



IMPACT OF INSULIN RESISTANCE ON PREGNANCY AND NEONATAL OUTCOMES IN WOMEN UNDERGOING IN VITRO FERTILIZATION: A COMPARATIVE COHORT STUDY

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ABSTRACT

Background: Insulin resistance (IR) is a common metabolic disorder associated with obesity, polycystic ovary syndrome (PCOS), and infertility. Its influence on pregnancy outcomes in assisted reproductive technologies (ART), particularly in vitro fertilization (IVF), remains a subject of ongoing debate. This study aimed to compare maternal, neonatal, and early pregnancy outcomes between insulin-resistant and non-insulin-resistant women undergoing IVF.

Methods: We conducted a retrospective cohort study including women who achieved pregnancy following IVF, stratified by IR status. Data on maternal characteristics (age, BMI), pregnancy outcomes (missed abortion, live birth), and neonatal parameters (birth weight, length, and sex) were analyzed. Statistical comparisons utilized independent t-tests and chi-square tests. A post hoc power analysis assessed the adequacy of the sample size for detecting differences in abortion rates.

Results: A total of 84 pregnancies were analyzed: 19 in the IR group and 65 in the non-IR group. IR patients were younger (31.6 ± 3.7 vs. 34.5 ± 4.1 years; $p = 0.018$) and had higher BMI (27.9 ± 3.2 vs. 22.3 ± 2.9 kg/m²; $p = 0.0025$). No significant differences were found in neonatal birth weight ($p = 0.579$), length ($p = 0.5712$), fetal sex distribution ($p = 0.3207$), or missed abortion rates ($p = 0.619$).

Conclusions: Despite differences in maternal age and BMI, insulin resistance did not significantly impact neonatal anthropometrics or early pregnancy loss in IVF-conceived pregnancies. These findings suggest that IR may not independently impair pregnancy outcomes in the context of well-controlled ART protocols.

Keywords: Insulin resistance, In vitro fertilization (IVF), Assisted reproductive technology (ART), Neonatal outcomes, Maternal BMI, Early pregnancy loss, Metabolic syndrome,

INTRODUCTION:

Insulin resistance (IR), defined as a reduced biological response to normal circulating insulin levels, is a hallmark of several endocrine disorders and metabolic conditions, including polycystic ovary syndrome (PCOS), obesity, and type 2 diabetes mellitus (T2DM) [1, 2]. In women of reproductive age, IR is particularly concerning due to its association with subfertility, ovulatory dysfunction, and increased miscarriage rates [3,4]. Mechanistically, IR induces compensatory hyperinsulinemia, which exacerbates hyperandrogenism, disrupts folliculogenesis, and may impair endometrial receptivity, all of which are critical determinants of successful conception and implantation [5, 6].

Assisted reproductive technologies (ART), including in vitro fertilization (IVF), provide an opportunity to control and monitor these variables closely. Despite the ability to mitigate some of the adverse physiological effects through pharmacologic and procedural interventions, the impact of IR on ART outcomes remains uncertain [7]. Some studies have shown reduced implantation and pregnancy rates among IR patients, as well as higher miscarriage rates and altered perinatal outcomes [8, 9], while others suggest that proper metabolic management and optimized ART protocols can achieve comparable success rates [10, 11].

This study aimed to evaluate the impact of insulin resistance on pregnancy success and neonatal outcomes in a well-characterized cohort of women undergoing IVF. By examining maternal characteristics, fetal sex distribution, birth anthropometrics, and early pregnancy loss, we aimed to elucidate whether IR exerts an independent adverse effect on ART outcomes.

MATERIALS AND METHODS:

This retrospective cohort study was performed at a single university-affiliated reproductive medicine center between January 2020 and December 2021. Women undergoing IVF cycles with embryo transfer were eligible. Exclusion criteria included severe uterine abnormalities, known chromosomal abnormalities, and uncontrolled en-

doctrine or systemic diseases.

Participants were divided into IR and non-IR groups based on clinical diagnosis (history of PCOS with IR, metabolic syndrome, or elevated HOMA-IR > 2.5). Laboratory criteria included elevated fasting insulin or impaired glucose tolerance. All IVF protocols adhered to established clinical guidelines and included gonadotropin stimulation, oocyte retrieval, fertilization, embryo culture, and transfer. Luteal support was provided in all cases.

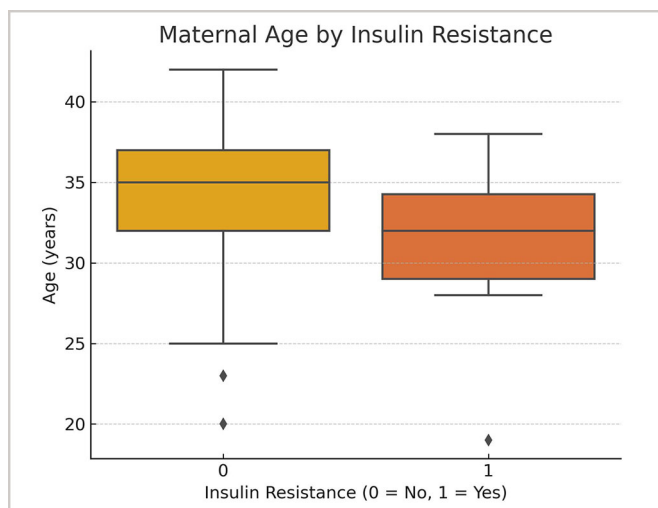
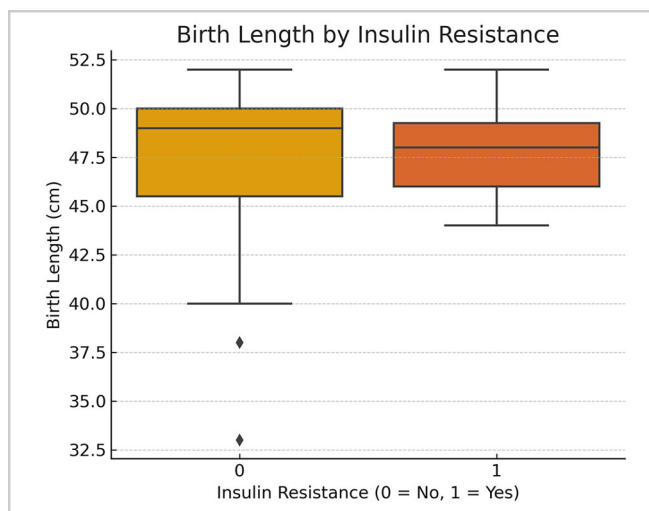
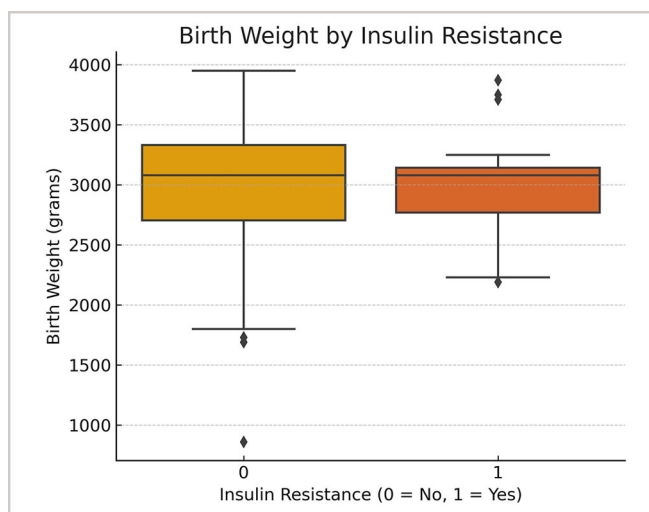
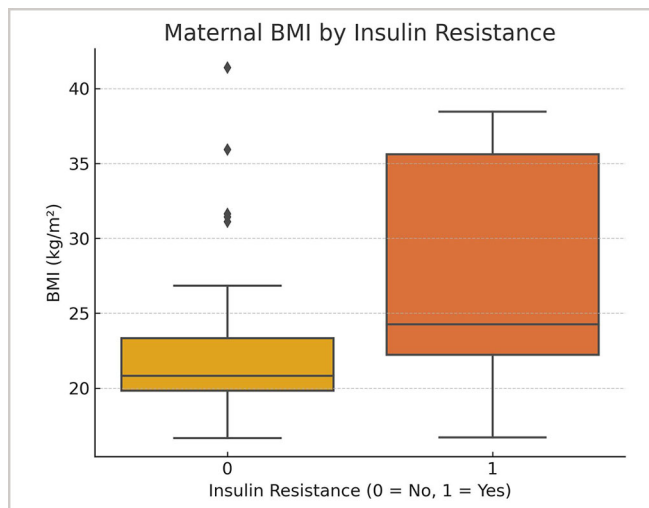
Maternal variables collected included age, BMI and reproductive history. Pregnancy outcomes (delivery vs. missed abortion) and neonatal data (birth weight, birth length, sex) were recorded. Statistical analysis included independent t-tests and chi-square tests. A post hoc power analysis was performed to determine the sample size needed to detect group differences in abortion rates with 80% power.

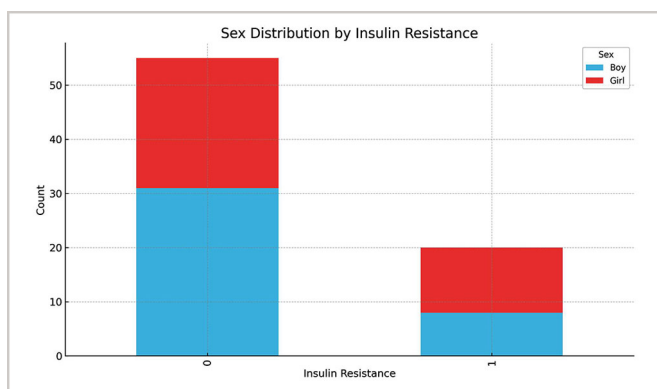
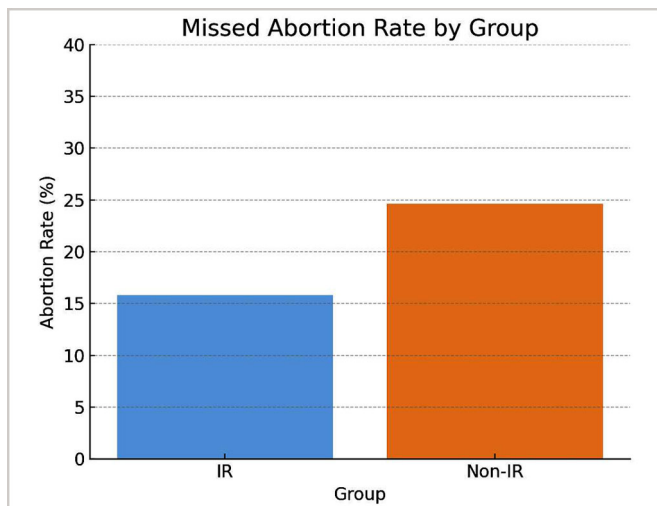
RESULTS:

Eighty-four pregnancies were analyzed, including 19 in the IR group and 65 in the non-IR group. Women in the IR group were significantly younger (mean 31.6 ± 3.7 years) compared to the non-IR group (34.5 ± 4.1 years; $p = 0.018$). BMI was significantly higher in the IR group (27.9 ± 3.2 kg/m² vs. 22.3 ± 2.9 kg/m²; $p = 0.0025$).

No statistically significant differences were found in birth weight (2982g vs. 2908g; $p = 0.579$) or birth length (47.6 cm vs. 48.0 cm; $p = 0.5712$). The distribution of neonatal sex was similar between groups ($\chi^2 = 0.986$; $p = 0.3207$). Missed abortion occurred in 3 of 19 IR pregnancies (15.79%) and in 16 of 65 non-IR pregnancies (24.62%), which was not statistically significant ($\chi^2 = 0.247$; $p = 0.619$) (Figure 1).

Fig. 1. Comparison of pregnancy outcomes and neonatal parameters between insulin-resistant (IR) and non-insulin-resistant (non-IR) women undergoing IVF. No statistically significant differences were observed in birth weight, birth length, fetal sex distribution, or missed abortion rates between the groups.





DISCUSSION:

Our findings indicate that insulin resistance, despite being associated with younger maternal age and higher BMI, does not significantly influence neonatal anthropometric measures or early pregnancy outcomes in IVF-conceived pregnancies. This supports the hypothesis that controlled ART environments, including embryo quality control and endometrial preparation, may mitigate the potential reproductive risks associated with metabolic disturbances [12].

Previous studies have shown conflicting results regarding the impact of IR on ART outcomes. For instance,

Zhang et al. found that IR negatively affected clinical pregnancy and live birth rates in PCOS patients undergoing IVF [13]. Conversely, Kalem et al. reported no difference in IVF success rates after controlling for BMI and PCOS phenotype [14]. Our study aligns more closely with the latter findings, suggesting that IR may not be a standalone predictor of ART failure when metabolic variables are addressed.

It is noteworthy that adjunctive treatments, such as metformin, have been proposed to improve reproductive outcomes in IR and PCOS patients. Metformin improves insulin sensitivity, reduces serum androgen levels, and may enhance endometrial receptivity [15, 16]. While our study did not stratify based on metformin use, its role in modulating IVF outcomes in IR patients remains a subject of future inquiry.

Moreover, while the abortion rate was numerically higher in the non-IR group, this may be explained by the older age in that cohort, a well-established risk factor for early pregnancy loss [17]. The lack of a significant difference in sex ratio also suggests that IR does not influence preimplantation embryonic development with respect to sex determination, although further studies using genetic screening could provide more detailed insights.

CONCLUSION:

In women undergoing IVF, insulin resistance is associated with distinct maternal profiles but does not independently predict poorer neonatal outcomes or increased risk of miscarriage. These findings reinforce the importance of individualized ART management and support the notion that reproductive success in IR patients is achievable with appropriate clinical strategies.

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