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Research Paper

Advanced maternal age and adverse obstetrical and neonatal outcomes of singleton pregnancies

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ABSTRACT

Objective: To assess the impact of advanced maternal age on pregnancy and childbirth outcomes of singleton pregnancies.

Study design: We retrospectively assessed singleton pregnant mothers who gave birth at Khaleej-e-Fars Hospital in Bandar Abbas, Iran, from January 2020 to January 2022. Demographic and obstetrical factors include educational level, medical insurance, residency place, access to prenatal care facilities, number of prenatal care visits, smoking status, gestational age, parity, infertility, maternal comorbidities, preeclampsia, eclampsia, preterm birth, low birth weight (LBW), intrauterine growth restriction (IUGR), macrosomia, placenta abnormalities (previa/acreta), placenta abruption, chorioamnionitis, meconium fluid, fetal distress, methods of delivery, rate of cesarean section (CS), perineal lacerations, postpartum hemorrhage, childbirth injury, shoulder dystocia, congenital malformation, neonatal asphyxia, and unfavorable maternal and neonatal outcome were compared between two groups. The Chi-square test assessed the relationship between categorical factors and maternal age groups. The influence of advanced maternal age on the risk of unfavorable pregnancy outcomes was evaluated using bivariate and multivariate logistic regression.

Results: Of 8354 singleton deliveries, 22.2% belonged to advanced-age mothers. Advanced-age mothers had less education than those aged 20–34 years old. Chronic hypertension, cardiovascular disease, overt diabetes, and thyroid dysfunction were more prevalent among advanced-age mothers. Compared with mothers aged 20–34 years, mothers aged 35 years and higher had a significantly higher risk of gestational diabetes (aOR: 3.18, 95%CI: 1.56–6.95), preeclampsia (aOR: 2.91, 95%CI: 1.35–4.72), placenta abnormalities (aOR: 1.09, 95%CI: 0.77–1.94), CS (aOR: 3.16, 95%CI: 1.51–3.87), postpartum hemorrhage (aOR: 1.94, 95%CI: 1.24–2.61), intensive care unit admission (aOR: 1.36, 95% CI: 1.15–1.99), LBW (aOR: 1.35, 95%CI: 0.97–2.96), preterm birth (aOR: 2.36, 95%CI: 1.65–4.83), stillbirth (aOR: 1.18, 95%CI: 1.01–3.16), and neonatal intensive care admission (aOR: 2.09, 95%CI: 0.73–3.92). According to bivariate regression, the risk of meconium fluid was lower in advanced-age mothers; however, the result of multivariate logistic regression found no correlation between advanced age and the Incidence of meconium fluid.

Conclusion: Advanced-age mothers are at increased risk of adverse pregnancy and childbirth outcomes, which persist even after adjusting for several potential confounders.

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1. Introduction

The exact age at which adverse pregnancy and childbirth outcomes for advanced-age mothers become significant is unknown. Some studies claim that the association only becomes significant after 35 years old.[1] Many countries have seen significant increases in maternal age at childbirth over the last three decades.[2,3] Lower fertility, a greater need for assisted reproductive therapy, and increased comorbidities such as hypertension and diabetes are among the factors contributing to the rise in adverse maternal and fetal outcomes.[4] Several studies on the impact of advanced age on pregnancy outcomes produced contradictory results due to differences in study group homogeneity and insufficient control for variables such as maternal diseases, assisted conception, obesity, multiple pregnancies, and parity.[3,5] This study aims to assess the impact of advanced maternal age on pregnancy and childbirth outcomes of singleton pregnancies.

2. Material and methods

We retrospectively assessed singleton pregnant mothers who gave birth at Khaleej-e-Fars Hospital in Bandar Abbas, Iran, between January 1st, 2020, and January 1st, 2022. Data were extracted by trained collectors from the "Iranian Maternal and Neonatal Network (IMaN Net)," a valid national system, using electronic patient records. These pregnant mothers were separated into two groups based on their age[1]: Advanced-age group: mothers aged 35 and older at the time of delivery[2]; Adults group: mothers aged 20–34 years at the time of delivery. Demographic and obstetrical factors include educational level, medical insurance, residency place, access to prenatal care facilities, number of prenatal care visits, smoking status, gestational age, parity, infertility, maternal comorbidities (including anemia, cardiovascular disease, thyroid dysfunction, chronic hypertension, overt diabetes, infertility, COVID-19, and hepatitis), preeclampsia, eclampsia, preterm birth, LBW, intrauterine growth restriction (IUGR), macrosomia, placenta abnormalities (previa/acreta), placenta abruption, chorioamnionitis, meconium fluid, fetal distress, methods of delivery, rate of cesarean section (CS), perineal lacerations, postpartum hemorrhage, childbirth injury, shoulder dystocia, congenital malformation, neonatal asphyxia, and unfavorable maternal and neonatal outcome were compared between two groups.

The IBM Statistical Package for the Social Sciences Statistics, version 25, was used to examine the data (IBM Corp, Armonk, NY). Categorical variables were expressed as percentages. The Chi-square test assessed the relationship between categorical factors and maternal age groups. The influence of advanced maternal age on the risk of unfavorable pregnancy outcomes was evaluated using bivariate and multivariate logistic regression. Logistic regression models were used to assess the influence of advanced maternal age on adverse pregnancy and childbirth outcomes (preeclampsia, chorioamnionitis, gestational diabetes, placenta abruption, placenta previa, meconium fluid, fetal distress, preterm labor, LBW, IUGR, rate of CS, shoulder dystocia, perineal lacerations, childbirth injury, congenital malformation, postpartum hemorrhage, intensive care unit admission, maternal death, and unfavorable neonatal outcome including stillbirth, neonatal intensive care unit admission, neonatal death), After adjusting for covariates (living place, education, medical insurance, access to prenatal care facilities, parity, fetal presentation, history of previous CS, and smoking). The result was presented as odds ratio (OR) or adjusted odds ratio (aOR) and 95% confidence interval (CI). $P < 0.05$ was considered statistically significant, and all statistical tests were two-tailed.

3. Results

During the study period, 8354 singleton deliveries occurred. Of these, 6499 (77.8%) pregnant mothers belonged to the adult group (20–34 years old), and 1855 (22.2%) pregnant mothers were advanced (35 years and older). All mothers in both groups were married. 8138 (97.4%) mothers were Iranian, while 216 (2.6%) were non-Iranian. Demographic and clinical characteristics are described by age groups in Table 1.

Table 1
Demographic characteristics of advanced-age mothers and aults n (%)

Demographic charectristics	Total (n = 8354)	Advanced-age (n = 1855)	Adults (n = 6499)	*P*-value
Educational level				<0.001
Illiterate	521 (6.2)	150 (8.1)	371 (5.7)	
Elementary	2474 (29.6)	734 (39.5)	1740 (26.8)	
High school	673 (8.1)	105 (5.7)	568 (8.7)	
Diploma	3184 (38.1)	569 (30.7)	2615 (40.2)	
Advanced	1501 (18)	297 (16)	1204 (18.5)	
Residency place				0.072
Urban	5517 (66)	1208 (65.1)	4309 (66.3)	
Rural	2837 (34)	647 (34.9)	2190 (33.7)	
Medical insurance				0.407
Yes	8020 (96)	1773 (95.6)	6247 (96.1)	
No	334 (4)	82 (4.4)	252 (3.9)	
Access to prenatal care				0.874
Yes	8272 (99)	1834 (98.9)	6438 (99.1)	
No	82 (1)	21 (1.1)	61 (0.9)	
Smoking				0.057
Yes	52 (0.6)	34 (1.8)	18 (0.3)	
No	8267 (98.9)	1820 (98.1)	6447 (99.2)	
Unknown	45 (0.5)	11 (0.6)	34 (0.5)	

Among sociodemographic factors, educational level was the only factor significantly different between groups. Advanced-age mothers had less education than adults ($p < 0.001$).

As shown in Fig. 1, chronic hypertension, cardiovascular disease, overt diabetes, and thyroid dysfunction were more prevalent among advanced-age mothers ($p < 0.05$).

The obstetrical factors and maternal and neonatal outcomes between adults and advanced age were compared (Table 2). A significant proportion of advanced-age mothers were multiparous compared to adults (83.1% vs. 69.3%). Regarding adverse pregnancy outcomes, gestational diabetes, preeclampsia, and placenta abnormalities (previa/acreta) were significantly higher in advanced-age mothers. The delivery method was significantly different between advanced-age and adult groups, with a higher rate of CS among advanced-age (43.8% vs. 31.2%). Adverse prenatal outcomes, including preterm birth, postpartum hemorrhage, and maternal transfer to the intensive care unit following childbirth, were more common in advanced-age. Regarding neonatal outcomes, the frequency of LBW, stillbirth, and neonatal intensive care unit admission in advanced-age mothers was higher than in adults. The Incidence of meconium fluid was less in advanced age than in adults (9.8% vs. 12.5%).

Table 3 represents the impact of advanced maternal age on adverse events of pregnancy and childbirth based on logistic regression analysis. Compared with mothers aged 20–34 years, advanced-age mothers had a significantly higher risk of gestational diabetes (aOR: 3.18, 95%CI: 1.56–6.95), preeclampsia (aOR: 2.91, 95%CI: 1.35–4.72), placenta abnormalities (aOR: 1.09, 95%CI: 0.77–1.94), CS (aOR: 3.16, 95%CI: 1.51–3.87), postpartum hemorrhage (aOR: 1.94, 95%CI: 1.24–2.61), intensive care unit admission (aOR: 1.36, 95% CI: 1.15–1.99), LBW (aOR: 1.35, 95%CI: 0.97–2.96), preterm birth (aOR: 2.36, 95%CI: 1.65–4.83), stillbirth (aOR: 1.18, 95%CI: 1.01–3.16), and neonatal intensive care admission (aOR: 2.09, 95%CI: 0.73–3.92). According to bivariate regression, the risk of meconium fluid was lower in advanced-age mothers; however, the result of multivariate logistic regression found no correlation between advanced age and the Incidence of meconium fluid.

4. Discussion

Based on our findings, educational level was the only factor significantly different between groups among sociodemographic factors. Advanced-age mothers had less education than those aged 20–34 years old. Mothers with higher levels of education had a lower risk of several prenatal adverse outcomes.[6] A recent meta-analysis across 12 European countries found a

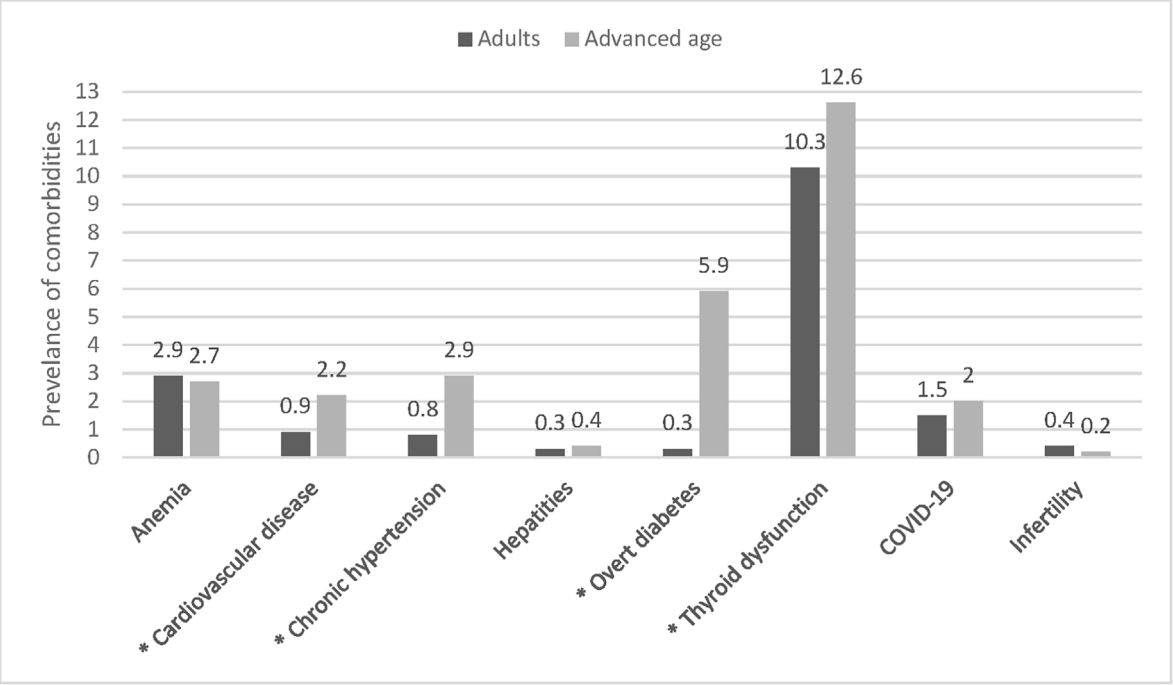

Fig. 1. Comparison of the prevelance of comorbidities between advanced-age mothers and adults.* P-Value <0.05.

48% risk excess of preterm births associated with low maternal education.[7] Such findings should not be overlooked. Among comorbidities, chronic hypertension, cardiovascular disease, overt diabetes, and thyroid dysfunction were more prevalent among mothers at an advanced age. These co-morbidities are more common in advanced-age mothers and are independently associated with adverse pregnancy and childbirth outcomes.[1,8]

According to the findings of this study, advanced maternal age is a significant risk factor for a variety of adverse maternal and neonatal outcomes even after adjusting for covariates. In terms of adverse maternal outcomes, advanced age increased the risk of gestational diabetes, preeclampsia, placenta abnormalities (previa/acreta), postpartum hemorrhage, and maternal intensive care unit admission. Compared with mothers aged 20–34 years, advanced-age mothers had a significantly higher risk of gestational diabetes (aOR: 3.18, 95%CI: 1.56–6.95). However, we did not observe an age-related increase in the risk of macrosomia. These findings are consistent with a previous study conducted by Kahvechi et al.[5] Clinical studies have shown that there is already resistance to insulin action with physiological aging, resulting in slightly elevated glycemia. Fulop et al. explained the decline in insulin sensitivity with age due to the progressive deterioration of pancreatic-cell function. Because of decreased insulin sensitivity and increased serum lipid levels, the prevalence of glucose intolerance rises with age.[9]

Consistent with other studies,[3,5] advanced-age mothers were nearly three times more likely to encounter preeclampsia than their adult counterparts (aOR: 2.91, 95%CI: 1.35–4.72). Duckitt et al. found that maternal age greater than 40 years doubles the risk of preeclampsia.[10] Furthermore, Saftlas et al. demonstrated that the risk of severe preeclampsia increases sharply after the age of 35.[11] Another study, on the other hand, found no link between preeclampsia and maternal age, which was interpreted as a result of controlling for covariates for gestational hypertension and preeclampsia, such as comorbidities.[12] It could be argued that because such comorbidities are most likely caused by old age, they should not be adjusted for because they are intermediate variables.

In this study, the risk of placenta abnormalities (placenta previa and placenta acreta) was slightly higher in advanced-age mothers (aOR: 1.09, 95%CI: 0.77–1.94). Advancing maternal age appears to increase the risk of placenta previa independent of other factors. A population-based, case-control study showed that mothers aged 34 years or older had a two to three times higher risk of placenta previa than mothers under 20 years old.[13] Another study by Biro et al. reported that advanced maternal age was independently associated with placenta previa (OR 2.2).[14] However, it has been reported that the risk of adverse maternal and neonatal outcomes for mothers with placenta previa was not substantially affected by maternal age if their different risk profiles were considered.[15] The placenta acreta spectrum has also been linked to advanced maternal age. One reason for the increased risk of placenta acreta in older mothers is that they are more likely to be multiparous and have a history of cesarean section. However, the prevalence of acreta in nulliparous mothers calls this interpretation into question. Our findings also show that even after controlling for covariates like parity and history of cesarean section, there is still a link between the risk of acreta and increasing maternal age, though this risk is low.

This study also discovered a link between maternal age and mode of delivery. The rising pregnancy rate at advanced maternal age corresponds to the increasing rate of CS. According to several studies, advanced maternal age is a risk factor for CS.[3,5] Bayrampour et al. discovered an increased risk of cesarean birth among mothers of advanced maternal age compared to younger mothers in a systematic review of twenty-one studies for nulliparous and multiparous.[16] The current study found that advanced-age mothers were more than three times more likely than their adult counterparts to have their babies delivered via CS (aOR: 3.16, 95%CI: 1.51–3.87). This odd is higher than those reported in Ethiopia (OR 2.7),[3] Turkey (OR 2.6),[5] and Ireland (OR 1.8).[8] This could be because the proportion of malpresentation (breech and transverse) was higher in advanced-age mothers in our study. Other poor obstetrical factors, including preeclampsia, gestational diabetes, and placenta abnormalities, were commonly seen in advanced-age mothers, and CS could have been considered for maternal reasons.

Another finding of our study was the increased risk of postpartum hemorrhage (aOR: 1.94, 95%CI: 1.24–2.61) in advanced age. Previous research has linked advanced maternal age to postpartum hemorrhage, but there is still no agreement. According to Kramer et al., maternal age of 35 years (aOR, 1.5; 95% CI, 1.5–1.6) increased the risk of postpartum hemorrhage.[17] Sheen et al. proposed that mothers over 45 years of age were at the highest risk for postpartum hemorrhage during delivery hospitalizations.[18] A meta-analysis, however, found no link between the maternal age of 35 years and postpartum hemorrhage.[19] Furthermore, another study

Table 2
Comparison of obstetrical (pregnancy and childbirth) outcomes based on maternal age n(%).

Variables	Total (n = 8354)	Advanced-age (n = 1855)	Adults (n = 6499)	*P*-value
Gestational age				<0.001
Less than 37 weeks	1183 (14.2)	349 (18.8)	834 (12.8)	
37–40 weeks	6050 (72.4)	1310 (70.6)	4740 (72.9)	
40^{+1}–41 weeks	942 (11.3)	169 (9.1)	773 (11.9)	
More than 41 weeks	179 (2.1)	27 (1.5)	152 (2.3)	
Parity				<0.001
Primiparous	2073 (24.8)	171 (9.2)	1902 (29.3)	
Multiparous (2-5)	6044 (72.4)	1541 (83.1)	4503 (69.3)	
Grand multiparous (6 parity or more)	237 (2.8)	143 (7.7)	94 (1.4)	
Gestational Diabetes				<0.001
No	7038 (84.2)	1425 (76.8)	5613 (86.4)	
GDM controlled with diet	774 (9.3)	223 (12)	551 (8.6)	
GDM controlled with medications	513 (6.1)	198 (10.7)	315 (5)	
Preeclampsia				<0.001
No	7803 (93.4)	1666 (89.8)	6137 (94.4)	
Yes	551 (6.6)	189 (10.2)	362 (5.6)	
Placenta abnormalities (previa/acreta)				0.038
No	8317 (99.6)	1837 (99)	6481 (99.7)	
Yes	36 (0.4)	18 (1)	18 (0.3)	
Placenta abruption				0.413
No	8086 (96.8)	1709 (96.5)	6296 (96.9)	
Yes	268 (3.2)	65 (3.5)	203 (3.1)	
Chorioamenionities				0.979
No	8326 (99.7)	1849 (99.6)	6477 (99.7)	
Yes	28 (0.3)	6 (0.4)	22 (0.3)	
Meconium fluid				0.001
No	7362 (88.1)	1674 (90.2)	5688 (87.5)	
Yes	992 (11.9)	181 (9.8)	811 (12.5)	
Fetal distress				0.505
No	7660 (91.7)	1694 (91.3)	5966 (91.8)	
Yes	694 (8.3)	161 (8.7)	533 (8.2)	
Fetal presentation				0.003
Cephalic	7998 (95.7)	1749 (94.2)	6249 (96.1)	
Breech	318 (3.8)	93 (5)	225 (3.5)	
Transverse	38 (0.5)	13 (0.7)	25 (0.4)	
Method of delivery				<0.001
Normal vaginal delivery	5435 (65.1)	1032 (55.7)	4403 (67.7)	
Vacuumed delivery	79 (0.9)	10 (0.5)	69 (1.1)	
Cesarean section	2840 (34)	813 (43.8)	2027 (31.2)	
Grade 3 or 4 of perineal lacerations				0.774
No	8349 (99.9)	1855 (100)	6494 (99.9)	
Yes	5 (0.1)	0	5 (0.1)	
Post-partum hemorrhage				<0.001
No	8105 (97)	1718 (92.6)	6387 (98.3)	
Yes	249 (3)	137 (7.4)	112 (1.7)	
Unfavorable maternal outcome				0.011
No	8265 (98.9)	1827 (98.45)	6438 (99.1)	
Intensive care unit admission	59 (0.78)	27 (1.5)	32 (0.87)	
Death	3 (0.03)	1 (0.05)	2 (0.03)	
Newborn weight				<0.001
Low birth weight (Less than 2500 g)	1128 (13.5)	312 (16.8)	816 (12.6)	
Normal weight (2500–4000 g)	7046 (84.3)	1514 (81.6)	5532 (85.1)	
Macrosomia (More than 4000 g)	180 (2.2)	29 (1.6)	151 (2.3)	
Intra uterine growth retardation				0.171
No	8095 (96.9)	1807 (97.4)	6288 (96.8)	
Yes	259 (3.1)	48 (2.6)	211 (3.2)	
Childbirth injury*				0.081
No	8326 (99.7)	1842 (99.3)	6484 (99.7)	
Yes	28 (0.3)	13 (0.7)	15 (0.3)	
Shoulder dystocia				0.169
No	8291 (99.2)	1846 (99.5)	6445 (99.2)	
Yes	63 (0.8)	9 (0.5)	54 (0.8)	
Neonatal congenital malformation				0.180
No	6957 (98.9)	1829 (98.6)	8261 (98.9)	
Yes	76 (1.1)	26 (1.4)	93 (1.1)	
Need for neonatal resuscitation				0.081
No	7594 (90.9)	1657 (89.3)	5937 (91.4)	
The primary levels of resuscitation	517 (6.2)	130 (7)	387 (6)	
Advanced levels of resuscitation	243 (2.9)	68 (3.7)	175 (2.6)	
Neoborn asphyxia				0.606
No	8267 (99)	1838 (99.1)	6429 (98.9)	
Yes	87 (1)	17 (0.9)	70 (1.1)	
Unfavorable neonatal outcome				<0.001
No	6661 (79.7)	1402 (75.5)	5259 (80.9)	

(*continued on next page*)

Table 2 (*continued*)

Variables	Total (n = 8354)	Advanced-age (n = 1855)	Adults (n = 6499)	*P*-value
Stillbirth	91 (1.1)	33 (1.8)	58 (0.9)	
Neonatal intensive care unit admission	1565 (18.8)	411 (22.2)	1154 (17.8)	
Death	37 (0.4)	9 (0.5)	28 (0.4)	

* Childbirth injury: Clavicle fracture, erb duchenne palsy, Klumpke palsy.

Table 3
Logistic regression analyses of adverse pregnancy and childbirth outcomes with maternal age.

Outcome	OR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
Gestational Diabetes	2.59 (1.15–5.91)	<0.001	3.18 (1.51–6.95)	<0.001
Preeclampsia	3.88 (1.56–6.99)	<0.001	2.91 (1.35–4.72)	<0.001
Placenta abnormalities (previa/acreta)	1.32 (1.09–3.03)	<0.001	1.09 (0.77–1.94)	<0.01
Meconium fluid	0.74 (0.41–1.12)	0.034	0.17 (0.09–1.02)	0.296
Cesarean section	3.52 (1.48–5.81)	<0.001	3.16 (1.51–3.87)	<0.001
Post-partum hemorrhage	2.97 (1.09–3.56)	<0.01	1.94 (1.24–2.61)	<0.01
Maternal intensive care unit admission	2.12 (1.56–2.87)	0.007	1.36 (1.15–1.99)	0.048
Low birth weight	1.49 (0.71–2.73)	<0.01	1.35 (0.97–2.96)	<0.01
Preterm birth	3.87 (0.31–6.90)	<0.001	2.36 (1.65–4.83)	<0.01
Stillbirth	2.89 (0.77–3.04)	<0.01	1.18 (1.01–3.16)	<0.01
Neonatal intensive care unit admission	3.18 (1.60–4.93)	<0.01	2.09 (0.73–3.92)	<0.01

OR: Odds Ratio.
aOR: adjusted Odds Ratio.

discovered that getting older protects against postpartum hemorrhage.[20] CS, abnormal placentation, and stillbirth are among the factors that have been linked to postpartum hemorrhage.[21] The higher Incidence of CS, placenta abnormalities, and stillbirth in our study could justify the increased risk of postpartum hemorrhage in advanced-age mothers. All of the above adverse maternal outcomes place advanced-age mothers at a higher risk of intensive care unit admission (aOR: 1.36, 95% CI: 1.15–1.99).

In terms of neonatal outcomes, advanced-age mothers had a higher rate of preterm birth, LBW, stillbirth, and neonatal intensive care unit admission. According to our findings, advanced age doubled the risk of preterm birth (aOR: 2.36, 95%CI: 1.65–4.83). Preterm birth is the most crucial determinant of neonatal morbidity and mortality, and it has a significant impact on it. However, the relationship between prematurity and advanced maternal age is still debated in the literature. Confounders identified in our studies, such as placenta previa, hypertensive complications, and maternal medical history, are the most significant influence on the risk of preterm birth. Several studies have attempted to investigate the specific impact of advanced maternal age after adjustment for confounders, but the evidence is still conflicting.[22,23] According to some studies, there is a U-shaped relationship between maternal age and the risk of preterm birth even after adjustment for confounders, with the lowest risk age being 24–30 years and sharply increased risk after the age of 40 years.[24,25]

In contrast, some studies have found a higher risk of preterm birth among younger mothers (30–34 years).[26,27] This disparity could be explained by differences in sociodemographic or clinical risk factors across studies. Preterm birth is thought to be the leading cause of birth asphyxia,[28] childbirth injury,[29,30] and neonatal mortality.[31] Despite the higher prevalence of preterm birth, there were no significant differences in the need for resuscitation, asphyxia, childbirth injury, and neonatal mortality rates between the groups in our study.

The prevalence of meconium fluid was lower in advanced-age mothers than in adults (9.8% vs. 12.5%). Bivariate regression also revealed that advanced-age mothers had a lower risk of meconium fluid than adults. This could be explained by the lower rate of post-term pregnancy, as post-term pregnancy is a risk factor for a higher rate of meconium fluid[32]; however, multivariate logistic regression found no correlation between advanced age and the Incidence of meconium fluid.

In our study, advanced-age mothers were more likely to have LBW newborns (aOR: 1.35, 95%CI: 0.97–2.96). Mehari et al. discovered that advanced-age mothers were three times more likely to have LBW newborns.[3] In contrast, two studies from Malaysia[4] and Turkey[5] found no link between maternal age and LBW. Although most research documents a positive association between advanced maternal age and the risk of LBW,[3,33] a subset of studies suggests that the association may be confounded by preexisting medical conditions, obstetrical history, and maternal social characteristics.[3,5] A study that determined whether the association between advanced maternal age and the risk of LBW is due to maternal age or other confounding factors found that advanced maternal age is not independently associated with the risk of LBW.[34]

Advanced-age mothers were at higher risk for stillbirth (aOR: 1.18, 95%CI: 1.01–3.16). Advanced maternal age is an independent risk factor for stillbirth in nulliparous[35] and multiparous mothers.[8] Mothers of advanced maternal age are at higher risk of stillbirth throughout gestation; the peak risk period is 37–41 weeks.[36] It is currently unknown the best way to prevent stillbirth in mothers aged 35 and above. The case for beginning antepartum surveillance at 37 weeks is that the risk of stillbirth at this gestational age is comparable to other high-risk conditions for which testing is routinely performed (chronic hypertension, diabetes, cholestasis, etc.). However, insufficient evidence confirms that antenatal testing for advanced maternal age alone reduces stillbirth or improves perinatal outcomes.[37] Consistent with a previous study,[5] admission to a NICU was more likely in the advanced-age mothers (aOR: 2.09, 95%CI: 0.73–3.92); however, the risk of neonatal congenital malformations, and need for resuscitation were not associated with maternal age.

The strength of our study is that our study registers are of high quality and in accordance with childbirth records. We investigated various factors associated with advanced maternal age, including pregnancy, childbirth, and neonatal outcome. The population study sample size was large enough to reflect the situation regarding obstetric challenges among all advanced maternal-age pregnancies during the study period. Our study was conducted retrospectively, which is still a limitation. The database did not allow for the precise timing of the various events during pregnancy. More data was missing for some variables, such as body mass index and weight gain during pregnancy, known as risk factors for adverse prenatal outcomes. We also were unable to evaluate the differences in prenatal screening tests and fetal chromosomal differences between groups due to missing data. Because our study group of 40 years and older was small in size, we lacked the power to detect risks of rare outcomes; thus, we did not conduct a subgroup analysis to determine the effect of very advanced age on the risk of adverse obstetric outcomes.

5. Conclusion

Regardless of the underlying mechanism, the findings of this study suggest that advanced-age mothers are at increased risk of a wide range of adverse pregnancy and childbirth outcomes, which persist even after adjusting for several potential confounders. As a result, maternity care providers will be interested in these findings.

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Ethical approval

This study complies with the Declaration of Helsinki and was performed according to ethics committee approval. The Ethics and Research Committee of the Hormozgan University of Medical Sciences approved the study (number: HUMS.REC.1401.115).

Consent to participate from patients

The records of all patients who provided informed consent for using their data for research purposes were analyzed. In cases of illiteracy, their legal guardians provided informed consent. Statistical analysis was performed with patient anonymity following ethics committee regulations.

Consent for publication

Not applicable.

Conflict of interest

The authors report no conflicts of interest.

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