

## RESEARCH ARTICLE

# Advanced Maternal Age Pregnancies: Perinatal Outcomes and Maternal Characteristics in Comparison with Women Aged 20–35 Years

Mehmet Can Keven<sup>1</sup>, Banu Derim Yegen<sup>2</sup>, Sevgi Gulec<sup>2</sup>

<sup>1</sup>Eskişehir City Hospital, Department of Gynecology Obstetrics, Division of Perinatology. Eskişehir, Türkiye.

<sup>2</sup>Eskişehir City Hospital, Department of Gynecology Obstetrics. Eskişehir, Türkiye

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### ORCIDs of the authors:

MCK: 0000-0003-2763-7602

BDY : 0009-0008-2479-2213

SG : 0000-0002-8394-3754

### Abstract

**Introduction:** Advanced maternal age (AMA) pregnancies are associated with increased maternal and perinatal risks; however, the relative contribution of maternal age itself versus accompanying maternal characteristics remains debated. This study aimed to evaluate maternal characteristics and perinatal outcomes in women aged  $\geq 35$  years compared with those aged 20–35 years.

**Methods:** This retrospective comparative cohort study included singleton pregnancies delivered between January 2022 and July 2025 at a tertiary referral center. Women aged  $\geq 35$  years constituted the AMA group, while women aged 20–35 years served as controls. Maternal characteristics, obstetric complications, mode of delivery, and perinatal outcomes were compared between groups. Neonatal intensive care unit (NICU) admission was defined as the primary outcome.

**Results:** A total of 599 women were included (300 AMA, 299 controls). Overweight/obesity, gestational diabetes mellitus, chronic hypertension, and cesarean delivery were significantly more frequent in the AMA group (all  $p < 0.01$ ). NICU admission was higher among infants born to women aged  $\geq 35$  years compared with controls (25.0% vs. 10.4%,  $p < 0.001$ ). Other key neonatal outcomes, including birth weight, Apgar scores, fetal growth restriction, and preterm birth, did not differ significantly between groups. Multivariable logistic regression analysis demonstrated that increased body mass index, gestational diabetes mellitus, and cesarean delivery were independently associated with the advanced maternal age group.

**Conclusion:** Advanced maternal age was associated with a higher burden of maternal comorbidities and increased cesarean delivery rates, whereas most neonatal outcomes were comparable between age groups. These findings suggest that adverse perinatal outcomes in AMA pregnancies are largely driven by coexisting maternal characteristics rather than maternal age alone when appropriate care is provided.

**Correspondence Address:** Eskişehir Şehir Hastanesi Perinatoloji Kliniği Eskişehir - Türkiye

**Phone:** +90 505 671 52 59 / **e-mail:** cankeven@yahoo.com

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## Introduction

Historically, advanced maternal age (AMA) has been defined as pregnancy in women aged 35 years or older at the expected time of delivery. This cutoff was selected based on the increasing incidence of fertility-related challenges and genetic abnormalities observed in women aged 35 years and older.<sup>1</sup> Indeed, recent studies have reported a higher incidence of chromosomal abnormalities and certain congenital anomalies among offspring born to women aged 35 years and older.<sup>2-4</sup> Notably, this association appears to become more pronounced with advancing maternal age.

In recent decades, the prevalence of advanced maternal age has increased substantially both worldwide and in Türkiye.<sup>5,6</sup> This rise has been attributed to multiple social, demographic, and medical factors, including delayed childbearing due to higher educational attainment and career planning, changes in family structure, improved access to effective contraception, and the widespread use of assisted reproductive technologies.<sup>7,8</sup> As a result, an increasing proportion of women are conceiving and delivering at older ages, resulting in a growing proportion of pregnancies occurring at older maternal ages.

Advanced maternal age pregnancies have been associated with a higher frequency of several obstetric and perinatal complications. In particular, increasing maternal age has been consistently linked to higher rates of spontaneous miscarriage, largely attributed to age-related chromosomal abnormalities.<sup>9,10</sup> In addition, previous studies have demonstrated that women of advanced maternal age more commonly experience gestational diabetes mellitus, hypertensive disorders of pregnancy, placental abnormalities, and higher rates of cesarean delivery.<sup>11-15</sup> Beyond maternal complications, adverse perinatal outcomes such as preterm birth, low birth weight, intrauterine growth restriction, neonatal intensive care unit admission, and perinatal mortality have been reported more frequently in this population.<sup>16,17</sup> However, the extent to which these outcomes are attributable to maternal age itself versus accompanying maternal characteristics remains a matter of ongoing debate.

Despite the growing literature on advanced maternal age pregnancies, data from tertiary care centers in Türkiye remain limited. Given the increasing prevalence of advanced maternal age, institution-specific analyses may provide valuable insights into real-world clinical practice. Therefore, this study aimed

to evaluate perinatal outcomes and associated maternal characteristics in pregnancies of women aged 35 years and older and to compare these findings with those of women aged 20–35 years who delivered at Eskişehir City Hospital.

## Material and Methods

This study was designed as a retrospective comparative cohort study conducted at Eskişehir City Hospital, a tertiary referral center. Pregnancies of women aged 35 years and older, identified over a 3.5-year study period from January 2022 to July 2025, were compared with those of women aged 20–35 years in terms of associated maternal characteristics and perinatal outcomes.

Inclusion criteria consisted of pregnancies that resulted in delivery at Eskişehir City Hospital between January 2022 and July 2025. Only singleton pregnancies were included. Participants were categorized into two groups according to maternal age at delivery: women aged 35 years and older constituted the advanced maternal age group, while women aged 20–35 years served as the control group.

Exclusion criteria included pregnancies complicated by multiple gestation, cases with lethal fetal anomalies incompatible with postnatal survival, pregnancies with incomplete or missing medical records regarding maternal characteristics or perinatal outcomes, and deliveries occurring before 24 weeks of gestation.

AMA was defined as maternal age of 35 years or older at the time of delivery.<sup>1</sup> Preterm birth was defined as delivery occurring before 37 completed weeks of gestation.<sup>18</sup> Low birth weight (LBW) was defined as a birth weight below 2500 g, according to World Health Organization and UNICEF criteria. Fetal growth restriction (FGR) was defined based on birth weight percentiles for gestational age and categorized as mild FGR (birth weight between the 3rd and 10th percentiles) and severe FGR (birth weight below the 3rd percentile), in accordance with institutional reference standards used in routine clinical practice.<sup>19</sup>

Preeclampsia was defined as new-onset hypertension developing after 20 weeks of gestation, with or without proteinuria and/or signs of maternal end-organ dysfunction, according to standard clinical diagnostic criteria.<sup>20</sup> Gestational diabetes mellitus (GDM) was diagnosed based on the results of routine screening and diagnostic testing performed during pregnancy, in line with the institutional protocol.<sup>21</sup>

Apgar scores were recorded at the 1st and 5th minutes after birth. Neonatal intensive care unit (NICU) admission was defined as admission of the newborn to the NICU for any indication following delivery. Stillbirth was defined as fetal death occurring at or after 24 weeks of gestation, and perinatal mortality was defined as stillbirth or neonatal death occurring within the first 7 days of life.

Data were obtained retrospectively from the electronic medical record system of Eskişehir City Hospital. Maternal demographic characteristics, obstetric history, and pregnancy-related complications were retrieved from antenatal follow-up records and ultrasonography reports. Information regarding delivery outcomes was collected from delivery room records, while neonatal outcomes, including Apgar scores and NICU admission, were obtained from neonatal intensive care unit and newborn medical records.

All relevant data were extracted using a standardized data collection form to ensure consistency. Data accuracy and completeness were verified through cross-checking of records, and the collected data were reviewed by the investigators prior to analysis.

Maternal characteristics evaluated in the study included maternal age, gravidity, parity, history of spontaneous abortion, body mass index (BMI), and smoking status. Obstetric and medical comorbidities assessed were chronic hypertension, gestational diabetes mellitus, and preeclampsia. In addition, obstetric complications such as fetal growth restriction, placental abruption, and preterm birth were recorded. Mode of delivery (vaginal delivery or cesarean section) was also documented as part of maternal and obstetric characteristics.

The primary outcome of the study was neonatal intensive care unit admission, given its clinical relevance and the observed difference between age groups. Secondary outcomes included gestational age at delivery, birth weight, low birth weight, fetal growth restriction, Apgar scores at the 1st and 5th minutes, mode of delivery, and stillbirth and perinatal mortality.

Statistical analyses were performed using IBM SPSS Statistics (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Continuous variables were presented as mean  $\pm$  standard deviation or median with interquartile range (IQR), as appropriate, while categorical

variables were expressed as number and percentage. Comparisons between the advanced maternal age group and the control group were performed using the independent samples t-test or the Mann–Whitney U test for continuous variables, depending on data distribution. Categorical variables were compared using the chi-square test or Fisher’s exact test, as appropriate. A two-sided  $p$  value  $< 0.05$  was considered statistically significant. In addition, multivariable logistic regression analysis was performed to identify factors independently associated with advanced maternal age ( $\geq 35$  years), and results were reported as adjusted odds ratios with 95% confidence intervals.

Following approval by the Ethics Committee of the Republic of Turkey Ministry of Health, Eskişehir City Hospital (approval date: September 11, 2025; decision number: ESH/BAEK 2025/221), this study was conducted in accordance with the principles of the Declaration of Helsinki (World Medical Association, revised 2024).

## Results

A total of 599 women were included in the analysis, comprising 300 women aged  $\geq 35$  years (advanced maternal age group) and 299 women aged 20–35 years (control group).

### *Maternal and obstetric characteristics*

Maternal and obstetric characteristics of the study population are presented in Table 1. Women in the advanced maternal age group had significantly higher gravida and parity values compared with the control group (both  $p < 0.001$ ). A history of spontaneous abortion was also more frequent among women aged  $\geq 35$  years ( $p < 0.001$ ).

The prevalence of overweight or obesity (BMI  $\geq 25$  kg/m<sup>2</sup>) was significantly higher in the advanced maternal age group than in the control group (93.7% vs. 83.3%,  $p < 0.001$ ). Gestational diabetes mellitus was more common among women aged  $\geq 35$  years (18.7% vs. 9.0%,  $p = 0.001$ ), and chronic hypertension was observed exclusively in the advanced maternal age group (2.7% vs. 0.0%,  $p = 0.004$ ). Smoking status and preeclampsia rates were similar between the two groups.

The distribution of fetal growth restriction categories did not differ significantly between groups ( $p = 0.38$ ). Rates of placental abruption and preterm birth ( $< 37$  weeks) were comparable between women aged  $\geq 35$  years and those aged 20–35 years. In contrast, cesarean delivery was significantly more frequent in the

advanced maternal age group compared with the control group (48.7% vs. 29.8%,  $p < 0.001$ ).

Multivariable logistic regression analysis was

Table 1. Comparison of maternal and obstetric characteristics between the advanced maternal age and control groups

Variable	Advanced maternal age group ( $\geq 35$ years)	Non-Pregnant (n=70)	p-value
Gravida (median, IQR)	3 (2)	2 (2)	<0.001
Parity (median, IQR)	1 (1)	1 (1)	<0.001
History of spontaneous abortion (median, IQR)	0 (1)	0 (0)	<0.001
BMI $\geq 25$ kg/m <sup>2</sup> , n (%)	281 (93.7%)	249 (83.3%)	<0.001
Smoking, n (%)	12 (4.0%)	10 (3.3%)	0.67
Chronic hypertension, n (%)	8 (2.7%)	0 (0.0%)	0.004
Gestational diabetes mellitus, n (%)	56 (18.7%)	27 (9.0%)	0.001
Preeclampsia, n (%)	13 (4.3%)	11 (3.7%)	0.68
FGR – None, n (%)	247 (82.3%)	241 (80.6%)	0.38
FGR – Mild (3rd–10th percentile), n (%)	32 (10.7%)	28 (9.4%)	
FGR – Severe (<3rd percentile), n (%)	21 (7.0%)	30 (10.0%)	
Placental abruption, n (%)	4 (1.3%)	1 (0.3%)	0.18
Preterm birth (<37 weeks), n (%)	24 (8.0%)	16 (5.4%)	0.19
Mode of delivery (cesarean), n (%)	146 (48.7%)	89 (29.8%)	<0.001

Data are presented as median (interquartile range) or number (percentage), as appropriate. Continuous variables were compared using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test. P values for fetal growth restriction represent the overall comparison across categories. BMI: Body mass index; FGR: Fetal growth restriction; IQR: Interquartile range.

performed to evaluate factors independently associated with advanced maternal age ( $\geq 35$  years). After adjustment, maternal body mass index  $\geq 25$  kg/m<sup>2</sup> (adjusted OR 2.64, 95% CI 1.50–4.63,  $p = 0.001$ ), gestational diabetes mellitus (adjusted OR 1.83, 95% CI 1.10–3.05,  $p = 0.020$ ), and cesarean delivery (adjusted OR 1.93, 95% CI 1.36–2.72,  $p < 0.001$ ) remained independently associated with advanced maternal age (Table 3). Chronic hypertension was not independently associated with advanced maternal age in the multivariable model.

Table 3. Multivariable logistic regression analysis of factors associated with advanced maternal age ( $\geq 35$  years)

Variable	Adjusted OR	95% CI	p value
BMI $\geq 25$ kg/m <sup>2</sup>	2.64	1.50–4.63	0.001
Gestational diabetes mellitus	1.83	1.10–3.05	0.020
Chronic hypertension	—	—	0.999
Cesarean delivery	1.93	1.36–2.72	<0.001

#### Model statistics:

Omnibus test  $\chi^2 = 49.19$ ,  $p < 0.001$ ; Nagelkerke  $R^2 = 0.105$ ; Hosmer–Lemeshow test  $p = 0.954$ .

#### Footnotes:

Data are presented as adjusted odds ratios (OR) with 95% confidence intervals (CI).

Multivariable logistic regression analysis was performed including BMI  $\geq 25$  kg/m<sup>2</sup>, gestational diabetes mellitus, chronic hypertension, and mode of delivery. Chronic hypertension could not be reliably estimated due to very low event counts in the control group.

BMI: Body mass index.

#### Perinatal and neonatal outcomes

Perinatal and neonatal outcomes are summarized in Table 2. Median gestational age at delivery and birth weight were similar between the two groups. The proportion of low birth weight infants did not differ significantly between women aged  $\geq 35$  years and controls.

No significant differences were observed in 1-minute or 5-minute Apgar scores between the groups. However, neonatal intensive care unit (NICU) admission was significantly more frequent among infants born to women aged  $\geq 35$  years compared with those born to younger women (25.0% vs. 10.4%,  $p < 0.001$ ).

Fetal congenital or chromosomal anomalies were detected in a small number of cases. In the advanced maternal age group, two neonates (0.7%) were diagnosed with fetal anomalies, including one case of ventricular septal defect and one case of mild renal pelviectasis. In the control group, one neonate (0.3%) was diagnosed with a ventricular septal defect. There was no statistically significant difference between the groups regarding the presence of congenital or chromosomal anomalies ( $p = 0.56$ ).

Rates of stillbirth were low in both groups and did not differ significantly between the advanced maternal age and control groups.

Table 2. Comparison of perinatal and neonatal outcomes between the advanced maternal age and control groups

Variable	Advanced maternal age group ( $\geq 35$ years) (n = 300)	Control group (20–35 years) (n = 299)	P value
Gestational age at delivery (weeks), median (IQR)	38 (2)	38 (2)	0.78
Birth weight (g), median (IQR)	3225 (624)	3190 (645)	0.62
Low birth weight (LBW, <2500 g), n (%)	34 (11.3%)	23 (7.7%)	0.168
Apgar score at 1 minute, median (IQR)	9 (0)	9 (0)	0.95
Apgar score at 5 minutes, median (IQR)	10 (0)	10 (0)	0.97
NICU admission, n (%)	75 (25.0%)	31 (10.4%)	<b>&lt;0.001</b>
Stillbirth, n (%)	5 (1.7%)	2 (0.7%)	0.26
Congenital /chromosomal anomaly, n (%)	2 (0.7%)	1 (0.3%)	0.56*

Data are presented as median (interquartile range) or number (percentage), as appropriate. Continuous variables were compared using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher’s exact test, as appropriate.

\*Fisher’s exact test was used due to low event counts. LBW: Low birth weight; NICU: Neonatal intensive care unit; IQR: Interquartile range.

## Discussion

In this retrospective comparative cohort study, pregnancies in women aged 35 years and older were associated with distinct maternal and obstetric characteristics when compared with women aged 20–35 years. Advanced maternal age was associated with higher rates of gestational diabetes mellitus, increased body mass index, and cesarean delivery. In addition, neonatal intensive care unit admission was more frequent among infants born to women of advanced maternal age. However, multivariable analysis demonstrated that increased body mass index, gestational diabetes mellitus, and cesarean delivery were independently associated with the advanced maternal age group, suggesting that the observed differences are largely driven by coexisting maternal characteristics rather than maternal age alone. In contrast, key neonatal indicators reflecting immediate postnatal condition, including Apgar scores at 1 and 5 minutes, birth weight, fetal growth restriction, and preterm birth, did not differ significantly between the two age groups. These findings suggest that while pregnan-

cies at advanced maternal age are accompanied by a higher burden of maternal comorbidities and obstetric interventions, maternal age alone does not necessarily translate into widespread adverse neonatal outcomes when appropriate antenatal and perinatal care is provided.

These findings are consistent with previous literature suggesting that advanced maternal age is mainly associated with increased maternal comorbidities and higher rates of obstetric intervention, particularly cesarean delivery, rather than uniformly adverse neonatal outcomes. A recent review published in *Best Practice & Research in Clinical Obstetrics and Gynecology* emphasized that many risks attributed to advanced maternal age are mediated through coexisting maternal conditions and clinical management strategies rather than maternal age itself.<sup>14</sup> In line with this perspective, our study demonstrated comparable Apgar scores, birth weight, fetal growth restriction, and preterm birth rates between age groups, despite a significantly higher rate of NICU admission among infants born to older women. The increased NICU admission rate may therefore reflect a more cautious neonatal management approach in the presence of maternal comorbidities and higher cesarean delivery rates, rather than an increase in immediate neonatal morbidity.<sup>14</sup> Overall, these findings support an individualized approach to risk assessment in advanced maternal age pregnancies, rather than reliance on maternal age alone in the absence of other risk factors as a predictor of adverse perinatal outcomes.

The present study has several strengths. First, it includes a relatively large and well-defined cohort with nearly equal numbers of women in the advanced maternal age and control groups, enhancing the robustness of group comparisons. Second, all data were obtained from a single tertiary referral center, ensuring consistency in antenatal follow-up, diagnostic criteria, and perinatal management protocols. Third, comprehensive maternal, obstetric, and neonatal outcomes were evaluated with minimal missing data, allowing for a reliable assessment of perinatal outcomes associated with advanced maternal age in routine clinical practice.

Several limitations should be acknowledged. The retrospective design of the study inherently limits causal inference and may be subject to residual confounding. Although a multivariable logistic regressi-

on analysis was performed, the possibility of unmeasured confounders cannot be excluded. In addition, some outcomes had relatively low event rates, which may have limited the precision of effect estimates. Finally, as this was a single-center study conducted in a tertiary care setting, the findings may not be fully generalizable to other populations or healthcare systems.

### Conclusion

Advanced maternal age was associated with a higher prevalence of maternal comorbidities and an increased rate of cesarean delivery. Although neonatal intensive care unit admission was more frequent among women aged 35 years and older, other key neonatal outcomes—including Apgar scores, birth weight, fetal growth restriction, and preterm birth—were comparable between advanced maternal age pregnancies and those of younger women. These findings suggest that advanced maternal age alone does not inevitably result in adverse neonatal outcomes when appropriate antenatal and perinatal care is provided. Therefore, individualized risk assessment based on accompanying maternal characteristics, rather than maternal age alone, should guide clinical management in advanced maternal age pregnancies.

### Ethics Committee Approval

This study was approved by the Ethics Committee of the Republic of Turkey Ministry of Health, Eskişehir City Hospital (approval date: September 11, 2025; decision number: ESH/BAEK 2025/221) and was conducted in accordance with the Declaration of Helsinki.

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#### Conflict of Interest

*The authors declare no conflict of interest.*

#### Financial Sources

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