Review Article

The Effect of Female Obesity on Live Birth Rate Following IVF: A Systematic Review

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ABSTRACT

This study aimed to investigate the effect of female obesity on live birth rates (LBR) after in vitro fertilization (IVF). A comprehensive search of four databases identified 881 relevant publications. After duplicate removal using Rayyan QCRI and relevance screening, 475 full-text articles were reviewed, with seven studies ultimately meeting inclusion criteria. The results showed that the live birth rate in studies of obese women undergoing IVF treatment showed considerable variability, ranging from 25.2% to 64.2%, with an overall mean of 41.2%. Control groups had live birth rates between 22.6% and 72.4%, with a mean of 57.7%. Research suggests that obesity significantly impacts live birth rates, particularly among younger women, with a general trend showing that higher body mass index (BMI) is associated with lower birth rates. Some studies did not observe any effect of obesity, suggesting that other factors may also be crucial. Findings from different regions highlight a complex relationship between obesity and reproductive outcomes, with some studies suggesting a direct association, while others suggest a more subtle interaction depending on BMI level. Ultimately, this systematic review confirms a complex link between female obesity and lower LBR after IVF, emphasizing the importance of considering obesity in IVF treatment planning. The study recommends further research with more rigorous designs and consistent BMI criteria to enhance understanding and improve IVF outcomes in obese patients.

Keyword: Obesity; In vitro fertilization; Live birth rate; Body mass index; Reproductive health; Female fertility.

Introduction

Globally, the prevalence of obesity among women of reproductive age has skyrocketed in recent years. About 40% of American women who are of reproductive age are considered obese, according to data from the Centers for Disease Control and Prevention (CDC).

Similar patterns are seen in many industrialized and developing countries, where growing obesity rates have been attributed to changes in lifestyle, such as consuming more processed foods and engaging in less physical exercise [1].

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The influence of obesity on reproductive health is multifaceted, involving several biological mechanisms. One of the primary concerns is the impact of obesity on hormonal balance and metabolic function. Women who are obese may experience an imbalance in reproductive hormones such as estrogen and progesterone, which are critical for ovulation and implantation. Elevated levels of estrogen, often found in women with excess body fat, can lead to irregular menstrual cycles, anovulation (the absence of ovulation), and various conditions such as polycystic ovary syndrome (PCOS), which further complicate fertility [2]. Insulin resistance, a disorder in which the body's cells lose their sensitivity to the hormone insulin, is another effect of obesity. This is particularly problematic as elevated insulin levels can lead to increased androgen levels (male hormones) in women, further interfering with the ovulatory process and affecting overall fertility. Moreover, the inflammatory state often associated with obesity can adversely impact the uterine environment, making it more hostile to embryo implantation and increasing the risk of pregnancy complications [3]. Research has consistently shown that obesity negatively correlates with successful outcomes in IVF. Studies indicate that women with a BMI of 30 or higher experience lower LBR compared to their non-obese counterparts. A research that was published in the journal "Fertility and Sterility" revealed, for instance, that women with a BMI higher than 35 were far less likely than women of normal weight to have a live delivery after IVF. Increased BMI is associated with lower oocyte quality (eggs), impaired embryo development, and a higher likelihood of miscarriage once pregnancy is achieved [4]. The interplay between obesity and IVF outcomes influences not only the success of fertilization but also the viability of resultant embryos. Data suggest that obese women have a greater incidence of chromosomal abnormalities in embryos, likely due to metabolic disruptions that affect cell division and quality. Furthermore, the uterine lining in obese women might not develop optimally for embryo implantation, further decreasing the likelihood of a live birth [5]. Given the detrimental effects of obesity on IVF success rates, the implications for clinical practice are significant. Health care providers are increasingly recognizing the importance of addressing obesity in women seeking fertility treatment [6]. Pre-conception counseling that includes discussions about weight management, dietary modifications, and physical activity is essential for potential IVF patients. According to studies, even a little weight loss of 5–10% can improve hormonal balance, improve reproductive results, and raise the chance of a live delivery [2].

Additionally, fertility clinics are increasingly adopting comprehensive approaches to patient care, integrating weight loss programs and psychological support to assist women in managing their weight. By fostering a multi-disciplinary approach, practices can provide holistic treatment options that may ultimately lead to better reproductive outcomes [6]. There are now alarmingly high rates of obesity among women of reproductive age, which raises questions about how it may affect reproductive health. IVF has emerged as a prominent solution for infertility; however, the intersection of female obesity and IVF outcomes remains inadequately explored. Understanding the implications of obesity on LBR post-IVF is crucial for healthcare providers, fertility specialists, and policymakers as it can guide more tailored approaches to fertility treatment and improve success rates for affected couples. Obesity has been identified as a significant risk factor influencing various health outcomes, including reproductive efficacy. Despite the established relationship between obesity and adverse reproductive health phenomena, the specific impact of female obesity on LBR following IVF has not been systematically synthesized. This gap in the literature hinders the development of effective clinical guidelines and interventions aimed at optimizing reproductive outcomes in obese women undergoing IVF. This systematic review's objective is to thoroughly assess how female obesity affects LBR after IVF, using the results of previous research to clarify the connection between obesity and reproductive outcomes.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards were adhered to in this systematic review [7] to guarantee openness and methodological rigor. This review's goal was to methodically look at how female obesity affected LBR after IVF. To find pertinent English-language research, a thorough search of electronic databases was carried out, including PubMed, Web of Science, SCOPUS, and Science Direct. Specific keywords related to female obesity, IVF, LBR, and reproductive outcomes were used to optimize the search strategy. After screening the search results, two independent reviewers chose studies that satisfied the eligibility requirements, retrieved pertinent information, and used standardized procedures to evaluate the included research' quality.

Eligibility Criteria

Inclusion Criteria:

• Studies examine the relationship between female obesity and LBR following IVF.

• To make sure the review represents the most recent data, only peer-reviewed English-language publications from the last five years were considered.

• Cohort studies, case-control studies, and randomized controlled trials (RCTs) were among the study types that were thought to offer a thorough examination of the subject.
• Studies must report clear data on LBR and include relevant demographic and clinical characteristics of participants.
Exclusion Criteria:
• Research that doesn't really examine how female obesity affects LBR or IVF results.
• Research focusing solely on obesity management or IVF techniques without examining their intersection.
• Studies involving pediatric populations, non-peer-reviewed literature, or those lacking clear data on LBR.
• Non-clinical studies, such as laboratory research, animal models, or theoretical analyses, were not included to maintain a focus on clinical relevance.
Data Extraction: To ensure consistency and dependability in the selection process, the search results were managed and screened using the Rayyan (QCRI) [8] platform. The predetermined inclusion and exclusion criteria were used to assess abstracts and titles for relevancy. Two researchers independently assessed full-text papers of possibly qualifying studies. Consensus talks were used to settle any disagreements over the choice of studies or the extraction of data. Key information was gathered using a standardized data extraction form, which included:
• Title of study, authors, and year of publication
• Study location and design
• Participant demographics (e.g., age, BMI, infertility diagnosis)
• IVF protocols and outcomes (e.g., LBR, pregnancy rates)
• Adjustments for confounding factors (e.g., age, ovarian reserve)
Furthermore, a distinct instrument was created to evaluate the possibility of bias in the included research.
Data Synthesis Strategy: The extracted data was synthesized to create summary tables and narrative summaries, facilitating a qualitative evaluation of the findings. The synthesis focused on identifying patterns, trends, and gaps in the evidence regarding the impact of female obesity on LBR following IVF.
Risk of Bias Assessment: The Joanna Briggs Institute (JBI) [9] critical assessment instrument for prevalence studies was used to assess the methodological quality of the included research. Nine questions make up this tool, and each one is assessed as either 1 (yes) or 0 (no/unclear/not relevant). Studies will be categorized as follows:
• Excellent quality: 8–9
• Moderate quality: 5–7 points
• Poor quality: Less than four points
Each paper was evaluated for quality by two independent reviewers, and differences were settled by discussion. To guarantee the validity of the review's results, studies judged to have a high risk of bias were not included in the final synthesis.

Results

797 papers were found using the given search technique (Figure 1). 433 trials were assessed based on title and abstract after duplicates (n = 364) were eliminated. Only 32 full-text articles remained for further assessment after 397 of these did not meet qualifying requirements. 7 in all met the qualifying standards for analysis using evidence synthesis. Sociodemographic and clinical outcomes: We included seven studies with a total of 3532 obese patients and 39,126 in the control group. Regarding study designs, all studies were retrospective cohorts [10-16]. Four studies were conducted in China [10, 11, 15, 16], one in South America [12], one in the USA [13], and one in France [14]. The LBR in the obese group ranged from 25.2% [11] to 64.2% [15], with a total prevalence of 1454 (41.2%). The LBR in the control group (CLBR) ranged from 22.6% [11] to 72.4% [15], with a total prevalence of 22,598 (57.7%). The main outcomes of the studies indicate a range of effects of female obesity on LBR following IVF treatment. One study found that while obesity significantly impacts LBR in younger patients, it does not affect older patients' outcomes [10]. Another study highlighted a strong correlation between BMI and LBR, suggesting that higher BMI negatively affects the chances of live birth [11]. Furthermore, research from South America demonstrated that overweight or obese women had substantially lower rates of pregnancy, implantation, and live births compared to those of normal weight, underlining the severe impact of obesity on reproductive outcomes [12]. In the United States, an analysis revealed a declining trend in LBR as BMI increased, particularly when BMI was 40 or greater, which statistically confirmed the negative trend [13]. Conversely, a French study concluded that obesity did not affect the cumulative LBR following IVF, indicating that other factors might play more crucial roles in the success of IVF in obese women [14]. Lastly, studies in China have shown mixed results; one observed that increasing BMI is associated with a decrease in the cumulative LBR [15], while another suggested that LBR initially increase with BMI among underweight women, plateau among normal and overweight women, and then decline for obese women, showing a complex relationship between BMI and reproductive outcomes [16].

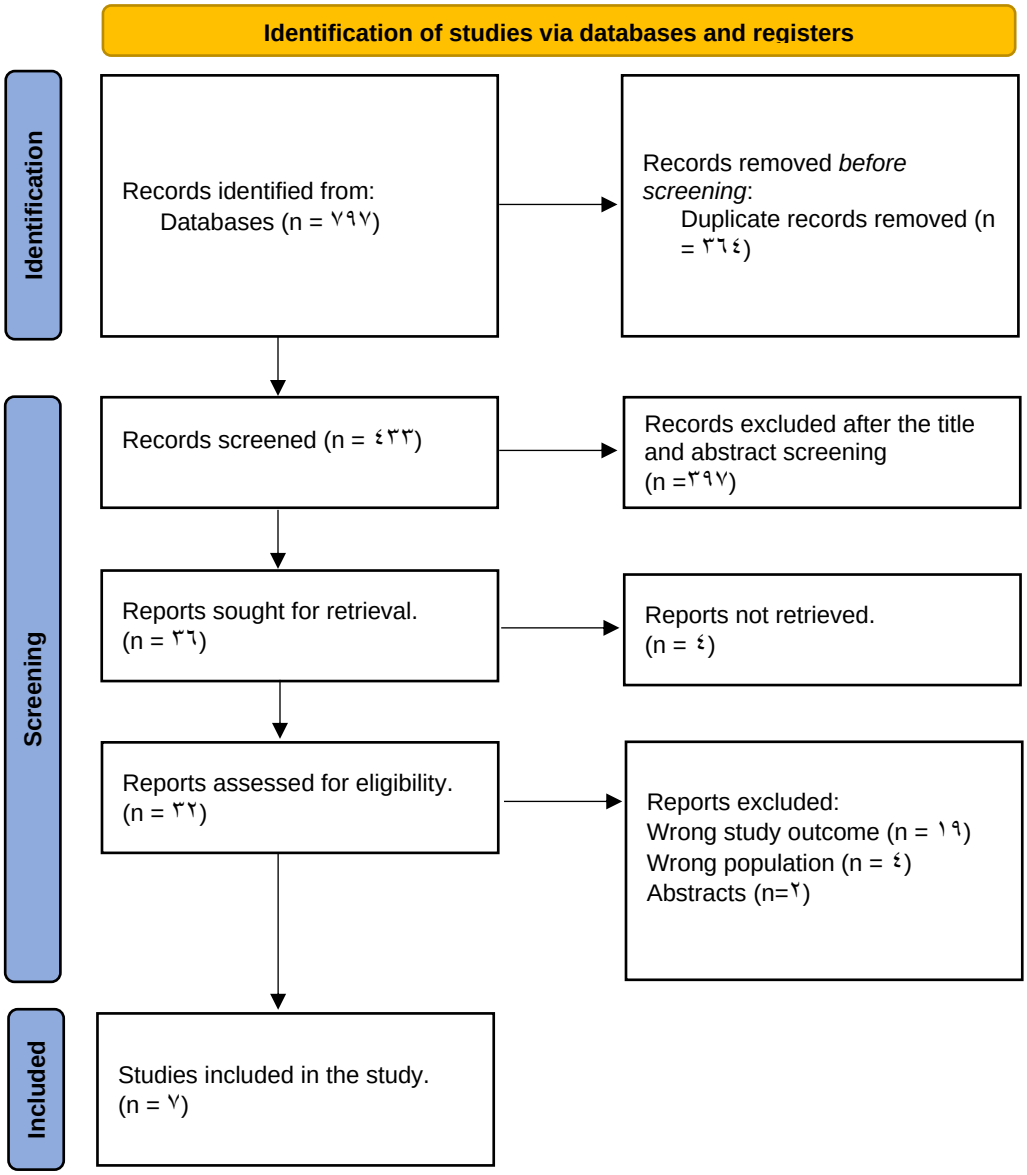

Figure 1: PRISMA flowchart [14].

Table 1: Outcome measures of the included studies using retrospective cohort study design.

Study ID	Country	Sociodemographic	Obesity cut-off point (kg/m^2)	LBR in obesity group	LBR in control group	Main outcomes	JBI
Ma et al., 2024 [10]	China	Cases: 372 Controls: 2005 Mean age: 30.7	≥24	220 (59.14 %)	1324 (66%)	While female BMI had a considerable impact on younger patients' CLBR, it had no effect on older patients' CLBR.	7
Tao et al., 2023 [11]	China	Cases: 886 Controls: 2579 Mean age: 32.8	≥24	224 (25.2 %)	582 (22.6%)	The LBR is strongly correlated with BMI.	8
García-Ferreyra et al., 2021 [12]	South America	Cases: 38 Controls: 153 Mean age: 33.7	≥30	15 (39.5 %)	105 (68.6%)	Women who were overweight or obese had significantly lower rates of pregnancy, implantation, and live births than women who were normal weight ($p<0.05$).	7
Romanski et al., 2021 [13]	USA	Cases: 891 Controls: 6479 Mean age: 37.1	≥30	256 (28.7 %)	2098 (32.4%)	BMI increased from 67.7% in normal-weight individuals to 53.3% in patients with a BMI ≥ 40, indicating a significant trend of declining LBR (test for linear trend, p value = 0.004).	7

Brunet et al., 2020 [14]	France	Cases: 164 Controls: 1424 Mean age: 32.6	≥30	44 (26.8 %)	339 (23.8%)	Following IVF, women's cumulative LBR was unaffected by their level of obesity.	7
Zheng et al., 2024 [15]	China	Cases: 380 Controls: 13,072 Mean age: 33	≥ 28	244 (64.21 %)	9461 (72.4%)	A correlation between CLBR and BMI was discovered, suggesting that a rise in BMI causes CLBR to decrease.	6
Xue et al., 2020 [16]	China	Cases: 801 Controls: 13,414 Mean age: 30.5	≥ 28	451 (56.30 %)	8689 (64.8%)	Underweight women's CLBR rose, plateaued for normal weight and overweight women with BMIs between 18.5 and 30.4, and subsequently fell for obese women in proportion to their BMI accumulation.	7

Discussion

The review pointed out that the relationship between BMI and LBR is not linear. Some studies reported that LBR initially increased or plateaued with an increase in BMI among underweight and normal-weight women before declining among those classified as obese. This indicates a threshold effect where BMI may only become a significant negative factor beyond a certain point. Understanding these thresholds could help in better targeting interventions aimed at weight management in women seeking IVF treatment. Additionally, the impact of obesity on IVF outcomes also varied depending on other factors like the baseline fertility status of the participants, the presence of other reproductive health issues, and the specific IVF protocols used. These findings underscore the need for personalized approaches in the treatment of obese women undergoing IVF, considering not just the BMI but also other individual health and treatment variables. Female obesity has a negative and significant impact on LBRs following IVF, according to a comprehensive review and meta-analysis by Sermondade et al. [17]. The link between female obesity and changes in the composition of follicular fluid is well established [18]. These metabolic changes primarily involve lipids, proteins, and growth factors, leading to heightened oxidative stress and disrupted steroidogenesis [19]. Additionally, elevated levels of leptin in obese women have been observed to impact the quality of oocytes and embryos [20], as well as the functionality of granulosa cells [21]. It has also been suggested by some researchers that the formation of blastocysts might be adversely affected in obese women [22]. A committee opinion issued by the American Society for Reproductive Medicine (ASRM) in 2021 states that obesity decreases the birth rate following IVF due to ovulation disorders, diminished ovarian response to ovulation-stimulating drugs, and functional alterations in the endometrium. Moreover, obesity during pregnancy is linked to adverse outcomes for both mother and fetus, including increased risks of gestational diabetes, gestational hypertension, preeclampsia, higher rates of cesarean sections, stillbirth, macrosomia, congenital abnormalities, and neonatal intensive care unit admissions [23]. This review's conclusions have many clinical ramifications. First of all, they stress how crucial it is to take a patient's BMI into account throughout the evaluation and counseling phases of IVF treatment. Clinicians should be aware of the potential for reduced success rates in obese patients and discuss weight management strategies where applicable. Additionally, these results suggest the need for tailored treatment protocols that consider the BMI of the patient to optimize outcomes.

Strengths. The inclusion of a wide range of research from different areas, which improves the findings' generalizability, is one of this review's strengths. Furthermore, the use of rigorous methodology following PRISMA guidelines ensures the reliability and validity of the results. The comprehensive search strategy and independent data extraction by multiple reviewers also minimize the risk of bias.

Limitations: However, there are several limitations to this review. The studies included are predominantly retrospective cohorts, which are more susceptible to selection and confounding biases than randomized controlled trials. Additionally, the variability in definitions of obesity and the cut-off points for BMI across studies could affect the comparability of the results. Another limitation is the focus on LBR without considering other factors such as the quality of life or psychological impacts on the patients.

Conclusion

This systematic review confirms that female obesity is associated with reduced LBR following IVF, though the relationship is complex and influenced by multiple factors. These findings highlight the need for clinicians to consider obesity as a significant factor in IVF treatment planning. Further research using more robust prospective designs and uniform BMI criteria across studies is recommended to better understand the underlying mechanisms and to develop effective strategies to improve outcomes for obese patients undergoing IVF treatment.

Conflict of Interest

None

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