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Perinatal Consequences of Later-Life Motherhood in Tanzania: Evidence Drawn from the Kilimanjaro Christian Medical Center Birth Registry

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ABSTRACT

With the steady rise in births among women of advanced maternal age (AMA), it has become essential to examine how AMA influences pregnancy outcomes in northern Tanzania, a region where healthcare capacity and access remain limited. This investigation evaluated the relationship between AMA and maternal–fetal outcomes within this resource-restricted setting. Using data from the maternally linked Kilimanjaro Christian Medical Center (KCMC) Medical Registry, the study assessed 32,798 singleton deliveries documented between 2004 and 2013. Multiple logistic regression analyses generated adjusted odds ratios (aORs) and 95% confidence intervals (CIs) to quantify the risk of adverse outcomes associated with AMA. Approximately 16% of the cohort fell into the AMA category, and this group showed significantly higher probabilities of cesarean delivery (aOR 1.32; 95%CI 1.24–1.41; $P < 0.001$), gestational diabetes (aOR 13.16; 95%CI 3.28–52.86; $P < 0.001$), pregestational diabetes (aOR 3.15; 95%CI 1.87–5.31; $P < 0.000$), and pre-eclampsia (aOR 1.63; 95%CI 1.41–1.89; $P < 0.000$). Compared with younger mothers, those in the AMA group more often reported consuming alcohol during pregnancy and had a greater prevalence of preexisting health conditions before conception. Maternal factors such as education, employment, urban living, and Christianity also showed significant associations. Overall, the findings indicate that AMA is strongly linked to heightened risks of cesarean section, diabetes (gestational and pregestational), and pre-eclampsia, alongside increased likelihoods of low birth weight, stillbirth, and NICU admission.

Keywords: Apgar score, Perinatal birth outcome, Perinatal maternal outcome, Sub-Saharan Africa

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Introduction

Women categorized under advanced maternal age (AMA) are defined as those who reach delivery at 35 years or older. Evidence from high-income countries indicates that the proportion of AMA pregnancies has risen markedly over the last three to four decades [1]. In contrast, information from low-resource settings—particularly sub-Saharan Africa—remains fragmented and insufficient. Globally, the proportion of AMA varies widely, from 2.8% in Nepal to 31.1% in Japan, while a multicountry analysis by the World Health Organization (WHO) reported an overall AMA prevalence of 12.3% [2]. Additional findings from South Africa show a prevalence of 17.7% and a mean maternal age of 38.1 years among AMA pregnancies, whereas data from Yaoundé, Cameroon, indicate a prevalence of 3%.

Several factors contribute to conception at AMA, including postponing marriage for professional advancement, opportunities for higher education, increased empowerment of women, broader access to reliable contraception, and country-specific population policies [3, 4]. Improvements in Assisted Reproductive Technologies (ART) have also expanded fertility options for women of older reproductive age [5]. Despite these shifts, women with AMA can still achieve favorable pregnancy outcomes and manage the emotional and physical demands of parenthood comparably to younger women [6].

Adverse outcomes associated with late pregnancies frequently arise from underlying chronic illnesses—including cancers, cardiovascular disease, renal and autoimmune disorders, and obesity [7]—as well as obstetric complications such as antepartum hemorrhage (including placenta previa, placental abruption, and vasa previa) [8], pregnancy-induced hypertension (PIH), and gestational diabetes mellitus (GDM) [9, 10]. AMA further elevates the likelihood of low birth weight, preterm delivery, unexplained fetal death, neonatal mortality, complications linked to ART, higher cesarean section rates, and maternal death [11, 12].

Stillbirth and neonatal death

Systematic reviews synthesizing evidence from 63 cohort studies and 12 case-control studies demonstrate a clear association between increasing AMA and stillbirth risk [13]. Another investigation showed a progressive rise in the relative risk (RR) of stillbirth as maternal age increased—RR = 1.23 for ages 30–34 and RR = 1.4 for ages 35–39 compared with the 20–29 age group [14]. Preterm birth represents another major concern, with data from California indicating that women in advanced age groups are twice as likely to deliver preterm based on obstetric gestational age estimates. Comparable trends have been documented in China, where higher preterm delivery rates among older mothers have also been reported [7, 15].

Congenital anomalies and rate of cesarean section

A broad range of studies has identified links between AMA and congenital anomalies [8, 16]. Pregnancies in older women are also associated with several obstetric challenges, including elevated cesarean section rates, breech presentation, antepartum hemorrhage, pre-eclampsia and eclampsia, as well as worsening of preexisting medical problems [9, 17]. A systematic review from developed countries exploring the relationship between AMA and cesarean delivery found that both nulliparous and multiparous advanced-age women had a markedly greater risk of cesarean birth compared to younger women, with relative risks ranging from 1.39 to 2.76 [17, 18].

Abnormal placentation

The association between AMA and abnormal placentation has also been highlighted in several studies. Research from China reported an increased likelihood of placenta previa among women of advanced maternal age [7].

Tanzania's demographic structure is shifting, with a growing proportion of older adults—including women of reproductive age. As childbearing is increasingly postponed, complications associated with AMA—including gestational diabetes, hypertensive disorders, placenta previa, and fetal distress—are likely to place greater demands on maternal and child health services. Managing these complications often requires specialized care and costly interventions, making them particularly impactful in regions with limited healthcare resources.

Access to reproductive healthcare in many parts of Africa is constrained, especially in rural settings, where delays in receiving prenatal care or emergency services exacerbate risks for pregnant women. Infants born to older mothers face higher risks of genetic abnormalities, developmental delays, and various health conditions, all of which may contribute to long-term financial and societal burdens for Tanzania's healthcare system.

Although Tanzania has extensively examined teenage pregnancies, data on AMA remain extremely limited. To date, no studies in the country have specifically explored adverse outcomes associated with AMA. Given this knowledge gap, robust, multi-regional studies are needed to clarify regional differences and establish causal pathways.

The North Kilimanjaro region—known for its stronger economy and higher educational attainment relative to other areas of Tanzania—offers a valuable setting for exploring how AMA trends may differ across populations. Findings from this region can provide an important reference point for broader national research and inform maternal and child health policy development. Across sub-Saharan Africa more broadly, existing evidence on AMA outcomes is scarce and largely limited to small-scale descriptive research.

In response to these gaps, the present study aimed to examine the relationship between AMA and perinatal outcomes among women in northern Tanzania.

Table 1. Characteristics of the study participants by maternal age groups (N = 32,798).
Abbreviation: ANC, antenatal care.

Problem or Issue	What is Already Known	What this Paper Adds
Consequences of Advanced Maternal	Prior research on AMA has predominantly originated	This study demonstrates how AMA influences pregnancy outcomes in northern Tanzania, where healthcare access and

Age (AMA) on pregnancy outcomes in a resource-constrained setting in northern Tanzania.	from high-income countries with well-established healthcare systems.	infrastructure are limited. It identifies heightened risks for both maternal and neonatal complications and documents socio-behavioral patterns linked to AMA—including increased alcohol consumption during pregnancy, higher educational attainment, employment, residence in urban locations, and religious background.
Scarcity of detailed evidence from low-resource countries.	Established literature associates AMA with elevated likelihood of cesarean delivery, gestational diabetes, pre-eclampsia, and adverse neonatal outcomes.	The study shows that these risks are amplified in northern Tanzania's healthcare context. It also identifies additional demographic and clinical associations specific to this population, such as a higher prevalence of preexisting health conditions and greater alcohol use among older pregnant women.

Materials and Methods

Participants and procedures

This investigation employed a cross-sectional analytical design and drew upon maternally linked records maintained within the Kilimanjaro Christian Medical Center (KCMC) Medical Birth Registry. The analysis encompassed women aged 20 years and above who gave birth to singleton infants at KCMC between January 2004 and December 2013, with an additional emphasis on those ≥35 years, who constituted the advanced maternal age (AMA) group.

KCMC functions as a major referral and teaching institution in Tanzania, receiving obstetric patients not only from its immediate surroundings but also from the broader Kilimanjaro, Arusha, Manyara, Tanga, and Singida regions, as well as cross-border areas of Kenya. The facility contains 450 beds and routinely oversees 4,000–4,800 annual deliveries.

Pregnancies involving multiple fetuses were not included. AMA represented the primary outcome variable, whereas maternal occupation, marital status, educational attainment, parity, preexisting non-communicable disease, and a range of maternal and perinatal complications were examined as exposure variables. Maternal outcomes consisted of cesarean section, hypertensive disorders of pregnancy (including pre-eclampsia, eclampsia, and pregnancy-induced hypertension), gestational diabetes mellitus (GDM), spontaneous preterm labor, miscarriage, antepartum and postpartum hemorrhage, and maternal death. Perinatal indicators included intrauterine fetal demise, Apgar score status, prematurity, growth-related abnormalities such as low birth weight, small-for-gestational-age, large-for-gestational-age, and the presence of congenital malformations.

Measures

The KCMC Medical Birth Registry, initiated in 1999 and fully implemented by 2000, operates as a prospective surveillance system for all births occurring within the hospital. Trained midwife-nurses collect maternal and neonatal information through structured interviews conducted within 24 hours postpartum, or following stabilization after complicated deliveries. Infants requiring specialized care in the neonatal intensive care unit (NICU) are also documented using standardized procedures.

For the present study, previously recorded registry data from the 2004–2013 period were retrieved using a predefined abstraction checklist. Demographic variables, clinical events, and immediate maternal and neonatal complications were extracted. Institutional approval was obtained, and verbal informed consent had been secured at the time the original interviews were conducted.

Data analysis

All analyses were conducted using IBM SPSS Statistics version 20.0. Categorical variables were described using proportions, whereas continuous measurements were summarized through averages and corresponding measures of variation. Group differences in continuous variables were examined via the Student's t-test, and categorical associations were assessed using the χ^2 test.

The relationship between AMA and adverse maternal or perinatal outcomes was evaluated using multivariable logistic regression, generating odds ratios (ORs) and 95% confidence intervals (CIs). A threshold of $P < 0.05$ (two-sided) was used to determine statistical significance.

Normality assessments were carried out using the Kolmogorov–Smirnov and Anderson–Darling tests. These diagnostics informed the selection of statistical procedures, which ultimately supported the use of parametric methods due to acceptable distribution characteristics.

Results and Discussion

Characteristics of the study population

A total of 32,798 women satisfied the inclusion criteria. The majority (27,499; 84%) were under 35 years of age, with a mean age of 26.82 ± 4.05, whereas 5299 (16%) fell within the AMA category, averaging 37.56 ± 2.45 years. Most participants reported primary-level education, and nearly two-thirds (21,585; 65.8%) indicated that they were unemployed. Marriage was the predominant marital status, accounting for 29,260 (89.2%) of the women.

Compared with younger women, those classified as AMA exhibited notably higher levels of alcohol consumption during pregnancy and a greater burden of preexisting health conditions. Statistically significant differences were also observed in several socio-demographic indicators: older mothers were more likely to have attained education beyond the primary level, to hold formal employment, and to reside in urban settings **(Table 1)**.

Table 1. Characteristics of the study participants by maternal age groups (N = 32,798). Abbreviation: ANC, antenatal care.

Characteristics	Total	Maternal age, y		χ^2 *P*
		20–34, n (%)	≥35, n (%)	
Mother's education				
None	546	442 (2)	104 (2)	<0.001
Primary (Grade 1–7)	17,895	14,725 (54)	3170 (60)	
Secondary (Grade 8–11)	3036	2679 (10)	357 (7)	
Higher (Grade 12+)	11,216	9570 (35)	1646 (31)	
Occupation				
Unemployed	21,585	18,086 (66)	3499 (66)	<0.001
Employed	8678	7133 (26)	1545 (29)	
Other	2495	2253 (8)	242 (5)	
Marital status				
Married	29,260	24,339 (89)	4921 (81)	<0.001
Single	3357	3024 (11)	333 (19)	
Alcohol use in pregnancy				
Yes	8518	6714 (24)	1804 (34)	<0.001
No	24,164	20,695 (76)	3469 (66)	
Residence				
Rural	12,613	10,169 (37)	2444 (46)	<0.001
Urban	20,106	17,269 (63)	2837 (54)	
Pregestational diabetes				
Yes	18,766	15,632 (57)	3134 (59)	0.001
No	13,992	11,840 (43)	2152 (41)	
Attended ANC in pregnancy				
Yes	32,509	27,265 (99)	5244 (99)	0.88
No	169	141 (1)	28 (1)	
Religion				Religion
Christian	25,829	21,513 (79)	4316 (82)	<0.001
Muslim	6738	5795 (21)	943 (18)	

Prevalence of AMA at KCMC from 2014 to 2022

Within the analyzed cohort, 16% of deliveries involved women classified as advanced maternal age (≥35 years), totaling 5299 participants. This indicates that roughly one in six women giving birth at KCMC during the study period belonged to the AMA category, as depicted in **Figure 1**.

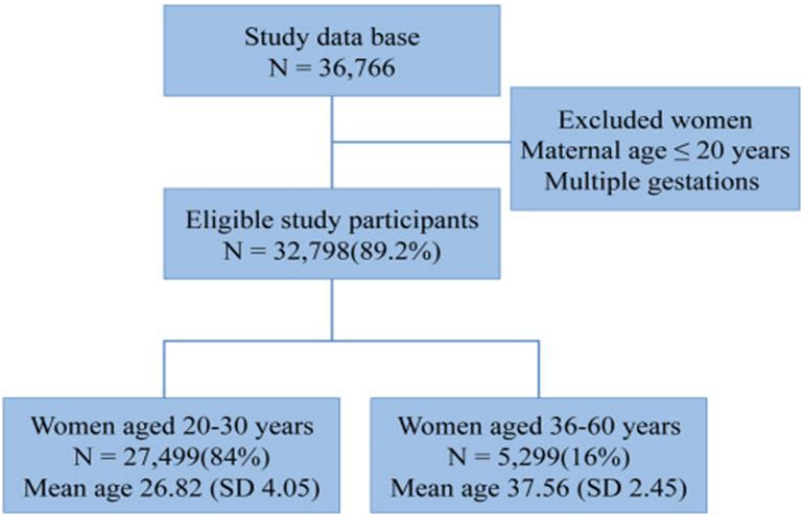

Figure 1. Study flow chart.

Proportion of deliveries among age groups

During the study period, the total number of births grew across both younger and advanced maternal age groups **(Figure 2)**. Starting in 2011, however, the share of deliveries among women aged 35 years and above rose sharply, overtaking that of younger mothers and maintaining a consistently higher proportion in the following years.

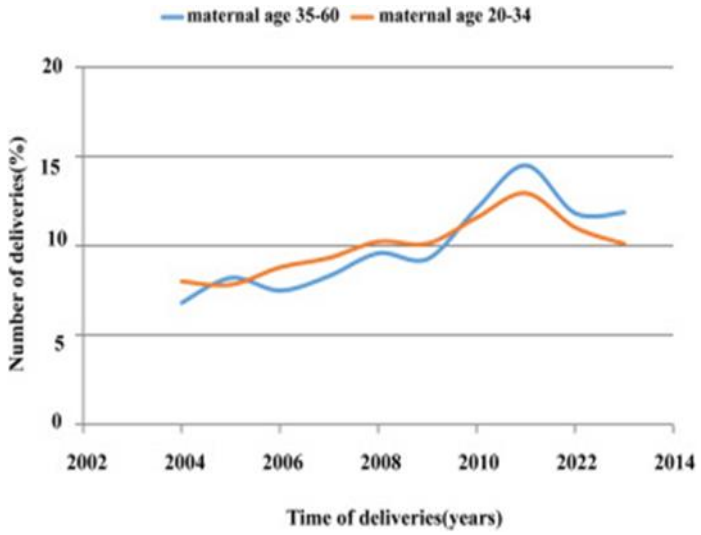

Figure 2. Proportion of deliveries among age groups.

Maternal outcomes (obstetrics) associated with AMA

Analysis revealed that advanced maternal age (AMA) was strongly linked to several obstetric complications. Older mothers exhibited higher rates of cesarean delivery, gestational diabetes, pregestational diabetes, and pre-eclampsia compared with women under 35 years **(Table 2)**. Specifically, women undergoing cesarean section were approximately 3.9 times more likely to belong to the AMA group (OR 3.86; 95% CI 1.30–1.49; $P < 0.001$), while the risk of gestational diabetes was over 10-fold greater among AMA women (OR 10.29; 95% CI 2.57–41.18; $P < 0.001$). Pre-eclampsia risk was also elevated, with older mothers showing 1.67 times higher odds. Although maternal death appeared more frequent in the AMA group, this difference did not achieve statistical significance.

After adjusting for maternal age, alcohol consumption, urban versus rural residence, and antenatal care visits,

multivariable logistic regression confirmed that AMA remained an independent predictor for key obstetric outcomes. The adjusted odds for cesarean section among AMA women were 1.32 times higher than in younger mothers (aOR 1.32; 95% CI 1.24–1.41; P < 0.001). The risk of gestational diabetes remained substantially increased (aOR 13.16; 95% CI 3.28–52.86; P < 0.001), and pregestational diabetes was over three times more likely in AMA women (aOR 3.15; 95% CI 1.87–5.31; P < 0.001). Detailed outcomes for other maternal complications are presented in **Table 2**.

Table 2. Association between advanced maternal age (≥35 years) and selected maternal outcomes (N = 32,798 pregnancies)

Outcome	Total events	Women aged 20–34 years (n = 27,499)	Women aged ≥35 years (n = 5,299)	Crude OR (95% CI)	Adjusted OR (95% CI)
Cesarean delivery					
No	21,776*	18,578 (67.7%)	3,198 (60.5%)	Reference	Reference
Yes	10,936	8,849 (32.3%)	2,087 (39.5%)	1.39 (1.30–1.49)	1.32 (1.24–1.41)
Gestational diabetes					
No	32,789	27,496 (100.0%)	5,293 (99.9%)	Reference	Reference
Yes	9	3 (0.01%)	6 (0.11%)	10.29 (2.57–41.18)	13.16 (3.28–52.86)
Pre-gestational diabetes					
No	32,733	27,461 (99.9%)	5,272 (99.5%)	Reference	Reference
Yes	65	38 (0.14%)	27 (0.51%)	3.58 (2.15–5.98)	3.15 (1.87–5.31)
Pre-eclampsia					
No	31,528	26,539 (96.5%)	4,989 (94.1%)	Reference	Reference
Yes	1,270	960 (3.5%)	310 (5.9%)	1.67 (1.45–1.92)	1.63 (1.41–1.89)

Analyses were adjusted for maternal alcohol consumption, area of residence, and the number of antenatal care visits.
* Some data were missing. Abbreviations used: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

Advanced maternal age and perinatal complications

Table 3 presents the results of multivariable logistic regression evaluating the influence of gestational age at delivery, placental abruption, premature rupture of membranes, and gestational diabetes mellitus (GDM) on adverse perinatal outcomes, including low birth weight, Apgar scores at 1 and 5 minutes, NICU admission, and stillbirth. The analysis revealed that infants with a low 1-minute Apgar score were significantly more likely to be born to mothers of advanced maternal age (AMA) compared with younger mothers (OR: 1.28; 95% CI: 1.15–1.42; P < 0.001). Moreover, AMA increased the probability of a low 5-minute Apgar score by 70% relative to the younger reference group (OR: 1.70; 95% CI: 1.62–2.79; P < 0.001). Women of AMA also had a modestly higher chance of giving birth to low-birth-weight infants (aOR: 1.18; 95% CI: 1.07–1.31; P < 0.001), a 23% greater likelihood of their newborns requiring NICU care (aOR: 1.23; 95% CI: 1.10–1.36; P < 0.001), and were 1.47 times more likely to experience stillbirth (aOR: 1.47; 95% CI: 1.12–1.92; P < 0.005). Further details of these associations are provided in **Table 3**.

Table 3. Association between advanced maternal age (≥35 years) and selected perinatal outcomes (N = 32,798 pregnancies)

Perinatal outcome	Total events	Women aged 20–34 years (n = 27,499)	Women aged ≥35 years (n = 5,299)	Crude OR (95% CI)	Adjusted OR (95% CI)
Low birth weight (<2.5 kg)					
No	*28,650	24,157 (88.6%)	4,493 (85.7%)	Reference	Reference
Yes	3,850	3,103 (11.4%)	747 (14.3%)	1.32 (1.20–1.45)	1.18 (1.07–1.31)
Apgar score <7 at 1 minute					
No	*29,467	24,803 (90.9%)	4,664 (88.8%)	Reference	Reference

Yes	3,080	2,494 (9.1%)	586 (11.2%)	1.28 (1.15–1.42)	0.86 (0.71–1.05)
Apgar score <7 at 5 minutes					
No	*30,550	25,725 (94.0%)	4,825 (92.0%)	Reference	Reference
Yes	2,028	1,599 (6.0%)	429 (8.0%)	1.70 (1.62–2.79)	0.84 (0.65–1.09)
NICU admission					
No	*28,217	23,763 (87.0%)	4,454 (84.0%)	Reference	Reference
Yes	4,475	3,647 (13.0%)	828 (16.0%)	1.26 (1.15–1.38)	1.23 (1.10–1.36)
Stillbirth					
No	31,598	26,579 (97.0%)	5,019 (95.0%)	Reference	Reference
Yes	1,200	920 (3.0%)	280 (5.0%)	1.63 (1.39–1.92)	1.47 (1.12–1.92)

Analyses were adjusted for gestational age at delivery, placental abruption, premature rupture of membranes, and gestational diabetes.
*Some data were missing. Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval; LBW, low birth weight; NICU, neonatal intensive care unit.

This study investigated the impact of advanced maternal age (AMA) on pregnancy outcomes among women delivering at the Kilimanjaro Christian Medical Center (KCMC) in northern Tanzania. Analysis of this large cohort revealed that AMA was significantly associated with increased risks of gestational diabetes, pre-eclampsia, cesarean delivery, low birth weight, NICU admission, and stillbirth, even after adjusting for maternal characteristics and obstetric history.

The prevalence of AMA in our cohort was 16%, aligning with reports from Southern Ethiopia (29.5%) and Spain (26.2%) for women aged 35–40 years, with 3.1% for those over 40. Slightly higher rates observed in Ethiopia and Spain may reflect greater access to advanced reproductive technologies and higher educational levels during the respective study periods. Conversely, some studies report lower prevalence estimates, particularly when only women aged 40 and above are considered—for instance, a study from Turkey reported 7.1% prevalence [19].

Our findings demonstrated a notable increase in gestational diabetes mellitus (GDM) among AMA women. The diagnosis in this study was based solely on fasting and random blood glucose levels, which could have led to misclassification. Nonetheless, the rising prevalence of GDM likely parallels trends in obesity and undiagnosed type 2 diabetes, consistent with meta-analyses from Saudi Arabia, Spain, and China [4, 11, 20, 21].

The risk of pre-eclampsia was elevated by 63% among AMA women, a finding comparable to studies in Northern Ethiopia, Spain, and South Korea [10, 11, 22]. This association may partly reflect unmeasured factors such as preexisting medical conditions or sedentary lifestyles, which were not captured in our database, limiting causal interpretation.

Consistent with prior research in Spain and the USA [17, 21], AMA was associated with a 32% higher likelihood of cesarean delivery. Factors contributing to this trend may include maternal or fetal complications, history of adverse obstetric events, or clinical concerns regarding fetal size and intrauterine outcomes. However, the absence of information on previous cesarean sections in the database represents a limitation in fully understanding these associations.

Regarding perinatal outcomes, AMA was linked to a 47% increased risk of stillbirth and a 23% higher likelihood of NICU admission, along with greater incidence of low birth weight. Similar patterns have been reported in China, Spain, and Southern Ethiopia [11, 12, 21, 23]. These adverse outcomes may result from complications such as GDM and pre-eclampsia, which can precipitate preterm birth or other neonatal challenges.

A major strength of this study is the large dataset, which allowed for robust analysis and adjustment for multiple confounding factors. Nonetheless, several limitations should be acknowledged. As a tertiary referral hospital-based study, there is potential selection bias, as women with complicated pregnancies are more likely to be represented. Some data were also missing, although the large sample size likely mitigates the impact on overall findings.

Additionally, the study could not account for variables such as parity, prior cesarean delivery, and other unavailable obstetric histories, which may influence the observed associations. The contribution of these factors to maternal and perinatal outcomes warrants further investigation.

Conclusion

Delivery at advanced maternal age is associated with a heightened risk of cesarean section, pre-eclampsia, gestational and pregestational diabetes, as well as adverse neonatal outcomes including low birth weight, stillbirth, and NICU admission. These findings emphasize the importance of risk awareness and counseling for healthcare providers managing pregnancies in AMA women.

Effective risk stratification and preparedness are essential for optimizing maternal and neonatal outcomes. Further research is needed to clarify causal relationships between AMA and adverse pregnancy outcomes.

Our results also suggest the need for enhanced screening protocols for pre-eclampsia, gestational diabetes, and overt diabetes in all AMA pregnancies, alongside vigilant intrapartum monitoring to allow early identification and timely intervention for complications.

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