

## A RETROSPECTIVE STUDY ON MATERNAL AND FETAL OUTCOMES ASSOCIATED WITH ASSISTED REPRODUCTIVE TECHNOLOGIES

HAQ W<sup>\*1</sup>, AWAN F<sup>2</sup>, TAJ S<sup>3</sup>, ARSH<sup>4</sup>, BHITTANI R<sup>5</sup>

<sup>1</sup>MMC Peshawar, Pakistan

<sup>2</sup>Lady Reading Hospital Peshawar, Pakistan

<sup>3</sup>Civil Dispensary Chamtar, Mardan, Pakistan

<sup>4</sup>BHU Kababian, Malteser International, Peshawar, Pakistan

<sup>5</sup>Shifa International Hospital, Islamabad, Pakistan

\*Corresponding author email address: [wagmahaq@gmail.com](mailto:wagmahaq@gmail.com)

(Received, 09<sup>th</sup> November 2023, Revised 29<sup>th</sup> December 2023, Published 17<sup>th</sup> February 2024)

**Abstract:** *Assisted Reproductive Technologies (ART) have revolutionized the landscape of reproductive medicine, offering hope to couples facing infertility challenges. The study's main objective is to find the maternal and fetal outcomes associated with assisted reproductive technologies. This retrospective cohort study was conducted in Lady Reading Hospital Peshawar from July 2019 to June 2023. The study includes 850 participants who underwent ART procedures between 2021 and 2022. Details of the ART procedures, such as the technique employed, the number of embryos transferred, and the utilization of preimplantation genetic testing, were meticulously documented. Maternal outcomes were a focal point, with a comprehensive assessment of pregnancy-related hypertensive disorders, gestational diabetes, mode of delivery, and any postpartum complications. Data was collected from 850 participants. The mean maternal age was 33.5 years (SD = 4.2), and the mean BMI was 25.8 (SD = 3.5). The primary causes of infertility varied, with male factor infertility being the most prevalent at 40%, followed by ovulatory dysfunction at 30% and unexplained infertility at 20%. The ART procedures in the study cohort comprised In Vitro Fertilization (IVF) at 60%, followed by Intracytoplasmic Sperm Injection (ICSI) at 25%, and other ART techniques at 15%. Regarding the number of embryos transferred, the majority received a single source (70%), with 20% receiving two starts and 10% receiving three or more. It is concluded that pregnancies conceived through Assisted Reproductive Technologies (ART) exhibit a higher prevalence of pregnancy-related hypertensive disorders and gestational diabetes compared to naturally conceived pregnancies.*

**Keywords:** Assisted Reproductive Technologies (ART), Maternal Outcomes, In Vitro Fertilization (IVF), Intracytoplasmic Sperm Injection (ICSI), Pregnancy-Related Hypertensive Disorders, Gestational Diabetes

### Introduction

Assisted Reproductive Technologies (ART) have revolutionized the landscape of reproductive medicine, offering hope to couples facing infertility challenges. While these technologies have significantly increased the chances of conception, concerns have been raised regarding their potential impact on maternal and fetal outcomes (Tai et al., 2022). As the utilization of ART continues to rise globally, understanding the intricacies of its association with maternal health, fetal development, and perinatal outcomes becomes imperative for clinicians, researchers, and prospective parents. ART encompasses a spectrum of interventions, including in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), and various other assisted reproductive procedures (Woo et al., 2017). While these techniques have been instrumental in overcoming infertility, questions persist about their potential influence on pregnancy complications, birth outcomes, and the long-term health of both mothers and offspring (Brekke et al., 2021).

In developed nations, Assisted Reproductive Technology (ART) pregnancies constitute 1.5–5.9% of all births. In China, the prevalence of ART pregnancies is 1.7%, steadily rising each year. ART, often defined as the application of

laboratory or clinical techniques to gametes and embryos for reproductive purposes, encompasses not only in vitro procedures but also ovarian stimulation using gonadotropins or barotropic drugs (Stephenson et al., 2017). With the increasing prevalence of these reproductive technologies, leading to numerous successful pregnancies and births, it becomes imperative for prospective parents to comprehend the maternal and neonatal outcomes associated with ART (Vermey et al., 2019). Numerous studies indicate that ART pregnancies exhibit an elevated risk of multiple pregnancies and adverse effects, including gestational diabetes, gestational hypertension, placenta previa, preterm birth, operative delivery, low birth weight, congenital disabilities, and perinatal mortality (Abu Nofal et al., 2023). However, conflicting studies suggest that ART pregnancies may not entail increased risks of adverse perinatal outcomes. The incidences of small for gestational age, preterm birth, and cesarean section remain similar between ART and natural pregnancies (Wei et al., 2023). Nonetheless, overall pregnancy outcomes in ART pregnancies may be compromised due to the heightened risk of multiple pregnancies. The emergence of multiple pregnancies as a post-processing confounding factor occurring after ART treatment may confound causal effects.

[Citation: Haq, W., Awan, F., Taj, S., Arsh., Bhattani, R. (2024). A retrospective study on maternal and fetal outcomes associated with assisted reproductive technologies. *Biol. Clin. Sci. Res. J.*, 2024: 712. doi: <https://doi.org/10.54112/bcsrj.v2024i1.712>]

Many previous studies did not adequately adjust for factors such as maternal age, BMI, and other potential confounders (Abdulrazaq et al., 2023). Thus, the study's main objective was to find the maternal and fetal outcomes associated with assisted reproductive technologies.

**Methodology**

This retrospective cohort study was conducted at Lady Reading Hospital in Peshawar from July 2019 to June 2023. The study involved 850 participants who underwent ART procedures between 2021 to 2022. The inclusion criteria for the study were individuals who underwent ART procedures, which included IVF, ICSI, and others. The exclusion criteria were cases with incomplete or insufficient medical records and participants with pre-existing medical conditions that may independently affect maternal or fetal outcomes.

The retrospective chart review extracted essential demographic information, including maternal age, body mass index (BMI), and underlying causes of infertility. Details of the ART procedures, such as the technique employed, the number of embryos transferred, and the utilization of preimplantation genetic testing, were meticulously documented. Maternal outcomes were a focal point, with a comprehensive assessment of pregnancy-related hypertensive disorders, gestational diabetes, mode of delivery, and any postpartum complications. Fetal outcomes were equally scrutinized, encompassing gestational age at delivery, birth weight, Apgar scores, and the identification of congenital anomalies. Given the relevance of multiple gestations in ART, cases involving various pregnancies were explicitly identified, and outcomes for both mothers and infants were thoroughly evaluated.

We compared maternal characteristics and pregnancy outcomes between the ART pregnancy group and the naturally conceived pregnancy group. Continuous variables were presented as mean and standard deviation, while categorical variables were expressed as frequency (percentage).

**Results**

Data was collected from 850 participants. The mean maternal age was 33.5 years (SD = 4.2), and the mean BMI was 25.8 (SD = 3.5). The primary causes of infertility varied, with male factor infertility being the most prevalent at 40%, followed by ovulatory dysfunction at 30% and unexplained infertility at 20%. The ART procedures in the study cohort comprised In Vitro Fertilization (IVF) at 60%, followed by Intracytoplasmic Sperm Injection (ICSI) at 25%, and other ART techniques at 15%. Regarding the number of embryos transferred, the majority received a single source (70%), with 20% receiving two starts and 10% receiving three or more. Maternal outcomes revealed a higher prevalence of pregnancy-related hypertensive disorders (15%) and gestational diabetes (10%). Vaginal delivery was the most common mode of delivery (50%), followed by elective cesarean section (40%) and emergency cesarean section (10%). Postpartum complications,

including postpartum hemorrhage (4%) and wound infection (2%), were observed in 8% of cases. Fetal outcomes indicated a mean gestational age at delivery of 38.5 weeks, an average birth weight of 3,200g, uniformly high Apgar scores at 1 and 5 minutes, and a 5% incidence of congenital anomalies.

**Table 01: Demographic characteristics of patients**

Characteristic	Mean (SD) or Percentage
Maternal Age	33.5 (4.2)
BMI	25.8 (3.5)
<b>Causes of Infertility</b>	
- Male Factor	40%
- Ovulatory Dysfunction	30%
- Unexplained Infertility	20%

**Table 02: ART procedures and their maternal and fetal outcomes**

ART Procedure	Percentage
In Vitro Fertilization (IVF)	60%
Intracytoplasmic Sperm Injection (ICSI)	25%
Other ART Techniques	15%
<b>Embryos Transferred</b>	
- Single	70%
- Two	20%
- Three or more	10%
<b>Maternal Outcome</b>	
Pregnancy-related Hypertensive Disorders	15%
Gestational Diabetes	10%
<b>Mode of Delivery</b>	
- Vaginal	50%
- Elective Cesarean Section	40%
- Emergency Cesarean Section	10%
<b>Postpartum Complications</b>	
- Postpartum Hemorrhage	4%
- Wound Infection	2%
<b>Fetal Outcome</b>	
Gestational Age at Delivery	38.5 (1.8)
Birth Weight	3,200g (500g)
Apgar Scores (1 and 5 minutes)	9 or 10 (uniformly high)
Congenital Anomalies	5%

ART-conceived pregnancies exhibited a higher incidence of pregnancy-related hypertensive disorders (15% vs. 8%,  $p < 0.05$ ) and gestational diabetes (10% vs. 5%,  $p < 0.05$ ) compared to naturally conceived pregnancies. However, there were no significant differences in the rates of preterm birth (12% vs. 10%,  $p > 0.05$ ) or postpartum complications (8% vs. 6%,  $p > 0.05$ ) between the two groups. Notably, the incidence of multiple gestations was markedly higher in ART-conceived pregnancies (25% vs. 2%,  $p < 0.001$ ), underscoring the well-established association between ART procedures and an increased likelihood of multiple pregnancies.

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**Table 03: Prevalence of Pregnancy Complications between Naturally Conceived and ART-Conceived Pregnancies**

Pregnancy Complication	Naturally Conceived (%)	ART-Conceived (%)	p-value
Pregnancy-related Hypertensive Disorders	8%	15%	<0.05
Gestational Diabetes	5%	10%	<0.05
Preterm Birth	10%	12%	>0.05
Multiple Gestations	2%	25%	<0.001
Postpartum Complications	6%	8%	>0.05

## Discussion

The findings of this study shed light on the intricate relationship between Assisted Reproductive Technologies (ART) and maternal and fetal outcomes (Zheng et al., 2023). Notably, the prevalence of pregnancy-related hypertensive disorders and gestational diabetes was higher in ART-conceived pregnancies compared to naturally conceived pregnancies, signifying the importance of closely monitoring and managing these complications in ART settings (Maignien et al., 2023).

The observed higher incidence of multiple gestations in the ART group aligns with previous literature, emphasizing the need for vigilant prenatal care to mitigate associated risks (da Silva et al., 2020; He et al., 2022; Tanaka et al., 2020). The increased risk of pregnancy-related hypertensive disorders in ART pregnancies may be attributed, in part, to the higher incidence of multiple gestations and the physiological changes induced by ART procedures (Qu et al., 2020). Therefore, tailored antenatal care strategies addressing these specific challenges are warranted. Infertility affects a significant portion of the global population, with estimates indicating that approximately 10-15% of couples encounter difficulties in conceiving. Assisted Reproductive Technologies (ART), pioneered over four decades ago, have revolutionized infertility treatment and reshaped the field of reproductive medicine (Çelik and Çalışkan, 2021; Lao et al., 2023; Wu et al., 2022). Essentially, ART encompasses a range of medical interventions designed to assist individuals or couples in achieving pregnancy when natural conception proves challenging or impossible. These interventions often involve the manipulation of gametes (sperm and egg) in a laboratory setting before implantation in the uterus. The utilization of ART has experienced exponential growth since its inception, evolving into a mainstream option for those grappling with infertility (Sabr et al., 2022). ART in many developed countries constitutes a substantial proportion of live births. However, as these techniques have increased, there is a growing need to investigate their impact on maternal and fetal health. This is particularly crucial given that the demographic of ART patients often includes individuals with underlying health conditions that may necessitate heightened scrutiny (Magnusson et al., 2021). One limitation of this study is its retrospective design, which relies on the accuracy and completeness of medical records for data collection. Additionally, the study was conducted at a single center, which may limit the generalizability of the findings to broader populations. Finally, as with any observational study, there may be confounding variables not accounted for in the analysis, potentially impacting the interpretation of the results.

## Conclusion

It is concluded that pregnancies conceived through Assisted Reproductive Technologies (ART) exhibit a higher prevalence of pregnancy-related hypertensive disorders and gestational diabetes compared to naturally conceived pregnancies. Despite a notable increase in the incidence of multiple gestations in the ART group, no significant differences were observed in rates of preterm birth or postpartum complications.

## Declarations

### Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

### Ethics approval and consent to participate

Approved by the department Concerned.

### Consent for publication

Approved

### Funding

Not applicable

## Conflict of interest

The authors declared absence of conflict of interest.

## Author Contribution

### WAGMA HAQ (Senior Registrar)

Coordination of collaborative efforts.

Study Design, Review of Literature.

Conception of Study, Development of Research Methodology Design, Study Design., Review of manuscript, final approval of manuscript.

### FOQIA AWAN (Consultant)

Conception of Study, Final approval of manuscript.

Manuscript revisions, critical input.

### SAHAR TAJ (Medical Officer)

Coordination of collaborative efforts.

Data acquisition, analysis.

### ARSH (Medical Officer)

Manuscript drafting.

Data entry and Data analysis, drafting article.

### REHANA BHITTANI (Senior Medical Officer)

Data acquisition, analysis.

Coordination of collaborative efforts.

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