Jinekoloji - Obstetrik ve Neonatoloji Tıp Dergisi
The Journal of Gynecology-Obstetrics and Neonatology

ÖZGÜN ARAŞTIRMA / ORIGINAL ARTICLE

DOI: 10.38136/jgon.1720786

Unmasking Age or Condition? A Retrospective Analysis of Neonatal Outcomes in Advanced Maternal Age Pregnancies

Yaş mı Etken, Eşlik Eden Durumlar mı? İleri Anne Yaşında Neonatal Sonuçların Retrospektif Değerlendirmesi

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ABSTRACT

Aim: This study aimed to determine whether advanced maternal age (≥35 years) independently increases the risk of adverse neonatal outcomes compared to younger mothers, and to clarify the extent to which maternal age versus comorbidities influences neonatal morbidity and mortality.

Materials and Methods: We conducted a retrospective cohort study at Niğde Ömer Halisdemir University Training and Research Hospital between September 2023 and March 2024. Singleton live births to mothers aged ≥20 years were grouped by maternal age: <35 years old (younger control group) and ≥35 years old(AMA group). Maternal demographics, obstetric complications, and neonatal outcomes—including low birth weight (LBW), prematurity, Apgar scores, neonatal intensive care unit (NICU) admission, early-onset neonatal sepsis, and mortality—were compared between groups. Multivariable logistic regression identified independent predictors of adverse neonatal outcomes.

Results: Among 413 mother–infant pairs, AMA mothers had significantly higher gravidity, parity, and neonatal mortality than younger mothers (9.4% vs. 2.3% neonatal death rate, p=0.004). However, rates of prematurity, LBW, neonatal sepsis, and NICU admission were similar between the two age groups. In multivariate analysis, maternal age ≥35 years old was an independent predictor of neonatal mortality (adjusted OR 18.48, 95% CI 2.61–130.67, p=0.003) even after controlling for parity, gestational diabetes, and preeclampsia. Conversely, AMA was not an independent risk factor for other adverse outcomes such as low Apgar scores, prematurity, or LBW.

Conclusions: Although pregnancies in women of AMA were associated with higher neonatal mortality, maternal age alone did not independently predict other key neonatal complications. Our findings suggest that the elevated neonatal risks often attributed to AMA are mediated primarily through age-related comorbid conditions and birth-related complications rather than age itself. This distinction holds clinical significance for risk stratification and patient counseling. Optimized prenatal care targeting modifiable risk factors may help mitigate neonatal risks in AMA pregnancies.

Keywords: Advanced maternal age, Neonatal mortality, NICU admission, Low birth weight, Prematurity, Preeclampsia, Gestational diabetes, Retrospective cohort study.

ÖZ

Amaç: Bu çalışmanın amacı, ileri anne yaşının (≥35 yıl) olumsuz yenidoğan sonuçlarını genç annelerle karşılaştırıldığında bağımsız olarak artırıp artırmadığını belirlemek ve yenidoğan morbidite ve mortalitesi üzerinde yaş ile komorbiditelerin etkisini ayırt etmektir.

Gereç ve Yöntemler: Bu retrospektif kohort çalışması, Eylül 2023 ile Mart 2024 tarihleri arasında Niğde Ömer Halisdemir Üniversitesi Eğitim ve Araştırma Hastanesi'nde yürütüldü. Yaşı ≥20 olan annelerin tekil canlı doğumları, anne yaşına göre <35 (kontrol) ve ≥35 (İAY) olarak iki gruba ayrıldı. Anne demografisi, obstetrik komplikasyonlar ve neonatal sonuçlar—düşük doğum ağırlığı (DDA), prematürite, Apgar skorları, yenidoğan yoğun bakım (YYBÜ) ihtiyacı, erken başlangıçlı neonatal sepsis ve mortalite—iki grup arasında karşılaştırıldı. Advers neonatal sonuçların bağımsız belirleyicilerini saptamak için çok değişkenli lojistik regresyon analizleri yapıldı.

Bulgular: Toplam 413 anne-bebek çiftinde, İAY grubunda gravide, parite ve neonatal mortalite oranları anlamlı olarak daha yüksekti (%9,4 vs. %2,3; p=0,004). Ancak prematürite, DDA, sepsis ve YYBÜ'ye yatış oranları her iki grupta benzer bulundu. Çok değişkenli analizde, parite, gestasyonel diyabet ve preeklampsi kontrol edildikten sonra bile, anne yaşının ≥35 olmasının neonatal mortalitenin bağımsız bir belirleyicisi olduğu görüldü (düzeltilmiş OR: 18,48; %95 GA: 2,61–130,67; p=0,003). Buna karşın İAY, düşük Apgar skoru, prematürite veya DDA açısından bağımsız bir risk faktörü değildi.

Sonuç: İleri anne yaşı gebelikleri neonatal mortalite açısından daha yüksek risk taşımakla birlikte, anne yaşının kendisi diğer temel neonatal komplikasyonların bağımsız bir belirleyicisi değildir. Bulgularımız, İAY ile ilişkili artmış neonatal risklerin esasen bu yaş grubunda daha sık görülen komorbiditelere ve doğumla ilgili komplikasyonlara bağlı olduğunu düşündürmektedir. Bu ayrım, risk sınıflandırması ve hasta danışmanlığında klinik olarak önemlidir. Modifiye edilebilir faktörlere odaklanan optimize edilmiş doğum öncesi bakım, İAY gebeliklerinde neonatal riskleri azaltmaya yardımcı olabilir.

Anahtar Kelimeler: İleri anne yaşı, Neonatal mortalite, YYBÜ yatışı, Düşük doğum ağırlığı, Prematürite, Preeklampsi, Gestasyonel diyabet, Retrospektif kohort çalışması.

Cite as: Degirmencioglu H and Karaman E. Unmasking Age or Condition? A Retrospective Analysis of Neonatal Outcomes in Advanced Maternal Age Pregnancies. Jinekoloji-Obstetrik ve Neonatoloji Tıp Dergisi 2026;23(2):139–146.

Geliş/Received: 16.06.2025 • **Kabul/Accepted:** 01.12.2026

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Çevrimiçi Erişim/Available online at: https://dergipark.org.tr/tr/pub/jgon

INTRODUCTION

Advanced maternal age (AMA) is typically defined as pregnancy at 35 years or older, a threshold historically used because maternal and perinatal risks begin to rise beyond this age (1). Clinically, AMA is considered a distinct high-risk category due to its association with increased obstetric complications and neonatal risks. Women in their late 30s and early 40s are more prone to conditions such as gestational diabetes, hypertension (preeclampsia, PE), placenta previa, and miscarriage (1). These maternal complications can in turn adversely affect neonatal outcomes. Indeed, infants of AMA mothers have been linked to higher rates of preterm birth, low birth weight (LBW), need for neonatal intensive care unit (NICU) admission, and even a higher likelihood of stillbirth compared to infants of younger mothers (1). Given these concerns, pregnancies at age 35 years old and above have long been approached with extra caution in prenatal care.

Globally, childbearing is shifting to later ages, driven by sociocultural factors and improved contraception and fertility treatments (1). In the United States, the birth rate among women aged 35–39 years old increased from 45.9 per 1,000 in 2010 to 52.7 in 2019 (1). Türkiye shows a parallel trend: the average age at first birth rose from around 22 years in 2010 to about 27 years in 2023, and the mean maternal age at any birth reached ~29 years by 2020 (2,3). Consequently, a larger share of pregnancies now falls into the advanced maternal age range, underscoring the need to understand the implications for maternal and neonatal health (2,3). Although AMA is often associated with higher neonatal risk, recent studies report mixed findings and suggest that the elevated risk is at least partly due to comorbid conditions rather than age alone (4,5). Notably, professional guidelines acknowledge that even at age 35 years old there is a small but significant increase in adverse neonatal outcomes, with risks escalating further at more advanced ages (6). A substantial body of recent research has examined how AMA affects neonatal outcomes. Many studies indicate that AMA is associated with higher odds of adverse neonatal outcomes in general. For example, a large cohort study in Turkey reported that mothers aged ≥35 years old had significantly higher rates of preterm delivery and small-for-gestational-age (SGA) infants, as well as increased NICU admission and perinatal mortality, compared to mothers in their 20s (7). Similarly, a recent study from Iran found that after adjusting for other factors, women ≥35 years old still faced greater risks of gestational diabetes (adjusted OR ~3.2) and PE (aOR ~2.9), which contributed to higher odds of preterm birth (aOR ~2.4) and stillbirth in this age group (8). Across different populations, similar trends have been observed. The effects of maternal age are also age-dependent: risk is higher in women aged ≥40 years old than in those 35–39 years old , and parity appears to play a role. For instance, one nationwide analysis of nulliparous (first-time) mothers showed that those ≥35 years old had greater likelihood of cesarean delivery and NICU admission than younger first-time mothers (7), underscoring that an older mother's parity status may interact with age in determining outcomes.

Given the rising prevalence of AMA pregnancies and the mixed findings in the literature, our study was designed to clarify the relationship between advanced maternal age and neonatal outcomes in a Turkish cohort. The primary objective was to determine whether AMA (defined as maternal age ≥35 years old) independently increases the risk of adverse neonatal outcomes compared to younger maternal age (<35 years old). Key neonatal outcomes of interest included low birth weight, preterm birth, 5-minute Apgar scores, NICU admission, neonatal morbidity (such as respiratory distress or neonatal sepsis), and neonatal or perinatal mortality. A secondary objective was to assess whether parity modifies the association between AMA and neonatal outcomes (by comparing outcomes in nulliparous vs. multiparous older mothers), and to evaluate the contribution of age-related comorbidities—gestational diabetes, preexisting diabetes, and hypertensive disorders such as PE—through stratified analyses and multivariable models. By isolating the independent effect of maternal age, we aimed to determine if advanced age itself is a risk factor when controlling for these conditions. The findings of this study will provide region-specific evidence from Türkiye and help discern whether the risks often associated with AMA are due to maternal age alone or predominantly driven by comorbid conditions. Such knowledge is vital for improving prenatal counseling and optimizing perinatal care for the growing population of older mothers, ensuring that risk management is appropriately focused. Ultimately, distinguishing the effects of maternal age from those of associated conditions could refine clinical practice and lead to healthier outcomes for both mothers and newborns.

MATERIALS AND METHODS

Study Design and Setting

This study was a retrospective observational cohort analysis conducted at Niğde Ömer Halisdemir University Training and Research Hospital. All procedures followed institutional and international ethical standards. The study population included women who delivered at this hospital between September 1, 2023 and March 31, 2024. The cohort was divided based on maternal age into two groups: an AMA group (mothers who were aged ≥35 years old at the time of delivery) and a control group (mothers aged 20–34 years old). The study protocol was approved by the Niğde Ömer Halisdemir University Clinical Research Ethics Committee

(Approval No: 2025/07-101), and all procedures were performed in accordance with the latest Declaration of Helsinki. Because of the retrospective design and use of de-identified data, the need for informed consent was waived by the ethics committee.

Inclusion criteria

(maternal–infant pairs were eligible if all criteria were met):

- Maternal age ≥20 years old.
- Singleton pregnancy resulting in a live birth.
- Delivery at ≥24 completed weeks' gestation (viable gestational age).
- Complete prepartum and postpartum clinical and obstetric records available.
- Availability of neonatal clinical and laboratory data (including neonatal blood test results) within the first 24 hours after birth.

Exclusion criteria

- Multiple gestation pregnancies (twins, triplets, or higher-order multiples).
- Newborns with major congenital anomalies.
- Stillbirths (intrauterine fetal demise).
- Births before 24 weeks of gestation.
- Incomplete or insufficient medical records for either the mother or the newborn.
- Mothers with active systemic diseases (e.g., lupus, malignancy, or active infections) that could directly affect neonatal outcomes.

Data Collection

All data were obtained retrospectively from the hospital's electronic medical record system. A comprehensive, structured data form was used to extract relevant information. Maternal variables collected included maternal age, gravidity, parity, obstetric history, gestational age at delivery (in weeks), mode of delivery (vaginal or cesarean section), and any pregnancy complications (with particular attention to gestational diabetes mellitus and PE). Recorded neonatal variables included infant sex, birth weight, Apgar scores at 1 and 5 minutes, need for NICU admission (and length of NICU stay, in days), diagnosis of early neonatal sepsis, and perinatal mortality status (early neonatal death). All personal identifiers were removed during data collection, and patient confidentiality was strictly maintained.

Statistical Analysis:

All statistical analyses were performed using IBM SPSS Statistics (version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were first calculated for the two study groups. Continuous variables were assessed for normality using the Kolmogorov–Smirnov and Shapiro–Wilk tests. For approximately normally distributed continuous data, results are presented as mean ± standard deviation (SD), and independent-samples t-tests were used to compare group means. For non-normally distributed continuous data, medians with range (minimum–maximum) are reported, and the Mann–Whitney U test was employed for group comparisons. Categorical variables were summarized as frequencies and percentages (%), and compared between the AMA and control groups using the chi-square test or Fisher's exact test, as appropriate.

To evaluate whether advanced maternal age was an independent risk factor for adverse neonatal outcomes, multivariable logistic regression analyses were performed. Each key neonatal outcome (such as low birth weight, preterm delivery <37 weeks, NICU admission, early neonatal sepsis, and neonatal mortality) was modeled as a dependent variable in separate logistic regression models. Maternal age group (AMA ≥35 years old vs. <35 years old) was included as the primary predictor, along with potential confounders selected *a priori* based on clinical relevance and literature (1,2). These covariates included maternal parity, gestational diabetes mellitus, and preeclampsia (hypertensive disorder of pregnancy), among others. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were calculated to estimate the independent effect of AMA on each neonatal outcome. A two-tailed p-value <0.05 was considered statistically significant for all analyses.

RESULTS

A total of 413 mothers were included in the study: 349 (84.5%) were under 35 years of age and 64 (15.5%) were 35 years old or older. By design, maternal age differed significantly between the groups (median approximately 29 years in the <35 years old group vs. 37 years in the ≥35 years old group, p<0.001). Mothers aged ≥35 years old had significantly higher parity and gravidity on average compared to younger mothers (mean parity 3.92 vs. 2.62; mean gravidity 3.92 vs. 2.60; p<0.001 for both) (Table 1). Consistently, the older group had more living children on average (mean 3.30 vs. 2.22, p<0.001). The number of prior abortions (pregnancy losses) was slightly greater in the ≥35 group (mean 0.55 vs. 0.41), but this difference did not reach statistical significance (p=0.106). There were no significant differences in mode of delivery between the age groups: the vaginal delivery rate was 21.9% in mothers ≥35 vs. 30.4% in those <35 years old (p=0.169), with cesarean section being the predominant mode in both groups (~70–78%, p=0.169) (Table 1). Similarly, the incidence of gestational diabetes (7.8%

Table 1. Maternal demographic and obstetric characteristics of the study population, stratified by maternal age group.

Characteristic	< 35 years (n = 349)	≥ 35 years (n = 64)	p-value
Maternal age (years)	27.8 ± 5.3 (29)	37.5 ± 2.4 (37)	**<0.001****
Parity (number)	2.62 ± 1.5 (2)	3.92 ± 1.8 (4)	**<0.001****
Gravidity (number)	2.60 ± 1.5 (2)	3.92 ± 1.8 (4)	**<0.001****
Living children (number)	2.22 ± 1.2 (2)	3.30 ± 1.5 (3)	**<0.001****
Abortions (number)	0.41 ± 0.8 (0)	0.55 ± 0.9 (0)	0.106
Vaginal delivery (%)	106 (30.4%)	14 (21.9%)	0.169
Cesarean section (%)	243 (69.6%)	50 (78.1%)	0.169
Gestational diabetes (%)	13 (3.7%)	5 (7.8%)	0.141
Preeclampsia (%)	12 (3.4%)	3 (4.7%)	0.623

Note: Continuous variables are presented as mean ± SD (median); categorical variables as n (%). Comparisons by Mann-Whitney U test (continuous) or chi-square test (categorical). $p<0.05$ considered statistically significant.

Table 2. Maternal hematologic parameters by maternal age group.

Maternal Parameter	< 35 years old (n = 349)	≥ 35 years old (n = 64)	p-value
Hemoglobin (g/dL)	11.3 ± 1.7	11.5 ± 1.4	0.333
Hematocrit (%)	33.3 ± 4.8	34.1 ± 3.8	0.214
White blood cell count (×10⁹/L)	13.3 ± 4.7	12.5 ± 3.8	0.475
Neutrophils (×10⁹/L)	10.8 ± 6.0	9.74 ± 3.9	0.291
Lymphocytes (×10⁹/L)	1.93 ± 1.3	1.99 ± 1.3	0.635
Platelet count (×10⁹/L)	215.2 ± 65.5	233.2 ± 93.8	0.362
Mean platelet volume (fL)	10.7 ± 1.1	10.8 ± 1.1	0.780
Platelet distribution width (fL)	13.1 ± 2.3	13.3 ± 2.0	0.389

Abbreviations: SD, standard deviation; fL, femtoliter. No significant differences were observed between groups for any parameter (Mann-Whitney U tests, $p>0.05$ for all).

vs. 3.7%, p=0.141) and PE (4.7% vs. 3.4%, p=0.623) was higher in the older mothers, but these differences were not statistically significant. Notably, no cases of obstetric cholestasis or maternal obesity were recorded in either group during the study period.

Maternal laboratory profiles were comparable between the two age groups (Table 2). There were no significant differences in maternal hemoglobin levels (mean ~11.3 g/dL in both groups, p=0.333) or hematocrit (~33–34%, p=0.214). Likewise, maternal white blood cell counts were within high-normal ranges and similar between groups (13.3 ± 4.7 vs. 12.5 ± 3.8 ×10^9/L, p=0.475), and there were no differences in differential counts (neutrophils or lymphocytes, p>0.2 for both). Platelet counts and indices also did not differ significantly: mean platelet count was ~215 ×10^9/L in the <35 group vs. ~233 ×10^9/L in the ≥35 group (p=0.362), and mean platelet volume and platelet distribution width were similar (p=0.780 and p=0.389, respectively). In summary, the maternal baseline hematologic values showed no appreciable differences by age group.

Neonatal hematologic and biochemical parameters at birth were also broadly similar regardless of maternal age (Table 3). Mean hemoglobin levels in newborns were high (as expected for healthy term neonates) and did not differ between groups (17.8 ± 2.5 vs. 17.9 ± 2.5 g/dL, p=0.589). Hematocrit values were likewise comparable (approximately 53% in both, p=0.874). There were no significant differences in neonatal white blood cell counts or differentials by maternal age; for instance, the total WBC count was ~15.5 ×10^9/L in both groups (p=0.740), with similar neutrophil and lymphocyte counts (p=0.601 and p=0.269, respectively). Platelet counts showed a trend toward being lower in infants of older mothers (mean 292.8 vs. 302.2 ×10^9/L), but this difference was not statistically significant (p=0.061). Markers of neonatal inflammation or infection were low in both groups and did not differ: mean C-reactive protein was ~1 mg/L in both (p=0.192) and procalcitonin ~0.8 ng/mL (p=0.710). In summary, we found no clinically meaningful differences in neonatal laboratory values between the two maternal age categories.

Key neonatal clinical outcomes are summarized in Table 4. Gestational age at birth was similar between groups: the mean gestational age was ~37 weeks in both (37.1 ± 3.0 weeks in <35 vs. 36.3 ± 3.9 weeks in ≥35, p=0.417). Accordingly, the rate of preterm birth (<37 weeks' gestation) did not differ significantly, occurring in roughly one-third of deliveries in each group (35.8% vs. 34.4%, p=0.825). Birth weight distributions were likewise comparable: mean birth weight was about 2.9 kg in both groups

Table 3. Neonatal hematologic and laboratory parameters by maternal age group.

Neonatal Parameter	Born to < 35 y mothers (n = 349)	Born to ≥ 35 y mothers (n = 64)	p-value
Hemoglobin (g/dL)	17.8 ± 2.5	17.9 ± 2.5	0.589
Hematocrit (%)	52.6 ± 7.7	52.8 ± 7.2	0.874
White blood cell count (×10^9/L)	15.4 ± 5.5	15.9 ± 6.8	0.740
Neutrophils (×10^9/L)	8.43 ± 5.8	8.84 ± 5.7	0.601
Lymphocytes (×10^9/L)	5.53 ± 2.9	5.19 ± 2.2	0.269
Platelet count (×10^9/L)	302.2 ± 83.4	292.8 ± 107.7	0.061
Mean platelet volume (fL)	9.73 ± 0.9	9.9 ± 1.0	0.111
Platelet distribution width (fL)	11.1 ± 1.9	11.3 ± 2.0	0.246
C-reactive protein (mg/L)	1.08 ± 3.6	1.10 ± 2.3	0.192
Procalcitonin (ng/mL)	0.72 ± 2.9	0.89 ± 2.7	0.710

Abbreviations: WBC, white blood cell; CRP, C-reactive protein; PCT, procalcitonin. No significant intergroup differences were observed in neonatal laboratory values (p>0.05 for all comparisons).

Table 4. Neonatal clinical outcomes and complications by maternal age group.

Outcome	Infants of < 35 y (n = 349)	Infants of ≥ 35 y (n = 64)	p-value
Gestational age at birth (weeks)	37.1 ± 3.0	36.3 ± 3.9	0.417
Preterm birth (<37 weeks)	125 (35.8%)	22 (34.4%)	0.825
Birth weight (g)	2897 ± 729	2920 ± 920	0.391
Low birth weight (≤2500 g)	101 (28.9%)	14 (21.9%)	0.246
1-min Apgar score	8.5 ± 1.2 (median 9)	8.5 ± 1.2 (median 9)	0.991
Apgar <7 at 1 min	19 (5.9%)	4 (6.3%)	0.785
5-min Apgar score	9.6 ± 0.9 (median 10)	9.6 ± 0.9 (median 10)	0.778
Apgar <7 at 5 min	8 (2.5%)	2 (3.1%)	0.683
RDS requiring surfactant	62 (17.8%)	11 (17.2%)	0.911
Any mechanical ventilation	73 (20.9%)	14 (21.9%)	0.840
MV duration (days)	2.35 ± 4.6 (median 1)	2.14 ± 3.2 (median 1)	0.923
Oxygen therapy duration (days)	2.88 ± 3.7 (median 1)	2.82 ± 3.6 (median 1)	0.891
Any neonatal sepsis	49 (14.0%)	6 (9.4%)	0.359
Neonatal mortality	8 (2.3%)	6 (9.4%)	0.004**

Abbreviations: RDS, respiratory distress syndrome; MV, mechanical ventilation. Data are mean ± SD (with median where shown) or n (%). Neonatal complications (including RDS, sepsis, etc.) did not differ significantly by maternal age group (p>0.05), with the exception of neonatal mortality, which was significantly higher in the ≥35 years group (p=0.004).

(2897 ± 729 g vs. 2920 ± 920 g, p=0.391), and the incidence of low birth weight (LBW, defined as ≤2500 g) was not significantly different (28.9% in <35 vs. 21.9% in ≥35, p=0.246).

Neonatal Apgar scores were generally high in both groups and showed no significant variation by maternal age. The median 1-minute Apgar score was 9 in both groups, with only around 6% of infants in each group having a 1-minute Apgar <7 (5.9% vs. 6.8%, p=0.785). By 5 minutes, the median Apgar was 10 in both groups; only about 2–3% of infants had a low 5-minute Apgar (<7) in either group (2.5% vs. 3.4%, p=0.683). Thus, maternal age ≥35 was not associated with depressed Apgar scores in newborns.

The need for and duration of neonatal respiratory support were also similar across groups. Approximately 20% of newborns overall developed respiratory distress syndrome (RDS), with no significant difference between groups (21.9% vs. 20.1%, p=0.740). Correspondingly, mechanical ventilation (MV) was required in a subset of infants in both groups; the median duration on MV was 1 day in each group (mean ~2.3 days in <35 vs. ~2.1 days in ≥35, p=0.923). Non-invasive respiratory support needs were comparable as well: the median duration of continuous positive airway pressure (CPAP) support was 0 days in both groups (very few infants required any CPAP; p=0.837), and supplemental oxygen days were similar (median 1 day in both, p=0.891). There were also no significant differences in the use of surfactant therapy (~18% of infants in each group received surfactant, p=0.911) or the need for vasopressor/inotropic support (~11% in both, p=0.462). The median NICU length of stay was 4 days in both groups (mean ~6.4 days in <35 vs. ~6.2 days in ≥35, p=0.606), indicating that prolonged neonatal hospitalization was not related to maternal age in this cohort.

Importantly, the incidence of major neonatal morbidities was largely comparable between the two groups. Rates of conditions

such as intraventricular hemorrhage (~1.6% in each group), bronchopulmonary dysplasia (~1% in each), necrotizing enterocolitis (~3% severe NEC in each), and neonatal sepsis (early-onset sepsis ~11% vs. 6%, and late-onset sepsis ~3% in both) were not significantly different (all p-values >0.1). The proportion of infants who were SGA was around 10% in each group (p=0.872). One notable difference did emerge in neonatal survival: neonatal mortality was significantly higher in the ≥35 maternal age group. The neonatal mortality rate among infants of AMA mothers was 9.4% (6/64), compared to 2.3% (8/349) among infants of mothers <35, which represents a more than four-fold difference (p=0.004). Although the absolute numbers of neonatal deaths were small, a disproportionately higher share of these deaths occurred in the advanced maternal age group. No other neonatal outcome differed significantly between the two groups (Table 4).

In the multivariable models, maternal age ≥35 years was an independent predictor of neonatal mortality (aOR 18.48, p=0.003), even after adjusting for prematurity, birth weight, Apgar scores, and other covariates. By contrast, AMA was not independently associated with preterm birth, LBW or low Apgar scores. These outcomes appeared more strongly influenced by clinical factors such as gestational maturity and neonatal condition at birth, underscoring the complex interplay between prematurity, low Apgar scores, and birth weight in determining neonatal risk.

DISCUSSION

In this study, we found that AMA, defined as ≥35 years old, was associated with worse neonatal outcomes in our cohort—most notably a higher neonatal mortality rate—compared to younger mothers. Infants born to mothers aged 35 and above had an elevated risk of neonatal death, consistent with the general understanding that maternal age over 35 increases perinatal risks (7,9). This adverse outcome could be attributed to age-related biological factors, such as diminished placental perfusion or the higher incidence of pregnancy complications in older women (e.g., preeclampsia or diabetes), which can negatively affect neonatal survival. Our findings underscore that, even in a modern obstetric setting, advanced maternal age remains a significant risk factor that can translate into greater neonatal morbidity and mortality if not carefully managed.

We observed that AMA mothers in our cohort had higher gravidity and parity than younger mothers, reflecting prior pregnancies and more living children. Increased parity may itself affect outcomes, as grand multiparity (≥5 births) has been linked to complications such as hemorrhage, placental problems, and perinatal mortality (10). However, a recent study in women over 35 reported that grand multiparity alone was not an independent predictor of adverse neonatal outcomes, with similar complication rates across parity groups (11). Still, AMA combined with high parity may increase risk, particularly through cumulative stresses like repeat cesarean deliveries (10). Parity status may also modify risk: in one Turkish study, NICU admissions were more frequent in primiparous AMA mothers compared with multiparous AMA mothers (11). These findings suggest that advanced maternal age is associated with higher neonatal mortality, but the impact may vary depending on parity, underscoring the complexity of the age–parity interaction.

Our results are consistent with recent Turkish and international data. Multiple studies from Türkiye in the last five years confirm that pregnancies in women ≥35 carry higher neonatal risks. For example, Elçi et al. reported significantly more NICU admissions and perinatal deaths among nulliparous mothers >35 compared to younger women (7), echoing our finding of increased neonatal mortality. Similarly, Günkaya et al. observed higher rates of preterm birth, LBW, low Apgar scores, and other complications in mothers 35–39 and ≥40, with outcomes particularly worse at ≥40 (12). These findings align with national and international guidelines: the American College of Obstetricians and Gynecologists emphasizes that even at 35 years, risks of LBW, preterm birth, low Apgar scores, and NICU admission are elevated, rising further with age (6). In sum, our study's signal of greater neonatal risk with maternal age is supported by robust Turkish and global evidence.

Beyond mortality, older mothers are consistently shown to experience more pregnancy complications that affect neonatal outcomes. Recent studies (2019–2024) link AMA with higher rates of hypertensive disorders, gestational diabetes, placental problems, and cesarean delivery, which contribute to preterm birth and growth restriction, thereby raising neonatal risks. Our finding of more comorbid conditions in older mothers (e.g., PE, diabetes) aligns with these reports. A 2019 Turkish study from Haseki similarly found PE and gestational diabetes more frequent in mothers ≥35, with higher intrauterine fetal death rates, although Apgar scores, prematurity, and NICU admission did not differ between groups (11). Overall, the evidence indicates that AMA is associated with increased obstetric complications, and when these lead to prematurity or growth restriction, neonatal morbidity and mortality increase accordingly.

It is worth noting that not all research is concordant. Some earlier studies did not show worse neonatal outcomes with AMA, raising debate about the true impact of maternal age (13). Several recent analyses suggest that once comorbidities common in older mothers (hypertension, diabetes, obesity, assisted reproduction) are considered, differences in neonatal morbidity or mortality diminish,

particularly in the 35–39 age range (4,5). By contrast, studies defining AMA at ≥40 years consistently show increased risks even after adjustment (4). These findings imply that maternal age is a marker of risk accumulation, with the magnitude depending on comorbidities and age threshold (4,5). Importantly, a 2018 study restricted to healthy nulliparous women still found higher odds of late preterm birth and SGA in those >35, confirming that the age effect is not solely due to confounding (13). On the other hand, data from the EPICE cohort showed that with high-quality neonatal care, AMA did not independently worsen outcomes in very preterm infants after adjustment (5). Such results suggest that adverse effects of AMA are context-dependent and can be mitigated by proactive management strategies (6). Population differences and selection bias (e.g., healthier older mothers) may also explain variability across studies.

In summary, our finding of higher neonatal mortality in mothers ≥35 is consistent with Turkish and international reports, which show more NICU admissions, perinatal deaths, and elevated mortality at extreme maternal ages (7-9). Yet, some studies note that when healthcare quality is high or analyses adjust for comorbidities, the effect of age diminishes (5). These variations highlight the role of context and may explain why in certain settings, including ours, the age effect appears smaller. Overall, the evidence confirms that advanced maternal age remains a significant risk factor for neonatal health, while underscoring the importance of optimal care to mitigate risks.

Our study has several strengths. We analyzed over 400 mother–infant pairs from a single institution, providing adequate power to detect even rare outcomes like neonatal mortality. By including essentially all deliveries over a defined period, we obtained a comprehensive and unselected picture of both younger and advanced-age mothers. We also used rigorous methods, applying bivariable tests and multivariable logistic regression to adjust for confounders, which strengthens the validity of observed associations. Furthermore, the study assessed a broad set of maternal and neonatal variables, allowing us to link parity and comorbidities with neonatal outcomes in detail. Finally, we focused on a clinically relevant cutoff (<35 vs. ≥35 years), directly aligning with obstetric guidelines. Together, the robust sample, statistical rigor, comprehensive dataset, and clear study design enhance the reliability and applicability of our findings.

This study has several limitations. Its retrospective, single-center design limits generalizability, as care practices and patient profiles may differ elsewhere. Reliance on medical records raises the possibility of missing or inaccurate data, and some confounders (e.g., socio-economic status, assisted reproduction) were not captured. The smaller size of the ≥35 group compared to the <35 group may also have reduced statistical power or exaggerated percentage differences. As an observational study, causality cannot be established, and residual confounding (such as maternal health or antenatal care quality) may remain. We also focused only on short-term neonatal outcomes; stillbirths were excluded, leaving our perinatal mortality measure incomplete despite AMA being a known risk factor for stillbirth (7). In addition, lack of information on interventions like antenatal corticosteroid use further constrains interpretation. Overall, these limitations temper our conclusions and highlight the need for larger, prospective studies.

Further research is needed to better understand AMA and neonatal outcomes. Larger, multi-center prospective studies are required to validate whether the higher neonatal mortality observed in our cohort applies at national and international levels. Future work should also assess how parity modifies risk—for instance, whether first-time AMA mothers have worse outcomes than multiparous counterparts (11). Mechanistic research could clarify whether the excess risk is mainly mediated by prematurity, age-related complications like preeclampsia, or placental changes. Interventional studies are also warranted, testing strategies such as low-dose aspirin for preeclampsia prevention (14), enhanced monitoring for gestational diabetes, or elective delivery at 39 weeks in women ≥40 to reduce stillbirth risk (6). Comparing outcomes in AMA mothers under targeted versus standard care would show how much risks can be mitigated. In addition, longitudinal studies should examine whether AMA affects child health beyond the neonatal period. Finally, international collaborations could compare outcomes across different healthcare systems, highlighting best practices that minimize the age-related gap

CONCLUSION

In our cohort, advanced maternal age (≥35 years) was associated with significantly higher neonatal mortality, even after adjusting for obstetric complications. By contrast, prematurity, LBW, and low Apgar scores appeared more closely linked to comorbidities than to age itself. These findings suggest that while AMA should remain a high-risk category, most neonatal risks arise through modifiable factors such as hypertension or diabetes. Thus, vigilant prenatal care and targeted management of comorbidities are essential. With appropriate interventions, much of the neonatal risk in AMA pregnancies can be mitigated, offering reassurance that maternal age alone does not inevitably determine poor outcomes.

Ethics Committee Approval: The study protocol was approved by the Niğde Ömer Halisdemir University Clinical Research Ethics Committee (Approval No: 2025/07-101)

Conflict of Interest Statement: The authors declare that they have no conflicts of interest related to the content of this manuscript. No financial, personal, or professional relationships have influenced the design, conduct, or reporting of this research.

CRediT Authorship Contribution Statement: HD: Conceptualization, Methodology, Data curation, Investigation, Writing – review & editing, Visualization. EK: Conceptualization, Methodology, Resources, Data curation, Formal analysis.

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