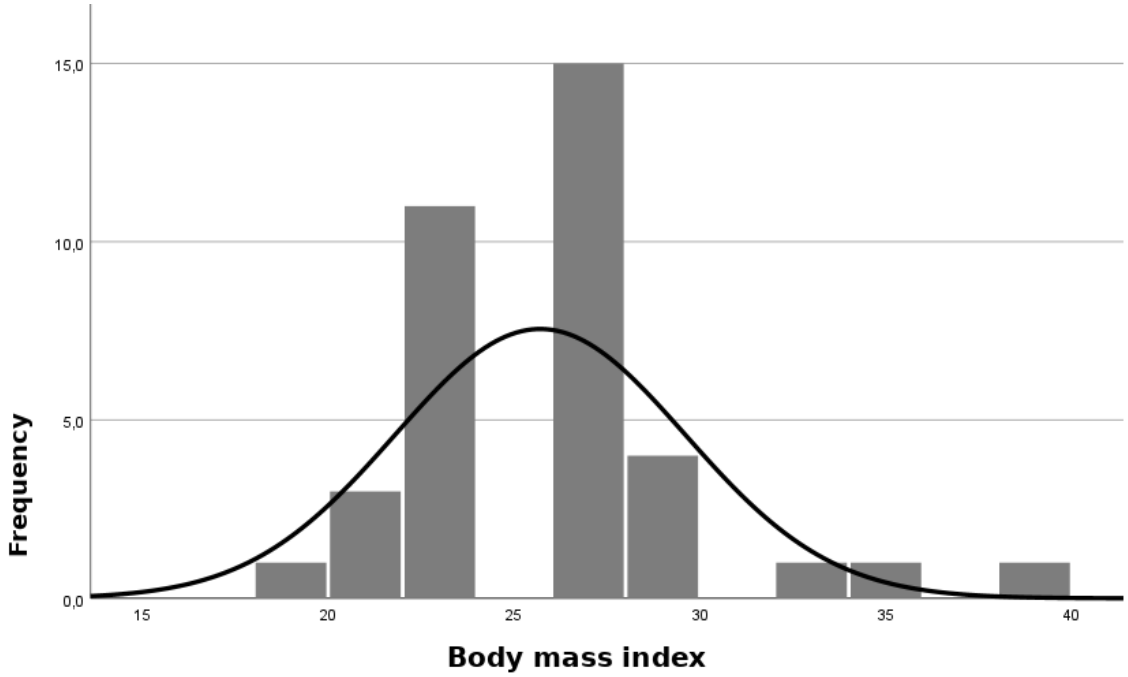
Lastly, the researchers declare the absence of any conflict of interest in the study development. They were aimed at being impartial and objective and not being influenced by any outside factor that would influence the findings or undermine the research integrity. No such financial, personal or professional ties existed to cloud their judgement, and no one directly or indirectly funded them that had a stake in the outcome.

The researchers reiterate their focus on undertaking the research in an ethical manner, as per the best of scientific practices, and to the benefit of health knowledge, namely, the association between BMI and pregnancy outcomes in conventional IVF patients.

Results

The data was gathered among 37 patients that fulfilled the inclusion and exclusion criteria previously set out. The statistical analysis has provided the most relevant findings, as indicated below.

Table 1. Histogram of BMI among patients receiving conventional IVF therapy at PROVIDA, between January 2022 and June 2024.



Note. According to the Shapiro-Wilk test, BMI showed a normal distribution; therefore, the mean and standard deviation should be presented as measures of central tendency.

Based on the gathered data, the general BMI range of the research population was 19-38 kg/m², indicating the presence of both the characteristics of people with the values of the lower norm and women with obesity. The average result was 25.70 ± 3.91 kg/m², which is a little higher than the WHO threshold of overweight.

It indicates that the selected sample of the study was inclined to excess weight that may be linked to an increased risk of metabolic and reproductive issues, particularly in the case of fertility treatments like traditional IVF..

Table 2. Clinical characteristics of women treated at PROVIDA between January 2022 and June 2024.

Clinical characteristics	**Total patients N = 37**
Age, mean ± SD	35.73 ± 3.73 (26–44)
Body mass index, %	
≥ 25 kg/m2	22 (59.50)
< 25 kg/m2	15 (40.50)

Number of follicles, median and IQR	12.00 ± 13.00 (3.00–31.00)
Number of oocytes, median and IQR	10.00 ± 11.00 (3.00–31.00)
Number of blastocysts after 5 days, median and IQR	4.00 ± 4.00 (0.00–13.00)
Medication type, %	
Antagonist	27 (73.00)
Agonist	10 (27.00)
Implantation failure, %	
Yes	4 (10.80)
No	33 (89.20)
Pregnancy rate, %	
No	16 (43.20)
Yes	21 (56.80)

Note. According to the Shapiro-Wilk test, the appropriate measure of central tendency was identified. SD: standard deviation. IQR: interquartile range.

The population comprised women who had a mean age of 35.73 +- 3.73 years with the range of 26 to 44 years. With regard to BMI and considering the cutoff weight of 25 kg/m², it was noted that over half of the respondents were overweight and obese, whereas 40.50 were at a normal weight range as compared to their height.

On reproductive parameters, the identified follicle range was 3.00 to 31.00 with the median and interquartile range of 12.00 +- 13.00. The mean retrieved oocyte count was 10.00 -11.00 and the range was 3.00 to 31.00, but the number of blastocysts at day 5 was 4.00 -4.00 and the range was 0.00 to 13.00.

Concerning the pharmacologic regimen, 73.00 per cent of them were administered antagonists and 27 per cent were administered agonists. Regarding the clinical outcomes, the implantation failure was registered in 10.80% of cases. Lastly, the pregnancy rate was 56.80 as opposed to the 43.20 per cent of patients who failed to get pregnant. The table below shows the statistical correlation between the qualitative variables.

Table 3. Relationship of medication type and implantation failure with pregnancy rate in women treated at PROVIDA between January 2022 and June 2024.

Clinical characteristics	No n (%)	Yes n (%)	Total n (%)	p	OR	95% CI
Medication type				0.046 *	0.214	0.04–1.03
Antagonist	9 (56.30)	18 (85.70)	27 (73.00)			
Agonist	7 (43.80)	3 (14.30)	10 (27.00)			
Implantation failure				0.435	-	-

Yes	1 (6.30)	3 (14.30)	4 (10.80)			
No	15 (93.80)	18 (85.70)	33 (89.20)			

Note. Chi-square test with 95% statistical significance in the study population.

According to the inferential analysis performed between medication type and pregnancy rate, a statistically significant relationship was identified at the 95% level. However, in the subsequent binary logistic regression analysis, a risk value of 0.214 was obtained with a confidence interval of 0.04 to 1.03.

Because this interval includes 1, the results are considered ambiguous for conclusively establishing whether the medication acts as a risk or protective factor; therefore, the association initially observed is discarded. Regarding implantation failure, no statistically significant associations ($p > 0.05$) were identified with pregnancy rate. The following table presents the correlation between quantitative variables and pregnancy rate.

Table 4. Correlation of age, number of oocytes, number of blastocysts, and number of follicles with pregnancy rate in women treated at PROVIDA between January 2022 and June 2024.

Clinical characteristics	p	Shapiro-Wilk normality test	Test	Correlation
Age	0.366	0.14	Pearson	-0.153
Number of oocytes	0.179	0.006**	Spearman	0.226
Number of blastocysts	0.040*	0.001**	Spearman	0.339
Number of follicles	0.260	0.02**	Spearman	0.19

*Note. Correlation is significant at the 95% level. **The variable has a non-normal distribution and is therefore treated as non-parametric.*

Initially, the number of blastocysts obtained by day 5 showed a positive, moderate-magnitude correlation with pregnancy rate, indicating that the greater the number of blastocysts retrieved, the higher the probability of achieving pregnancy. Although this association does not establish a causal relationship, it suggests that the number of blastocysts is a relevant indicator of reproductive success.

Table 5. Correlation of number of oocytes, number of blastocysts, and number of follicles with BMI in women treated at PROVIDA between January 2022 and June 2024.

Clinical characteristics	p	Shapiro-Wilk normality test	Test	Correlation
Number of oocytes	0.258	0.006**	Spearman	-0.191
Number of blastocysts	0.026*	0.001**	Spearman	-0.367
Number of follicles	0.144	0.02**	Spearman	-0.245

*Note. Correlation is significant at the 95% level. **The variable has a non-normal distribution and is therefore treated as non-parametric.*

The correlation analysis between BMI and reproductive characteristics indicated that excess weight could negatively

influence some indicators of ovarian response and embryonic quality. In particular, the number of blastocysts showed the most relevant association, evidencing that as BMI increased, the number of blastocysts obtained tended to decrease, with a moderate negative correlation (-0.367).

Although the number of oocytes and follicles also showed negative correlations, these were of lower intensity, suggesting that BMI has a more marked effect on the advanced embryonic stage than on the initial ovarian response.

Table 6. Relationship between BMI and pregnancy rate in women treated at PROVIDA between January 2022 and June 2024.

Clinical characteristics	No n (%)	Yes n (%)	Total n (%)	p	OR	95% CI
Body mass index				**0.002***	**11.37**	**9.65–13.09**
≥ 25 kg/m2	14 (87.50)	8 (38.10)	22 (59.50)			
< 25 kg/m2	2 (12.50)	13 (61.90)	15 (40.50)			

Note. Chi-square test with 95% statistical significance in the study population.

According to the inferential analysis between BMI and pregnancy rate, significant differences were determined between the groups. Among patients with BMI greater than or equal to 25 kg/m2, 87.50% did not achieve pregnancy, whereas only 38.10% achieved gestation, representing 59.50% of the total sample. However, in the normal-weight group, 12.50% of the sample never became pregnant, but 61.90% of the group got pregnant, which is equivalent to 40.50%.

The adaptability between BMI and the possibility of pregnancy was statistically significant (p [?] 0.05), with an odds ratio (OR) of 11.37 and a 95% interval of 9.65 to 13.09, meaning that a patient with an appropriate nutritional condition had a better chance of being pregnant compared to patients who were overweight and obese, implying that an appropriate nutritional condition is favorable in conventional IVF therapies.

DISCUSSION

The aim of the research was to analyze the effect of overweight on the success rate of achieving pregnancy in women undergoing conventional IVF. In the evaluated cohort, which included patients treated at PROVIDA between January 2022 and June 2024, approximately 90% of women with a BMI ≥ 25 kg/m² did not conceive, whereas 61.9% of those with a BMI < 25 kg/m² achieved pregnancy after undergoing treatment.

These results were supported by inferential analyses, such as the chi-square test, which showed a statistically significant association between BMI and pregnancy rate, and the logistic regression analysis showed that patients with BMI above the threshold were 11.37 times more likely to have difficulty achieving pregnancy.

This finding is supported by the results reported by Romanski et al. in 2020 (14), who observed that as BMI increased, especially above 35 kg/m2, there was a significant downward trend in live birth rate. These investigators went even further, noting that as BMI increased, the spontaneous abortion rate also increased.

Similarly, the systematic review conducted by Rittenberg et al. (15) in 2011, which included 33 studies with 47,967 treatment cycles, found that overweight and obesity were associated with significantly lower clinical pregnancy and live birth rates, as well as a higher spontaneous abortion rate, compared with women whose BMI was below 25 kg/m2 after treatment.

On the other hand, Russo and colleagues, in 2017 (16), showed that morbid obesity is a strong and independent predictor of poor pregnancy outcomes in patients undergoing single high-quality blastocyst transfer, in a cohort of 520 nulliparous and multiparous women treated at a North American university health center.

In contrast to these results, Insogna et al., in 2017 (18), conducted a retrospective cohort study in 641 women undergoing frozen-thawed blastocyst transfers under a standardized protocol and a homogeneous uterine environment, and found no differences in implantation, spontaneous abortion, clinical pregnancy, ongoing pregnancy, or live birth rates between BMI groups. The findings showed that overweight did not negatively affect implantation compared with normal BMI, although women with higher BMI required more time during transfer, without this translating into worse reproductive outcomes.

Likewise, Yang et al. (2021) (17), in a cohort of 461 women undergoing conventional IVF, found no statistically significant differences in implantation, spontaneous abortion, clinical pregnancy, ongoing pregnancy, or live birth rates among the

different BMI groups. Their findings suggest that overweight does not adversely affect implantation when compared with BMI within normal ranges. Even though women who had high BMI took a longer time to transfer embryos, this was not a reproductive outcome.

The analysis of a cohort of women treated at PROVIDA in the 2022-2024 time frame is a strength of the current study, as it has provided local and up-to-date evidence and made the research clinically and contextually relevant. Similarly, the strong statistical tools used have made the findings more valid and proved the above association between BMI and pregnancy rate.

One of the weaknesses of the current study is its cohort design that was carried out in one area that restricts the extrapolation and generalisation of the findings to other groups or clinical settings. Similarly, the management of potential confounding factors, including hormonal profile, quality of the embryo and lifestyles, is not indicated, and such variables could have had a significant impact on pregnancy rate and hence interpretation of the conclusions.

CONCLUSION

The findings reveal a correlation between being overweight and a low pregnancy success rate with traditional IVF, a conclusion that is well-known in most of the world literature. Nonetheless, there are also discordant studies which tend to point out that the correlation of BMI and the outcome of the reproductive process can depend on a number of various clinical, biological, and technical factors.

In this regard, the current research notwithstanding, the applicability of body weight management prior to the administration of assisted reproduction treatment, albeit there is a need to establish multicenter research that has larger samples and uniform study design that can generalise and provide clarity in the available evidence on this relationship..

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