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THE EFFECT OF AGE ON THE NUMBER OF OOCYTES, MATURE OOCYTES, FERTILIZATION, EMBRYO QUALITY, AND PREGNANCY IN WOMEN UNDERGOING IN VITRO FERTILIZATION AT WIN IVF CLINIC, RSIA PURI BUNDA HOSPITAL FROM 2019 TO 2021

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ABSTRACT

Background: Infertility affects approximately 10–15% of reproductive-age couples globally. In vitro fertilization (IVF) is a major treatment option, with success influenced by the quantity and quality of oocytes and embryos.
Methods: This retrospective study used total sampling of medical records from 402 patients undergoing IVF at WIN IVF Clinic, RSIA Puri Bunda, Denpasar, between 2019 and 2021. Patients were grouped by age: ≤30, 31–35, 36–40, and >40 years.
Results: Age significantly influenced the number of oocytes, mature oocytes, fertilization, and embryo quality. Women aged ≤35 years had more favorable outcomes in these parameters, while a significant decline was observed among women aged >35 years *($p<0.005$)*. The highest pregnancy rate occurred in women aged ≤30 years (41.8%), decreasing to 22.6% among women aged >40 years.
Conclusion: Female age is an important factor influencing IVF outcomes. Women aged ≤35 years have a greater likelihood of producing mature oocytes and high-quality embryos and achieving pregnancy. Specific strategies are therefore needed to improve IVF outcomes in older women.

Keywords: Embryo quality, female age, infertility, in vitro fertilization, oocyte count

INTRODUCTION

Pregnancy is a physiological condition that occurs when an ovum is fertilized by a sperm cell, and the resulting zygote attaches (implants) to the uterus. Couples who are unable to achieve pregnancy naturally after a minimum of one year of consistent sexual activity without contraception are classified as experiencing infertility.[1] In Indonesia, the infertility rate is estimated at 10-15% of the total population, with 12-22% of the affected population being of reproductive age.[2,3] Approximately 15% of Indonesian women face fertility challenges, amounting to around six million women.[4] A survey conducted by the Central Bureau of Statistics (BPS) in 2010 revealed that Bali Province ranks third among provinces in Indonesia with the lowest fertility rates, reporting a total fertility rate of 2.132 compared to the national average of 2.414.[5]

Infertility necessitates comprehensive evaluation of both men and women to identify underlying causes. One increasingly popular method to assist couples in overcoming infertility is assisted reproductive technology, including in vitro fertilization (IVF). IVF involves fertilization outside the woman's body, where oocytes are retrieved from the ovaries, fertilized in vitro with sperm, and the resulting embryos are incubated before being transferred back to the uterus.[6]

The success of IVF procedures is influenced by various factors, including reproductive health, sperm quality, and the quality and quantity of oocytes. Among these factors, a woman's age plays a crucial role in determining the outcome of IVF. Age significantly impacts both the quantity and quality of oocytes, which naturally decline over time, particularly after the age of 35.[7,8] The natural decline in the number of ovarian oocytes begins at birth, and by reproductive age, the number of oocytes available

for maturation and ovulation becomes limited. This decline accelerates significantly after the age of 35, thereby reducing the likelihood of IVF success.[9]

Moreover, age also affects the quality of embryos formed after fertilization. Embryos of higher quality are more likely to lead to successful pregnancies after implantation in the uterus, whereas lower-quality embryos are less likely to develop properly and may increase the likelihood of unsuccessful IVF outcomes.[10] Previous studies have shown that increasing age is associated with a decline in IVF success rates, particularly regarding the quantity of oocytes retrieved, fertilization rates, and overall pregnancy success rates.[11] Women under 35 years of age show significantly higher IVF success rates compared to those above this age, with a continual decline as age increases.[12,13]

This study designed to analyze how maternal age affects IVF patients' oocyte counts, mature oocyte counts, fertilization, embryo quality, and pregnancy outcomes at the WIN IVF Clinic, RSIA Puri Bunda Hospital, between 2019 and 2021.

MATERIALS AND METHODS

This study, approved by the Research Ethics Commission of the Faculty of Medicine, Udayana University (Ethical Clearance No. 0239/UN14.2.2.VII.14/LT/2024), retrospectively analyzed the relationship between patient age and in-vitro fertilization (IVF) outcomes at WIN IVF Clinic, RSIA Puri Bunda, Denpasar, from January to December 2024. Using secondary data from medical records of women undergoing IVF between January 2019 and December 2021, the study assessed variables including oocyte count, mature oocytes, fertilization rate, embryo quality, and pregnancy outcomes, with patient age as the independent variable and standardized IVF procedures as the control. Data were analyzed using Microsoft Excel and SPSS v.29, employing descriptive statistics, Kolmogorov-Smirnov tests, Kruskal-Wallis tests with Dunn post hoc analysis, and Chi-square tests, with significance set at $p < 0.05$.

The number of eggs was assessed starting from the initial Ovum Pick-Up (OPU) procedure to the stage where mature eggs were obtained. These mature eggs underwent fertilization and eventually developed into embryos intended for implantation in the uterus. The collected eggs were evaluated based on their quantity, maturity, and quality, as only mature eggs have the highest potential for fertilization. Once deemed mature, the eggs were fertilized in the laboratory using prepared sperm. The resulting embryos were monitored for several days to observe their development, with particular focus on their quality and ability to progress to the blastocyst stage, the stage preceding uterine implantation.

The success of this process is significantly influenced by age, which impacts the quantity and quality of eggs produced, the fertilization rate, and the quality of the resulting embryos. Differences among age groups were analyzed using the Kruskal-Wallis test to determine whether significant variations existed in reproductive outcomes across the studied age groups. This test was chosen due to the data not following a normal distribution, as confirmed by the Kolmogorov-Smirnov Normality Test (p<0.005), making non-parametric testing more appropriate. The analysis revealed significant differences in several variables related to the number of eggs and embryos among the studied age groups.

RESULTS

This study utilized medical record data from the IVF laboratory at WIN IVF Clinic, RSIA Puri Bunda Denpasar, collected between 2019 and 2021. A total of 409 samples were obtained: 137 in 2019, 136 in 2020, and 136 in 2021. After applying total sampling and inclusion criteria, 402 samples were analyzed, with 7 samples excluded due to incomplete data.

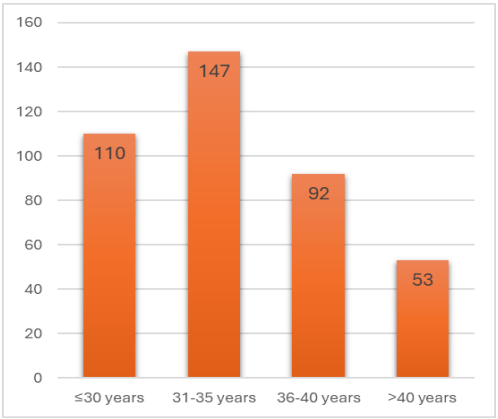


Figure 1. Number of Study Samples by Age Group

Based on data from **Figure 1.**, the number of samples varied by age group. The ≤30-year group included 110 samples (mean age: 28.22 ± 1.611 years), the 31–35-year group had 147 samples (mean: 33.02 ± 1.459 years), the 36–40-year group had 92 samples (mean: 37.61 ± 1.284 years), and the >40-year group had 53 samples (mean: 43.00 ± 2.287 years). The overall mean age was 34.07 years.

Number of Eggs and Embryos

Based on **Table 1**., the ≤30-year age group had the highest average OPU egg count compared to other age groups, with an average of 12.10 ± 5.307 embryos. Significant differences were identified between the ≤30-year age group and the 36-40 years (p<0.001) and >40 years (p<0.001) groups, as well as between the 31-35 years group and the 36-40 years (p=0.004) and >40 years (p<0.001) groups. Additionally, significant differences were noted between the 36-40 years and >40 years groups (p=0.001). However, no significant difference was found between the ≤30 years and 31-35 years age groups (p=1.000).

Table 1. Comparison of Egg and Embryo Numbers Across Age Groups

Variabel	≤30 years [Mean ± SD]	31-35 years [Mean ± SD]	36-40 years [Mean ± SD]	>40 years [Mean ± SD]	*P* Value
Oocytes OPU	12.10 ± 5.307[a]	11.92 ± 7.393[a]	9.01 ± 6.144[b]	5.64 ± 4.058[c]	<0.001
Mature Oocytes	9.34 ± 4.669[a]	9.34 ± 6.137[a]	7.01 ± 5.395[b]	3.79 ± 2.944[c]	<0.001
Fertilization	6.44 ± 4.207[a]	7.24 ± 5.247[a]	5.04 ± 4.744[b]	2.55 ± 2.162[c]	<0.001
Day-3 Embryos	6.68 ± 4.032[a]	7.48 ± 5.278[a]	5.26 ± 4.641[b]	2.72 ± 2.143[c]	<0.001
Grade 1 Day-3 Embryos	2.70 ± 2.352[a]	3.18 ± 3.239[a]	2.26 ± 2.781[a]	1.09 ± 1.445[b]	<0.001
Grade A/B Blastocysts	2.23 ± 2.044[a]	2.22 ± 2.086[a]	1.23 ± 1.951[b]	0.26 ± 0.524[c]	<0.001
Embryo Transfer	2.44 ± 0.773[a]	2.45 ± 0.829[a]	2.32 ± 1.048[ab]	1.92 ± 1.299[b]	0.014

Superscripts (a, b, c) represent statistical groupings; values with differing superscripts show a significant difference (P < 0.05).

In mature eggs, the highest results were obtained in the ≤30 years and 31-35 years age groups, which showed similar average values of 9.34 ± 4.669 and 9.34 ± 6.137, respectively. There was no significant difference between these two groups (p=1.000), but significant differences were found when comparing both groups with the 36-40 years (p<0.001 and p=0.005) and >40 years (p<0.001 for both comparisons) groups. Additionally, a significant difference was found between the 36-40 years and >40 years groups (p=0.006).

The highest average fertilization rate was found in the 31-35 years age group at 7.24 ± 5.247. There were significant differences between the ≤30 years and 36-40 years groups (p=0.020) and >40 years groups (p<0.001), and between the 31-35 years group and the 36-40 years (p=0.001) and >40 years (p<0.001) groups. Additionally, there was a significant difference between the 36-40 years and >40 years groups (p=0.004). However, there was no significant difference between the ≤30 years and 31-35 years groups (p=1.000).

On day three embryos, the highest results were observed in the 31-35 years age group with an average of 7.48 ± 5.278. Significant differences were found between the ≤30 years and 36-40 years (p=0.011) and >40 years (p<0.001) groups, and between the 31-35 years group and the 36-40 years (p=0.001) and >40 years (p<0.001) groups. Additionally, there was a significant difference between the 36-40 years and >40 years groups (p=0.003). However, no significant difference was found between the ≤30 years and 31-35 years groups (p=1.000).

The number of day three embryos with the best quality was highest in the 31-35 years age group, with an average of 3.18 ± 3.239. No significant differences were observed between the ≤30 years and 31-35 years groups (p=1.000), between the ≤30 years and 36-40 years groups (p=0.181), or between the 31-35 years and 36-40 years groups (p=0.057). However, there were significant differences when comparing the >40 years group with the ≤30 years (p<0.001), 31-35 years (p<0.001), and 36-40 years (p=0.042) groups.

High-quality blastocyst embryos were most frequently found in the ≤30 years age group, with an average of 2.23 ± 2.044. Significant differences were found between the ≤30 years and 36-40 years (p=0.001) and >40 years (p<0.001) groups, and between the 31-35 years and 36-40 years (p<0.001) and >40 years (p<0.001) groups. Additionally,

significant differences were found between the 36-40 years and >40 years groups (p=0.006). However, no significant difference was observed between the ≤30 years and 31-35 years groups (p=1.000).

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The highest embryo transfer rate was found in the 31-35 years age group, with an average of 2.45 ± 0.829. There were significant differences between the ≤30 years and >40 years groups (p=0.046), and between the 31-35 years and >40 years groups (p=0.008), but no significant difference was found between the ≤30 years and 31-35 years groups (p=1.000). Furthermore, no significant differences were found between the 36-40 years and ≤30 years (p=1.000), 31-35 years (p=1.000), or >40 years (p=0.070) groups.

Pregnancy Success

Pregnancy success in the IVF procedure is assessed based on β-hCG test results, a hormone produced after the embryo successfully attaches to the uterine wall, indicating the start of pregnancy. Based on data from **Table 2.**, the highest pregnancy success rate was observed in the ≤30 years age group, with a rate of 41.8%. Although no significant difference was found overall between the four age groups (p=0.105), a significant difference was noted between the ≤30 years and >40 years groups (p=0.017). This suggests that pregnancy success is higher in the younger age group (≤30 years) compared to the >40 years group.

Table 2. Comparison of Pregnancy Success Across Age Groups

	≤30 years	31-35 years	36-40 years	>40 years	*P* Value
β-hCG Positive	46	49	34	12	0,105
n	110	147	92	53	
Pregnancy Success Rate	(41,8%)[a]	(33,3%)[ab]	(37,0%)[ab]	(22,6%)[b]	

Chi-Square Test. Letters in the column signify statistical results, where identical letters represent no significant difference, and differing letters indicate a significant difference.

DISCUSSION

In the IVF (In Vitro Fertilization) procedure, a woman's age is a key factor influencing success. Age affects the number of eggs, the maturity of eggs, fertilization, embryo quality, and pregnancy outcomes. This is because egg quality and natural reproductive capacity decline with age.[14] Based on data from the WIN IVF Clinic at RSIA Puri Bunda for 2019-2021, this study discusses the comparison among four age groups (≤30 years, 31-35 years, 36-40 years, and >40 years) regarding the number of eggs, mature eggs, fertilization, embryo quality, and pregnancy outcomes.

According to **Table 1.**, significant differences were found in the number of OPU eggs, mature eggs, fertilization rates, Day 3 embryos, Day 3 Grade 1 embryos, Grade A/B blastocysts, and embryo transfers among the four age groups. The highest number of OPU eggs was found in the ≤30-year group, with a decreasing trend as age increased, particularly in the 36-40 and >40-year groups. The findings show that optimal egg production continues up to age 35. This aligns with previous research indicating a drastic decline in egg numbers after age 35.[15,16] Moreover, a study conducted at Sanglah General Hospital on patients undergoing antagonist protocol IVF treatments between 2014–2017 found similar trends, emphasizing the importance of age in influencing IVF outcomes.[17]

The highest number of mature eggs was found in the ≤30 and 31-35 age groups, with averages of 9.34 ± 4.669 and 9.34 ± 6.137, respectively. This study indicates that egg quality remains good up to age 35 but declines significantly thereafter. Similarly, a study in Brazil reported a significant decline in mature eggs with age, comparing Group A (≤35 years) with Groups B (36-39 years) and C (≥40 years), though no significant difference was observed between Groups B and C.[18]

Fertilization rates were highest in the 31–35 age group, indicating that optimal fertilization occurs before age 35, with a sharp decline thereafter. These findings align with previous studies that demonstrated declining fertilization rates as maternal age increases.[11]

Embryo development, particularly on Day 3, was also most optimal in the 31–35 age group, as evidenced by the highest average number of Day 3 embryos. This suggests that egg and embryo quality remain favorable until age 35, with a significant decline afterward. Previous research has similarly linked advanced maternal age with decreased embryo quantity and quality, further limiting the potential for successful implantation.[19]

Blastocyst quality, particularly Grade A/B blastocysts, was highest in the ≤30-year age group. This indicates that embryo quality remains optimal at younger ages, supporting the observation that the 36–40 and >40 age groups had fewer high-quality embryos. Women in older age groups often undergo embryo transfer on Day 3 while embryos are still in the cleavage stage, as lower oocyte counts make it challenging to develop embryos to the blastocyst stage. Prior studies have also reported increasing chromosomal abnormalities and declining embryo quality with advancing age.[10,20]

The highest average number of embryo transfers occurred in the 31–35 age group, further suggesting that embryo transfer outcomes are more favorable up to age 35 and decline significantly in women aged >40 years. These findings are consistent with earlier research that demonstrated reduced embryo transfer rates among women in older age groups.[11]

From **Table 2.**, the ≤30-year group had the highest IVF pregnancy success rate at 41.8%. Although no significant differences were observed overall among the four groups, significant differences were found between the ≤30 and >40 age groups, suggesting that younger age positively contributes to IVF pregnancy success. There was a marked decline in pregnancy success rates in women over 40 years, underscoring the importance of age as a key factor in IVF success.

Interestingly, previous studies involving more than 11,000 IVF cycles found that older women tend to have higher initial β-hCG levels after a successful embryo transfer. However, higher β-hCG levels in older women do not necessarily indicate better pregnancy outcomes due to declining embryo quality with age.[21,22]

This study concludes that age significantly influences parameters such as the number of OPU eggs, mature eggs, fertilization, Day 3 embryos, Grade 1 Day 3 embryos, Grade A/B blastocysts, and embryo transfers. While age did not significantly impact overall pregnancy success among the four groups, significant differences were observed when comparing ≤30 years and >40 years, as well as ≤40 years and >40 years.

1. CONCLUSIONS AND SUGGESTIONS

The study on the effect of age on various IVF outcomes, conducted at the WIN IVF Clinic, RSIA Puri Bunda between 2019 and 2021, reveals significant variations across age groups in several key parameters. The number of eggs retrieved varies considerably, with women aged ≤30 years showing the most substantial counts. Similarly, the number of mature eggs differs significantly, with women aged ≤30 years and 31-35 years having the highest numbers. Fertilization rates also exhibit significant differences, with the most favorable rates observed in the 31-35 years age group. Regarding embryo quality, the best-quality embryos on Day 3 are predominantly found in women aged 31-35 years, while the highest-quality blastocysts are noted in women aged ≤30 years. Pregnancy success rates similarly vary by age, with women aged ≤30 years experiencing the most successful outcomes, particularly when compared to women over 40 years.

However, these findings are based on a limited sample from a single IVF clinic in Bali. To improve the applicability of the results, future research should involve larger sample sizes with greater diversity across several IVF clinics or regions.

REFERENCES

1. World Health Organization. Infertility [Internet]. 2020 [cited 2022 Mar 16]. Available from: https://www.who.int/news-room/fact-sheets/detail/infertility
2. Panjaitan RF, Manurung E. Analisis Faktor Resiko Kejadian Infertilitas Pada Perawat di RSU Sembiring. BEST J (Biology Educ Sains Technol. 2020;3(2):244–50.
3. Septyani T. PERFITRI Sosialisasikan Bayi Tabung Fertilisasi In Vitro melalui Media Briefing. 2019 [cited 2022 Apr 3]; Available from: https://www.perfitri.org/files/journal/NL2.2.pdf
4. Bennett LR. The silencing of sexual health in Indonesian infertility care - Indonesia at Melbourne [Internet]. The University of Melbourne. 2015 [cited 2022 Apr 3]. Available from: https://indonesiaatmelbourne.unimelb.edu.au/the-silencing-of-sexual-health-in-indonesian-infertility-care/
5. Nuraini. Fertilitas Penduduk Indonesia, Hasil Sensus Penduduk 2010 [Internet]. 2012 [cited 2022 May 24]. Available from: https://www.bps.go.id/publication/2012/05/23/b962187337275cff3815f4ea/fertilitas-penduduk-indonesia-hasil-sensus-penduduk-2010.html
6. Penzias A, Bendikson K, Butts S, Coutifaris C, Fossum G, Falcone T, et al. Guidance on the limits to the number of embryos to transfer: a committee opinion. Fertil Steril. 2017 Apr 1;107(4):901–3.
7. Cox E, Takov V. Embryology, Ovarian Follicle Development. StatPearls [Internet]. 2021 Aug 11 [cited 2022 Mar 17]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK532300/
8. Hsu A, Arny M, Knee AB, Bell C, Cook E, Novak AL, et al. Antral follicle count in clinical practice: analyzing clinical relevance. Fertil Steril [Internet]. 2012 Feb 1 [cited 2022 Mar 17];95(2):474–9. Available from: http://www.fertstert.org/article/S0015028210004607/fulltext
9. Wade JJ, MacLachlan V, Kovacs G. The success rate of IVF has significantly improved over the last decade. Aust New Zeal J Obstet Gynaecol. 2015 Oct 1;55(5):473–6.
10. Grøndahl ML, Christiansen SL, Kesmodel US, Agerholm IE, Lemmen JG, Lundstrøm P, et al. Effect of women's age on embryo morphology, cleavage rate and competence—A multicenter cohort study. PLoS One [Internet]. 2017 Apr 1 [cited 2024 Sep 14];12(4):e0172456. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0172456
11. Tan TY, Lau MSK, Loh SF, Tan HH. Female ageing and reproductive outcome in assisted reproduction cycles. Singapore Med J [Internet]. 2014 [cited 2024 Sep 16];55(6):305. Available from: /pmc/articles/PMC4294057/
12. Khalife D, Nassar A, Khalil A, Awwad J, Abu Musa A, Hannoun A, et al. Cumulative Live-Birth Rates by Maternal Age after One orMultiple In Vitro Fertilization Cycles: An Institutional Experience. Int J Fertil Steril [Internet]. 2020 Apr 1 [cited 2024 Oct 8];14(1):34. Available from: /pmc/articles/PMC7139227/
13. Wu CH, Lee TH, Chen HH, Chen CI, Huang CC,

Lee MS. The influence of female age on the cumulative live-birth rate of fresh cycles and subsequent frozen cycles using vitrified blastocysts in hyper-responders. Taiwan J Obstet Gynecol. 2015 Oct 1;54(5):567–71.
14. Vollenhoven B, Hunt S. Ovarian ageing and the impact on female fertility. F1000Research [Internet]. 2018 [cited 2024 Sep 16];7. Available from: /pmc/articles/PMC6259486/
15. Cimadomo D, Fabozzi G, Vaiarelli A, Ubaldi N, Ubaldi FM, Rienzi L. Impact of maternal age on oocyte and embryo competence. Front Endocrinol (Lausanne) [Internet]. 2018 Jun 29 [cited 2024 Sep 16];9(JUL):382238. Available from: www.frontiersin.org
16. Moghadam ARE, Moghadam MT, Hemadi M, Saki G. Oocyte quality and aging. JBRA Assist Reprod [Internet]. 2022 [cited 2024 Sep 16];26(1):105. Available from: /pmc/articles/PMC8769179/
17. Mahadevy P, Putri P, Manuaba IBGF, Wiradnyana AAGP, Adnyana IBP. Karakteristik pasien yang menjalani bayi tabung dengan protokol antagonis di klinik bayi tabung rumah sakit umum pusat sanglah tahun 2014 – 2017. 2021;10(10):85–90.
18. Kozlowski IF, Carneiro MC, da Rosa VB, Schuffner A. Correlation between anti-Müllerian hormone, age, and number of oocytes: A retrospective study in a Brazilian in vitro fertilization center. JBRA Assist Reprod [Internet]. 2022 [cited 2024 Sep 16];26(2):214. Available from: /pmc/articles/PMC9118965/
19. Warshaviak M, Kalma Y, Carmon A, Samara N, Dviri M, Azem F, et al. The Effect of Advanced Maternal Age on Embryo Morphokinetics. Front Endocrinol (Lausanne) [Internet]. 2019 Oct 25 [cited 2024 Sep 16];10:474799. Available from: www.frontiersin.org
20. Qiu P, Ye R, Li P, Huang H, Ding L. Effect of Day 3 cell number on the live birth rate of vitrified-warmed Day 5 single blastocyst transfer in young women. BMC Pregnancy Childbirth [Internet]. 2024 Dec 1 [cited 2024 Sep 16];24(1):1–8. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-024-06468-1
21. Betz D, Fane K. Human Chorionic Gonadotropin. StatPearls [Internet]. 2023 Aug 14 [cited 2024 Sep 16]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK532950/
22. Coskun S, Hollanders J, Al-Hassan S, Al-Sufyan H, Al-Mayman H, Jaroudi K. Day 5 versus day 3 embryo transfer: a controlled randomized trial. Hum Reprod [Internet]. 2000 Sep 1 [cited 2024 Sep 16];15(9):1947–52. Available from: https://dx.doi.org/10.1093/humrep/15.9.1947