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ORIGINAL ARTICLE

Impact of Age on Female Fertility: A Cross-Sectional Analysis of Reproductive Outcomes, Hormonal Profile, and Body Mass Index

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ABSTRACT

Background: The age factor on female fertility has been found to be a strong determinant and reproductive potential is also on the decline with age. This decrease is connected with the loss of ovarian reserve, hormonal alterations, and the risk of adverse pregnancy outcomes.

Objective: To assess the impact of age on female fertility by analyzing reproductive outcomes, hormonal profiles, and body mass index (BMI) among women of reproductive age.

Methods: The study was carried out in Al Khidmat Hospital between January 2023 to June 2023 involving 218 women aged 18 to 45 years to seek fertility assessment. Participants were stratified into four age groups (≤25, 26–30, 31–35, and 36–45 years). BMI, hormonal profile (FSH, AMH) and reproductive outcomes (clinical pregnancy, live birth, miscarriage) data were collected. The SPSS version 26 was used to conduct statistical analysis, which involved ANOVA and t-tests. A p-value ≤0.05 was considered significant.

Results: The mean age of participants was 29.8 ± 6.2 years. A significant decline in fertility outcomes was observed with increasing age. Clinical pregnancy and live birth rates were highest in younger women (≤25 years) and decreased progressively in older age groups (p=0.002 and p=0.001, respectively). Miscarriage rates increased significantly with age (p<0.001). Hormonal analysis showed a decline in AMH levels and an increase in FSH levels with advancing age (p<0.001). Higher BMI was also significantly associated with adverse fertility outcomes.

Conclusion: Advancing age significantly reduces female fertility, with declining ovarian reserve and increasing miscarriage risk. Early fertility assessment and lifestyle interventions are essential to improve reproductive outcomes.

Keywords: Female fertility, Age, AMH, FSH, BMI, Miscarriage, Live birth

INTRODUCTION

Female fertility is a complicated physiological process that is affected by various biological, hormonal, and environmental factors, with age being the most important one. The fertility of women reaches its peak during the early twenties and continually decreases thereafter with a more pronounced decrease after the age of 35 years. This reduction is mainly due to reduced ovarian reserve, poor quality of oocytes and a higher proportion of chromosomal abnormalities, all of which worsen the fertility performance[1-3]

As individuals age, their hormonal balance also changes, with an increase in follicle-stimulating hormone (FSH) and decreased anti-Mullerian hormone (AMH), as well, both of which are significant indicators of ovarian reserve. Such alterations are linked with diminished follicular responsiveness, disrupted ovulation, and diminished likelihoods of successful fertilization and implantation. Moreover, there are age-dependent changes in endometrial receptivity as they lead to higher rates of implantation failure and premature pregnancy losses[4-6].

Besides aging, other metabolic factors including body mass index (BMI) are also important in influencing the outcome of fertility. Hormonal imbalance, insulin resistance, and ovulatory dysfunction, which may further undermine reproductive potential, have been linked to obesity. On the other hand, younger women can have fertility issues as well because of the metabolic diseases like the polycystic ovarian syndrome (PCOS) and this indicates the intricate connection between age and metabolic well-being[7-9].

Globally, there has been a noticeable trend toward delayed childbearing due to social, educational, and economic factors. The result of this change has been the rise in the rate of age-related infertility and poor pregnancy prognosis, such as miscarriage and low rates of live births. Knowledge of how age and fertility relate is thus vital in informing clinical practice, patient counseling, and designing interventions[10, 11].

Even though there are a number of international researches that have investigated the relationship between age and fertility, there is a scarcity of local studies that have evaluated the interaction effect of age, hormonal profile, and BMI on the reproductive outcome amongst women of reproductive age.

Therefore, this study aimed to evaluate the impact of age on female fertility by analyzing reproductive outcomes, hormonal parameters, and BMI among women presenting for fertility assessment at a tertiary care hospital.

MATERIAL & METHODS

This cross-sectional research was carried out at Al Khidmat Hospital in six months January 2023 to June 2023 to find out how age affects female fertility outcomes. The samples were women who came to the reproductive health and gynecology outpatient department to be assessed on issues of fertility and similar questions.

The study involved a total of 218 women. The size of the sample was chosen depending on feasibility and availability of eligible participants in the study period. The study used a non-probability consecutive sampling method, in which all those women who met the inclusion criteria within the study period were included.

The study included women between 18 and 45 years of age who came to the fertility evaluation and gave informed consent. They excluded participants with known conditions that might independently influence fertility (uncontrolled systemic diseases e.g. diabetes mellitus, malignancy), previous surgical resection of reproductive organs or presence of a genetic disorder (e.g. Turner syndrome). Also, women who had undergone hormonal therapy or assisted reproductive techniques (ART) in the last three months were excluded to reduce confounding factors.

The structured proforma was used to collect the data, including demographic information, reproductive history, and clinical findings. Measurements of height and weight and Body

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Mass Index (BMI) were taken using standard formula(kg/m 2). Medical records provided hormonal profiles, follicle-stimulating hormone (FSH) and anti-Mullerian hormone (AMH). Outcomes in terms of fertility like clinical pregnancy rate, live birth rate, miscarriage rate, and infertility status were also recorded.

To make the analysis, the participants were stratified into four age groups: ≤25 years, 26–30 years, 31–35 years, and 3645 years. This stratification enabled a fine comparison of variables on reproductive and metabolic variables by various age groups.

All collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were computed as mean ± standard deviation (SD) for continuous variables and frequencies and percentages for categorical variables. Inferential analysis was performed using one-way analysis of variance (ANOVA) for comparison of means across age groups, and independent sample t-test where applicable. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 218 women were included in this study. The sample was divided into four age groups to study the age-related effects on fertility outcomes. There was a difference in both metabolic and reproductive parameters among age groups. The largest number of participants were in the age group of 2630 years (33.5), then 3135 years (27.5). The mean age was 29.8 ± 6.2 years. Obesity and overweight were more prevalent in the older age groups, which suggests that there is augmenting metabolic load with the age.

Hormonal analysis revealed that there was a considerable decrease in ovarian reserve markers as age advanced. There was a significant reduction in AMH levels and an increase in FSH levels, which means that older women have lower ovarian reserve.

Reproductive outcomes varied significantly across age groups. The young women were found to have greater pregnancy and live birth rates with a significant increase in miscarriage rates with age.

It was found that there is a statistically significant relationship between old age and unfavorable fertility outcomes, especially miscarriage and low live birth rates. Adverse reproductive outcomes were also connected with increased BMI.

Table 1: Demographic and Baseline Characteristics (n = 218)

Variable	Category	Frequency (%) / Mean ± SD
Age (years)	—	29.8 ± 6.2
Age Groups	≤25 years	52 (23.9%)
	26–30 years	73 (33.5%)
	31–35 years	60 (27.5%)
	36–45 years	33 (15.1%)
BMI (kg/m²)	—	27.4 ± 4.3
BMI Category	Normal	92 (42.2%)
	Overweight	78 (35.8%)
	Obese	48 (22.0%)
Duration of infertility (years)	—	3.1 ± 1.8

Table 2: Hormonal Profile across Age Groups

Variable	≤25 years	26–30 years	31–35 years	36–45 years	P-value
AMH (ng/mL)	4.2 ± 1.1	3.6 ± 1.0	2.8 ± 0.9	1.9 ± 0.7	<0.001
FSH (IU/L)	6.5 ± 1.2	7.1 ± 1.4	8.6 ± 1.6	10.2 ± 2.1	<0.001

Table 3: Reproductive Outcomes by Age Group

Outcome	≤25 years	26–30 years	31–35 years	36–45 years	P-value
Clinical Pregnancy Rate	38 (73.1%)	49 (67.1%)	34 (56.7%)	13 (39.4%)	0.002
Live Birth Rate	34 (65.4%)	44 (60.3%)	29 (48.3%)	10 (30.3%)	0.001
Miscarriage Rate	4 (7.7%)	9 (12.3%)	15 (25.0%)	14 (42.4%)	<0.001
No Birth / Infertility	18 (34.6%)	29 (39.7%)	31 (51.7%)	23 (69.7%)	0.003

Table 4: Association between Age, BMI and Fertility Outcomes

Variable	Outcome	P-value	Significance
Age	Clinical Pregnancy	0.002	Significant
Age	Live Birth Rate	0.001	Significant
Age	Miscarriage	<0.001	Highly Significant
BMI	Clinical Pregnancy	0.021	Significant
BMI	Live Birth Rate	0.018	Significant
BMI	Miscarriage	0.030	Significant

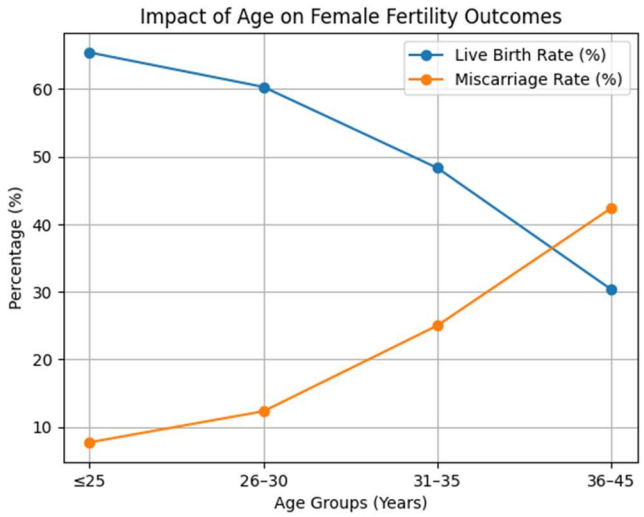

Figure 1: Impact of age on female fertility outcomes showing a progressive decline in live birth rate and a significant increase in miscarriage rate with advancing maternal age.

DISCUSSION

The present study evaluated the impact of age on female fertility by analyzing reproductive outcomes, hormonal profiles, and metabolic parameters among women aged 18–45 years. The findings demonstrate a clear age-related decline in fertility, with significant reductions in clinical pregnancy and live birth rates, and a marked increase in miscarriage rates among older women.

One of the key findings of this study is the progressive decline in ovarian reserve with advancing age, as reflected by decreasing AMH levels and increasing FSH levels. These results are consistent with recent studies, which report that ovarian reserve diminishes significantly after the age of 30, with a more pronounced decline after 35 years. This decline is primarily attributed to depletion of the primordial follicle pool and increased oocyte aneuploidy, which adversely affect fertilization and embryo viability[12-14]

Younger women (≤25 years) had a better clinical pregnancy and live birth rates than the other age categories. On the other hand, women between the age of 36 to 45 years had a much higher miscarriage rate. These results can be compared to the world evidence that indicates that high maternal age correlates with higher risks of chromosomal abnormalities, implantation failure, and early pregnancy loss . The sharp increase in miscarriage rates that we found is evidence of the biological constraints of aging during reproductive years and justifies early fertility planning approaches[15, 16].

The other key finding in this research is that body mass index (BMI) plays a role in determining fertility. There was a great deal of association between increased BMI and poor reproductive outcomes in form of fewer pregnancy rates and higher miscarriage rates. This is in line with the earlier studies that obesity leads to hormonal imbalance, insulin resistance and ovulatory dysfunction hence infertility impairment. Interestingly too, we found a fairly high rate of overweight prevalence among younger women in our study, indicating that lifestyle and dietary practices might be playing a role in causing early metabolic disruptions[17, 18].

Age and metabolic health also interact in such a way that they make fertility outcomes more complicated. Although the aging of the ovaries is a primary factor, the interaction of obesity and metabolic diseases can promote reproductive aging, as oxidative stress and chronic inflammation are among the possible mechanisms. This underlines the significance of an all-purpose method that would take into account both biological aging and risk factors that are modifiable[19, 20].

Although this study has some strengths, such as a sufficient sample size and a thorough evaluation of the variables, one must admit some limitations. The cross sectional design restricts the capability to have causal relationships. Also, due to the single-center study, the results might not be entirely applicable to the general population. It is suggested that longitudinal and multicenter studies in future will be necessary to further prove these findings and learn more about the underlying mechanisms.

In general, the results of this research confirm that age is the most important factor that predetermines female fertility, although the effect of this factor is strongly dependent on metabolic health and hormonal status. It can be better to identify at-risk people early and put in place specific interventions that could enhance reproductive outcomes.

CONCLUSION

This study concludes that advancing age has a significant negative impact on female fertility, characterized by declining ovarian reserve, reduced clinical pregnancy and live birth rates, and increased miscarriage risk. Additionally, higher BMI was found to adversely affect reproductive outcomes, further compounding the effects of age.

These findings underscore the need for early fertility assessment, timely family planning, and lifestyle modifications, particularly weight management, to optimize reproductive health. Integrating age-specific and individualized fertility care strategies can help improve outcomes and reduce the burden of infertility among wo539men of reproductive age.

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