

# Adverse Obstetric Outcomes at Advanced Maternal Age in Arba Minch Zuria, and Gacho Baba District, Southern Ethiopia: A Prospective Cohort Study

Abera Mersha (✉ [mershaabera@gmail.com](mailto:mershaabera@gmail.com))

Arba Minch University <https://orcid.org/0000-0002-4366-4128>

Gistane Ayele

Arba Minch University

Tilahun Worku

Arba Minch University

Zerihun Zerdo

Arba Minch University

Shitaye Shibiru

Arba Minch University

Agegnehu Bante

Arba Minch University

Tamiru Chonka

Arba Minch University

---

## Research

**Keywords:** Advanced maternal age, obstetric outcomes, Arba Minch

**Posted Date:** May 28th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-30341/v1>

**License:** © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background:** Advanced maternal age significantly increased the risk of adverse obstetric outcomes. So, adequate and updated information on the status of advanced maternal age and their effect on obstetric outcomes is vital for effective policy and program formulation in Ethiopia. Pockets of studies conducted, but most are retrospective and record reviews. Thus, studies that show the status of advanced maternal age and their effect on obstetric outcomes is very limited in Ethiopia. As such, this study fills those gaps in our set up.

**Methods:** A community-based prospective cohort study was conducted among 709 study participants from October 15, 2018, to September 30, 2019. A pretested interviewer-administered structured Open Data Kit survey tool was used to collect the data. The downloaded data from the Open Data Kit aggregate was exported to SPSS version 25 for analysis. Log-linear regression was used to compare obstetric outcomes among women aged 20–34 years and  $\geq 35$  years. The model was adjusted for educational and occupational status, parity, wealth index, body mass index, household food insecurity, habits, distance to health care institution, and sex of the neonate, antenatal care, postnatal care, and place of delivery. The model fitness was tested by the log-likelihood ratio.

**Results:** In this study, 209(29.5%) of the women were aged  $\geq 35$  years, and 500(70.5%) aged 20–34 years. Women aged  $\geq 35$  years were at increased risk of miscarriage ( $\beta = 0.29$ , 95%CI: 0.02, 0.56), and hypertensive disorder ( $\beta = 0.07$ , 95%CI: 0.004, 0.13).

**Conclusions:** Advanced maternal age was independently associated with miscarriage and hypertensive disorder after controlling for possible cofounders. As such, different intervention programs should be designed to create awareness and to provide counseling services for women with advanced age or delayed childbearing.

## Plain English summary

Women who bear a child at the age of  $\geq 35$  years old are stated as advanced maternal age. At this age, the risk of different obstetric complications is increased. This study was aimed to assess the effect of advanced maternal age on obstetric outcomes in the study settings.

A prospective follow-up study was conducted among pregnant women during the study period. The women were followed from the time pregnancy was confirmed up to the immediate postpartum period. Seven hundred forty-four women were interviewed in the baseline and 24 participants became lost to follow-ups during the follow-up period, and 11 excluded from the analysis because of incomplete information.

Of the study participants, 209 of the women were beard children at the age of  $\geq 35$  years (advanced maternal age), and 500 were age group from 20-34 years old.

This study found that advanced maternal age increased risk of miscarriage (termination of pregnancy before fetal viability) and hypertensive disorder during pregnancy, the intrapartum and immediate postpartum period after controlled for possible confounders.

In brief, this study showed that a significant number of women became pregnant during advanced maternal age. Therefore, different strategies should be designed for the women who planned to bear child, and information should be provided for women who are advanced age or delayed childbearing to alert them.

## Background

Advanced maternal age defined as a mother bearing a child at the age of 35 or older. If women have a baby at this age, there are some risks comes for mom and baby. Despite this, more and more women are waiting until later in life to have kids [1–3].

Worldwide, nowadays delayed childbearing is a growing option, and this trend is stronger in developed countries [4–6]. The average age at childbirth in the UK is increasing, and more women are giving birth over the age of 35 years. In 2013, 20% of live births were to women over the age of 35 years[7]. In the last four decades, the rate of pregnancy in older women has increased [8]. Different studies which were conducted in Iran, Jerusalem, Israel; multi-country study; Norway; Asia; Muar district, Johor, Malaysia, Northeastern Brazilian city and cohort study in Israel showed that the incidence of pregnant women with advanced maternal age was 49.8%, 14%, 12.3%, 33.4%, 11.4–19.1%, 14.8%, 5.9% and 2.3% respectively [4, 9–14]. Similarly, other studies reported 4.53% from Nepal, 17.5% from South Africa, and 19.1% from the UK by North Western Perinatal Survey; which was a large contemporary cohort study[15–17].

The main reason for delayed childbearing is the effective use of family planning, rise in educational involvement of women, increased labor market participation, gender equity, housing conditions, and lack of family support police [18]. Besides, advances in economic, technological, and social changes have significantly contributed to the delayed bearing to their late 30 s and beyond. This huge demographic shift has become the main public health issue, and it becomes challenging for both patients and clinicians because delaying pregnancy too advanced age-related to the adverse obstetric outcomes [4, 6, 7, 14, 19–21].

Various studies have been carried out to identify and assess the complications of pregnancy with increasing maternal age[16]. As maternal age advances, the risk of adverse obstetric outcomes elevated consistently [17, 20, 22]. The risk of maternal near-miss, maternal death and severe maternal outcomes significantly increased among women with advanced age [1, 2, 5, 9–11, 23–25]. Women of advanced age had increased incidence of hypertensive disorder of pregnancy, and breech presentation as shown in studies conducted in Nepal, Cameroon, and South Africa [15, 16, 24]. The rates of operative vaginal delivery in women aged < 35, 35–39, and forty or more were 23.5%, 36.9%, and 43% respectively[7]. The rate of the cesarean mode of delivery increased threefold among women aged 35–40 and fivefold among women over 40 years as compared to women aged  $\leq$  35 years old [4].

Thus, pocket studies conducted in parts of the different countries [1, 2, 5, 9–11, 23–25], but most are retrospective and used secondary data sources or record reviews. Besides, there are very limited studies that show the effect of advanced maternal age on obstetric outcomes as delayed childbearing increases in-country Ethiopia. Consequently, adequate and update information on the status of advanced maternal age and there effect on obstetric outcomes are very important for effective policy and program formulation. Therefore, this study was aimed to assess the effect of advanced maternal age on obstetric outcomes in the study setting.

## Methods

### Study setting, period and design

This community-based prospective cohort study conducted in the nine kebeles of Arba Minch zuria, and Gacho Baba districts included under Arba Minch-Health and Demographic Surveillance System sites (AM-HDSS) from October 15, 2018, to September 30, 2019. Arba Minch, the capital of the Gamo zone, is 505 km south of Addis Ababa and 275 km southwest of Hawassa, the capital city of the region. The total population of the districts has 164,529, of whom 82,199 are men and 82,330 women based on the 2007 central statistical agency (CSA) report. Arba Minch zuria, and Gacho Baba district have a total of 31 kebeles with three different climatic zones, high land, midland, and lowland, among which 9 kebeles are used as HDSS. The report of AM-HDSS showed the surveillance site has a total population of 74, 157.

### Population

All women who were pregnant in Arba Minch zuria, and Gacho Baba district, AM-HDSS site from 2018–2019 were source as well as study population for this study.

### Inclusion criteria

At enrollment for this study, all women who were pregnant and inhabitants to a minimum of six months in the study area were eligible for this study. The eligibility was defined by the pregnancy screening checklist which was developed by Whiteman *et al.*[26].

### Exclusion criteria

During recruitment, all women whose ages less than twenty years old and known to be preexisting illnesses were excluded.

### Sample size determination

The separate sample size was calculated in Epi info7 software Stat Calc for each specific objective. To determine the sample size for the first objective (to assess the status of advanced maternal age among pregnant women in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9) single population proportion was used by the following assumption:  $P = 0.334$  from the study conducted in Norway[11], 95% level of confidence and 5% margin of error. Based on this, the estimated sample size was 342. To determine the sample size for the second objective (to determine the effect of advanced maternal age on obstetric outcomes among pregnant women in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9) two-sample comparison proportion was used. The assumption was  $P_1$  (age group 20–34) = 0.207 and  $P_2$  (age group  $\geq 35$ ) = 0.124 in one of the obstetric outcome (anemia) in advanced maternal age from the study conducted in Malaysia [14], 95%CI, ratio 1:1, and Power = 80% and the sample size estimated by this assumption was 676. The sample size for this study was estimated by adding a non-response rate of 10% to the larger sample size (sample size of the second objective). Therefore, the calculated sample size for this study was 744.

## Data collection tool

The data were collected using a pretested interviewer-administered structured Open Data Kit (ODK) survey tool. The tools were developed by reviewing different works of literature. The questionnaire for wealth index indicators was adapted from Ethiopian Demographic Health Survey (EDHS) 2016[27] and included ownership of household assets and equipment, water supply, power supply, sanitary facility, residential homes, farmlands, and livestock ownership. The household food insecurity level was measured with Household Food Insecurity Access Scale (HFIAS), a structured, standardized, and validated tool that developed mainly by Food and Nutrition Technical Assistance (FANTA) [28]. The tool contains three main parts: Annex I (checklist to recruit the mothers to the study (background and pregnancy Information, and pregnancy screening checklist); Annex II (the tool to obtain baseline information); Annex III (tools for follow up survey to obtain obstetric outcomes) (Additional file 1).

## Pretest

The tools were pretested in the Chencha district, which was out of study area to verify the appropriateness of the tool, and modifications and amendments were taken accordingly before actual data collection.

## Data collection procedures

The well-trained nine data collectors and three field supervisors were prospectively identified obstetric outcomes among pregnant women during the study period. Intensive three days training gave for data collectors and supervisors separately regarding objectives of the study, and data collections ways. Data collectors discussed the information about the ODK survey tool and pregnancy screening checklists to

identify pregnant women. As this was a community-based prospective follow-up study, data collected in different phases. In the first phase: all the baseline information about the women was obtained and pregnancy status was checked by using a pregnancy-screening checklist. After identified whether women were advanced age or not and the data collectors have recruited the women into the cohort of the study. The data were collected by home-to-home visits. In the second phase: the women were followed during pregnancy up to the immediate postpartum period to identify the obstetric outcomes. In the community setting the data collectors frequently contacted women or any household members, surround health care institutions, and health extension workers during the follow-up period.

## **Measurements**

The description and measurements of the outcome and some of the explanatory variables were stated in detail below (Table 1).

Table 1

Measurements to assess the adverse obstetric outcomes at advanced maternal age in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9

<b>Variables</b>	<b>Description</b>	<b>Measurements</b>
<b>Outcome variables</b>		
<b>Obstetric outcomes</b>		
<i>Hypertensive disorder</i>	Increased blood pressure above 140/90 mmHg during pregnancy with two measurements in 6 hours apart, and known by a health care professional during antenatal care, delivery, or postpartum period.	Those fulfilled the stated criteria were coded as "1", not were coded as "2"
<i>Cesarean mode of delivery</i>	Gave birth by the invasive procedure (incision is done on the abdomen, facia, and uterine wall.	Those fulfilled the stated criteria were coded as "1", not were coded as "2"
<i>Hemorrhagic disorders</i>	Any excessive vaginal bleeding after 28 weeks of gestation, and in the postpartum period.	Those fulfilled the stated criteria were coded as "1", not were coded as "2"
<i>Miscarriage</i>	Any termination of pregnancy for a non-medical reason before fetal viability (before 28 weeks of gestation)	Encountered women were coded as "1", and not encountered were coded as "2"
<i>Prolonged labor</i>	The mother stayed for more than 12 hours in labor after active onset.	Encountered women were coded as "1", and not encountered were coded as "2"
<i>Premature rupture of membrane</i>	Rupture of membrane before 18 hours of the onset of labor.	Encountered women were coded as "1", and not encountered were coded as "2"
<i>Anemia</i>	Maternal hemoglobin (Hb) < 10 g/dl, and signs like dizziness, blurred vision, and confirmed by a health professional and informed for the mother.	Women this condition were coded as "1", and not encountered were coded as "2"
<i>Severe maternal morbidity</i>	Severe disease condition during pregnancy, delivery, and postpartum periods like heart failure, renal failure, shock, and amniotic fluid embolism.	Women faced such type of conditions and treated as critical in the health care institution were coded as "1", and not were coded as "2"
<b>Exposure variable</b>		
<i>Advanced maternal age</i>	Pregnant mother aged $\geq 35$ years old [7].	Categorized into two groups and for the mother aged 20–34 years old coded as "1" and "2" for $\geq 35$ years.
<b>Adjusted/confounding variable</b>		

Variables	Description	Measurements
<i>BMI</i>	Wight of women in kg per height square	Classified into underweight (< 18.5 kg/m <sup>2</sup> ), normal (18.5–24.9 kg/m <sup>2</sup> ), overweight (25–29.9 kg/m <sup>2</sup> ), obese (30–34.9 kg/m <sup>2</sup> ), and morbidly obese (≥ 35 kg/m <sup>2</sup> ).
<i>Wealth index</i>	Using EDHS household assets questions and principal component analysis will be done	Ranked into three categories, 1st quantile coded as 1, 2nd quantile coded as “2”, and 3rd quantile coded as “3”.
<i>Distance to the health center</i>	Approximate distance to the health center on foot which was responded by the respondent	Categorized in to two: “1”= ≤2hr on foot and “2”= >2hr (BEmOC)
<i>Distance to the hospital</i>	Approximate distance to the hospital on foot which was responded by the respondent	Categorized in to two: “1”= ≤2hr on foot and “2”= >2hr (CEmOC)
<i>Household food insecurity</i>	Both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life	Categorized households into four levels of household food insecurity (access) based on response to nine questions of HFIAS: food secure (1) and mild (2), moderately (3) and severely food insecure (4)[28].

## Data quality assurance

To ensure quality, experts translated questionnaires into the local language. A standard tool, which was commented by many experts, was used to collect the information. The data collectors and supervisors were trained to standardize and ensure consistency of data collection. The ODK survey tool that was very important to control the quality of data. The principal investigator and supervisors critically checked the data for completeness before uploaded to the ODK cloud server. Multiple imputation techniques were used for missed data that were not more than 20% of the needed information. Those study participants with inconsistent information were excluded from the final analysis. To maintain quality, the data were properly coded and categorized.

## Data analysis and processing

The collected data downloaded from ODK aggregate and then exported to SPSS version 25 for analysis. Univariate analysis done in relation to maternal age. Principal Component Analysis (PCA) used to determine wealth quintiles. Bivariate and multivariable analysis done by using log-linear regressions. The assumptions for log-linear regression checked, and the goodness of fit-tested by the log-likelihood ratio (LR). All the variables with  $P \leq 0.25$  in the bivariate analysis included in the final model of multivariate analysis to adjust the confounding effect, and the variables selected by the backward stepwise

technique. The model adjusted for educational and occupational status, party, wealth index, body mass index, household food insecurity access scale, habits, distance to health care institution, and sex of the neonate, antenatal care, postnatal care, and place of delivery to control the possible confounding effect. A standard error greater than two considered as suggestive of the existence of multi co-linearity. A crude and adjusted log-linear regression analysis done for each outcome variable with maternal age to estimate the beta coefficient ( $\beta$ ). A statistically association declared at P-value < 0.05. Then the information presented by using simple frequencies, summary measures, tables, and figures.

## Results

### The overall process of the study and response rate

Of the respondents, 744 (100%) were interviewed in the baseline based on the calculated sample size. During the follow-up period, 24 participants became lost to follow-ups, and 11 excluded from the analysis gave the response rate of 95.3%.

### Socio-demographic and economic characteristics in relation to maternal age

Out of study participants, 500 (70.5%) were age ranged from 20–34 years old, and 209(29.5%) were  $\geq$  35 years old. From women whose age group 20–34 years old, 308(61.6) had no formal education, 143(28.6) had primary, 35(7.0) secondary, and 14(2.8) college and above, and for age group  $\geq$  35 years old, 144(68.9) had no formal education, and 47(22.5), 13(6.2), and five (2.4) had primary, secondary, and college and above respectively. The majority of participants were Gamo ethnic group, 421(84.2) for age 20–34 years, and 174(83.3) for age  $\geq$  35 years. Out of study participants, 326(65.2) were protestant religious followers for the age group 20–34 years, and 126(60.3) for age  $\geq$  35 years. Four hundred ninety-six (99.2%) of participants married for the age group 20–34 years, and 208(99.5) for age  $\geq$  35 years (Table 2).

Table 2

Socio-demographic and economic characteristics in relation to maternal age for the study conducted in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9

<b>Variables</b>	<b>20–34 years</b>	<b>≥ 35 years</b>
<b>Educational status of the husband</b>		
No formal education	254(50.8)	110(52.6)
Primary(1–8)	171(34.2)	76(36.4)
Secondary(9–12)	58(11.6)	16(7.7)
College and above	17(3.4)	7(3.3)
<b>Occupation of the mother</b>		
Housewife	452(90.4)	194(92.8)
Other©	48(9.6)	15(7.2)
<b>Occupation of the husband</b>		
Farmer	358(71.6)	178(85.2)
Other±	142(28.4)	31(14.8)
<b>Body mass index (kg/m<sup>2</sup>)</b>		
Underweight (< 18.5)	35(7.0)	15(7.1)
Normal (18.5–24.9)	374(74.8)	132(63.2)
Overweight (25-29.9)	91(18.2)	62(29.7)
<b>The average distance from the health post (on foot)</b>		
≤ 2 hour	485(97.0)	206(98.6)
> 2 hour	15(3.0)	3(1.4)
<b>The average distance from the health center (on foot)</b>		
≤ 2 hour	457(91.4)	193(92.3)
> 2 hour	43(8.6)	16(7.7)
<b>The average distance from the hospital (on foot)</b>		
≤ 2 hour	131(26.2)	87(41.6)
> 2 hour	369(73.8)	122(58.4)
<b>Wealth index</b>		
First quantile	178(35.6)	59(28.2)

<b>Variables</b>	<b>20–34 years</b>	<b>≥ 35 years</b>
Second quantile	171(34.2)	76(36.4)
Third quantile	151(30.2)	74(35.4)
<i>© merchant, government employer, daily laborer, student, and farmer, and ± carpenters, Manson, no occupation, NA, Begger, Merchant, government employer, daily laborer, private worker, religious leader, student, and driver</i>		

## Household food insecurity access scale in relation to maternal age

Of the women, whose age was 20–34 years old, 325 (65.0%), and 71 (14.2%), and whose age 35 years old or more 144(68.9%), and 14(6.7%) were food secure, and severely food insecure respectively (Fig. 1).

## The habit of the mother in relation to age

Regarding habit of the mother, 20(4.0%), and 93 (18.6% participants had smoked and consumed alcohol-containing beverages for the age group from 20–34 years, and 14(6.7%), and 40 (19.1%) for age category 35 years old or more respectively (Fig. 2).

## Obstetric characteristics in relation to maternal age

Out of study participants, 12 (5.7%) ended their pregnancy with miscarriage for the age group 35 years old or more. Eighty-eight (17.6%) of study participants were primipara for age 20–34 years, 16(7.7%) for ≥ 35 years. Antenatal care was followed by 363(72.6%) of women age 20–34 years, and 151(72.2%) for 35 years or more. From them, 151(41.6%) had one to three visits, 212(58.4%) had four or more visits for the age group from 20–34 years, 70(46.4%), and 81(53.6%) for age group ≥ 35 years respectively. Of the neonates delivered, 228(46.8%) were male for the women aged 20–34 years, and 104(56.8%) for the age group ≥ 35 years. Regarding classifications of hypertensive disorder during pregnancy, 1(25.0) has chronic hypertension, 3(75.0%) had gestational hypertension for the age group 20–34 years, and 16(59.3%) pre-eclampsia-eclampsia syndrome, 6(22.2%) chronic hypertension, and 5(18.5%) gestational hypertension for age group 35 years or more (Table 3).

Table 3  
Obstetric characteristics in relation to maternal age for the study conducted in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9

<b>Variables</b>	<b>20–34 years</b>	<b>≥ 35 years</b>
<b>Place of delivery</b>		
Hospital	32(6.6)	16(8.7)
Health center	145(29.8)	32(17.5)
Health post	69(14.2)	19(10.4)
Home	241(49.4)	116(63.4)
<b>Mode of delivery</b>		
Spontaneous vaginally	429(88.1)	169(92.4)
Cesarean section	18(3.7)	7(3.8)
Assisted delivery	40(8.2)	7(3.8)
<b>Postnatal care</b>		
Yes	112(23.0)	34(18.6)
No	375(77.0)	149(81.4)
<b>Duration of labor</b>		
< 6 hr.	349(71.7)	135(73.8)
6–12 hr.	83(17.0)	17(9.3)
≥ 12 hr.	55(11.3)	31(16.9)
<b>Hemorrhagic disorder</b>		
Yes	33(6.8)	32(17.5)
No	454(93.2)	151(82.5)
<b>Hypertensive disorder</b>		
Yes	4(0.8)	27(12.9)
No	496(99.2)	182(87.1)
<b>Prolonged labor</b>		
Yes	55(11.3)	31(16.9)
No	432(88.7)	152(83.1)
<b>Complications during the late part of pregnancy and delivery</b>		

<b>Variables</b>	<b>20–34 years</b>	<b>≥ 35 years</b>
Yes	50(10.0)	31(14.8)
No	450(90.0)	178(85.2)
<b>Rupture of membrane</b>		
Before labor	103(21.1)	57(31.1)
During labor	384(78.9)	126(68.9)
<b>Anemia</b>		
Yes	39(7.8)	30(14.4)
No	461(92.2)	179(85.6)
<b>Severe maternal morbidity</b>		
Yes	21(4.2)	14(6.7)
No	479(95.8)	195(93.3)

## Association of maternal age with adverse obstetric outcomes

The adjusted model showed a significant association between maternal age, and miscarriage and hypertensive disorder. Miscarriage ( $\beta = 0.29$ ; 95% CI:0.02,0.56), and hypertensive disorder ( $\beta = 0.07$ ; 95% CI:0.004,0.13) were increased among age group 35 years or more as compared to age group 20–34 years (Table 4).

Table 4

Association of maternal age to adverse obstetric outcomes for the study conducted in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9

Obstetric outcomes	Maternal age $\geq$ 35 years	
	Crude estimate $\beta$	Adjusted estimate $\pm \beta$
Hemorrhage	0.27(0.14,0.39)	0.03(-0.01,0.07)
Miscarriage	0.63(0.29,0.98)	0.29(0.02,0.56)*
Cesarean mode of delivery	0.02(-0.19,0.24)	0.08(-0.03,0.18)
Prolonged labor	0.12(0.00,0.24)	0.02(-0.02,0.06)
PROM	0.13(0.04,0.23)	0.02(-0.02,0.06)
Hypertensive disorder	0.70(0.45,0.96)	0.07(0.004,0.13)*
Anemia	0.17(0.05,0.29)	0.02(-0.02,0.06)
Severe maternal morbidity	0.13(-0.05,0.29)	0.04(-0.02,0.09)
<i><math>\pm</math>adjusted for educational status, occupational status, party, wealth index, BMI, HFIAS, habits, distance to health care institutions, sex of the neonate, antenatal care, postnatal care, and place of delivery, PROM: premature rupture of membrane, and *significant at <math>P &lt; 0.05</math></i>		

## Discussion

This prospective cohort study aimed to fill a research gap in Ethiopia in assessing the status of advanced maternal age, and that effect on obstetric outcomes. In this finding, 1/3rd of women became pregnant during advanced maternal age. This study proofed the association of advanced maternal age to miscarriage and hypertensive disorder. The confounding effect of educational and occupational status, party, wealth index, BMI, HFIAS, habits, distance to health care institutions, sex of the neonate, antenatal and postnatal care, and place of delivery controlled in the model.

In this study, the status of advanced maternal age was 29.5% (95%CI: 26.1%, 32.8%). This was higher than studies conducted in Israel (2.3% and 14%)[4, 10], Malaysia (14.8%)[14], WHO Multicountry Survey (12.8%)[9], Northeastern Brazil (5.9%)[13], Nepal (4.53%)[15], South Africa (17.5%)[16], and United Kingdom (18.18%)[17]. However, it was lower than studies done in Iran (50.2%)[29], and Norway (33.4%)[11]. This discrepancy may be due to differences in socio-demographic, and economic characteristics, technological and health care system, social, and cultural factors that lead to delayed childbearing or having pregnant at an advanced age.

After controlling for possible confounders, hypertensive disorder (pre-eclampsia and eclampsia syndrome, gestational, and chronic hypertension) significantly associated with advanced maternal age. This was congruent with studies conducted in Iran[29], Israel[21], and South Australia[30]. Similarly, as maternal age increased above 35 years old was significantly increased miscarriage. This finding was in

line with the study conducted in a high-income developed country[31]. This is due to strong shreds of evidence those certain genetic risks highly evident as maternal age increases, the quality of egg compromised, and the decreased physical ability to stay pregnant.

Advanced maternal age was not significantly associated with cesarean mode of delivery as shown in this study. This was contradicted by different studies conducted in Iran[29], South Korea[20], Israel[21], Sweden[32], United Kingdom[17], South Australia[30], and a high-income developing country[31]. This may be a difference in the health care delivery system, socio-economic factors, and methodological variations.

Hemorrhagic disorders were not associated with advanced maternal age in the adjusted model. This was not in line with a study conducted in Israel[21]. Correspondingly, severe maternal morbidity was not associated with advanced maternal age. This was contrasting with the study conducted in Washington State, United States [33]. Other Obstetric outcomes such as prolonged labor, premature rupture of membrane, and anemia were not associated with advanced maternal age. This is due to variation in measurement, and socio-economic, and socio-cultural factors.

The implication of this study for public health is paramount. Women in advanced age are the risk population group for different adverse obstetric outcomes. Nowadays women delayed childbearing related to different conditions, such as delayed marriage, using family planning, education, and workload (occupation). During advanced maternal age, women may face unpreventable adverse obstetric outcomes even if the health care system is advanced. As such, studies on the effect of advanced maternal age on the adverse obstetric outcomes are very important to strengthen the intervention for women who planned to conceive. The finding of this study initiates different stakeholders in the health care system to design appropriate strategies and planning for the measurements taken at both in the health care institutions as well as in the community at large. This study becomes one input for health policymakers and program developers typical regarding maternal health in the health care delivery system.

The main strength of this study that the design was a community-based prospective follow up that gave a true measure of the effect of advanced maternal age on adverse obstetric outcomes as compared to other study designs except for interventional study. Standard and validated tools used to measure the pregnancy status, baseline assessment to maintain validity and reliability. The adequate sample size used for a study that resulted in high power and greater precision. Besides, it had a high response rate which 95.3% as per the nature of follow-up, and to accesses the obstetric outcomes.

The limitations of this were some of the medical words were difficult to translate to the local language exactly. Nevertheless, the help of local experts did maximum effort. Some values are difficult to set cut off points, and based on the maternal response as subjected to social desirability bias.

## Conclusions

This study showed that a significant number of women became pregnant during advanced maternal age. Those adverse obstetric outcomes are unpredictable, and unpreventable in the majority of bases, but highly increased during advanced age. This study identified that miscarriage, and hypertensive disorder was significantly associated with advanced maternal age. As such, different intervention programs designed to create awareness, and to provide counseling services for women with advanced age or delayed childbearing.

## List Of Abbreviations

AM-HDSS: Arba Minch-Health and Demographic Surveillance System sites, BMI: Body Mass Index, HFIAS: Household Food Insecurity Access Scale, and ODK: Open Data Kit

## Declarations

## Ethics approval and consent to participate

Ethical clearance obtained from Arba Minch University, College of Medicine and Health Sciences, Institutional Research Ethics Review Board (IRB). Written and signed voluntary consent obtained from all study participants before recruiting the women into the study. The concealment of the participants respected via the use of codes. The respondents also informed that the information obtained from them treated with the utmost confidentiality.

## Consent for publication

Not applicable

## Availability of data and materials

The data will not share to preserve participant anonymity.

## Competing interests

All authors assert that they have no competing interests

## Funding

Arba Minch University provided funds for this research project with a grant code of GOV/AMU/TH/CMHS/NUR/DSS/04/10. The website of the university is [www.amu.edu.et](http://www.amu.edu.et). "The funders

had no role in study design, data collection, and analysis, decision to publish, or preparation of the manuscript."

## Authors' contributions

AM designed the study, involved in data collection, done analysis, and interpretation of the result and drafted the paper, and participated in preparing all versions of the manuscript. GA, TW, ZZ, SS, AB, and TC assisted in the design and the proposal development, monitored data collection, assisted during analysis, and revised subsequent drafts of the paper. All authors read and approved the final manuscript.

## Acknowledgments

Our unreserved thank goes to the Arba Minch zuria, and Gacho Baba district local administrators, kebele leaders, and health extension workers who gave support during data collection, data collectors, and study participants. Finally, yet importantly, I would like to say thank you for all peoples who support directly or indirectly.

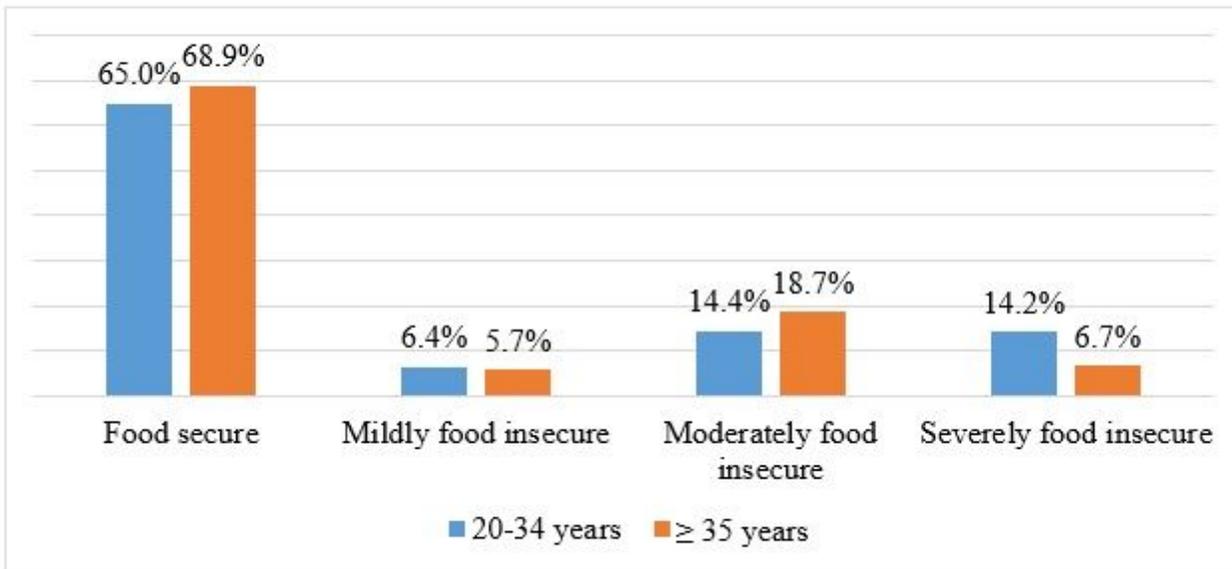
## References

1. Aaserud K. Advanced maternal age: What you need to know about getting pregnant after 35. 2017. Available at: <https://www.todayparent.com/pregnancy/being-pregnant/advanced-maternal-age-what-you-need-to-know-about-getting-pregnant-after-35/>. Access date: [Feb 16, 2018].
2. Stowers P. Advanced Maternal Age-Risks and Precautions, 2014. Available at: <https://www.everydayfamily.com/advanced-maternal-age-risks-and-precautions/>. Access date: [Feb 16, 2018].
3. Dekker R, Niles M, Breakey A. Evidence on: Advanced Maternal Age, or Pregnancy at Age 35 or Older, 2016. Available at: <https://evidencebasedbirth.com/advanced-maternal-age/>. Access date: [Mar 5, 2018].
4. Yaniv S, Levy A, Wiznitzer A, Holcberg G, Mazor M, Sheiner E. A significant linear association exists between advanced maternal age and adverse perinatal outcome. *Arch Gynecol Obstet*, 201. 283: 755-759.
5. Bekdas M, Demircioglu F, Kadi Z, Kismet E. Pregnancy Outcome in Women of Advanced Maternal Age: A Cross-Sectional Study in a Turkish Maternity Hospital. *Maced J Med Sci.*, 2013. 4(6): 365-369.
6. Claramonte NM, Dominguez GC, Gich SI, Olivella GA, Parra RJ, Armengol SJ. Hospital de Sant Pau, Barcelona, Spain. Pregnancy and neonatal outcomes at advanced maternal age: prospective results from a tertiary university referral hospital in Barcelona, Spain. 2016. 15th World Congress in Fetal Medicine.
7. Walker KF, Thornton JG. Advanced maternal age. *Obstetrics, Gynaecology and Reproductive Medicine*, 2016. 26(12): 335-357.

8. Mathews TJ, Brady EH. First Births to Older Women Continue to Rise. CDC's NCHS, Division of Vital Statistics, Reproductive Statistics Branch, 2014.
9. Laopaiboon M, Lumbiganon P, Intarut N, Mori R, Ganchimeg T, Vogel JP, Souza JP, Gulmezoglu AM, on behalf of the WHO Multicountry Survey on Maternal Newborn Health Research Network. Advanced maternal age and pregnancy outcomes: a multicountry assessment. *BJOG* 2014; 121 (Suppl. 1): 49–56.
10. Schimmel MS, Bromiker R, Hammerman C, Chertman L, Ioscovich A, Granovsky-Grisaru S, Samueloff A, Deborah E. The effects of maternal age and parity on maternal and neonatal outcome. *Arch Gynecol Obstet*, 2015. 291:793-798.
11. Wang Y, Tanbo T, Abyholm T, Henriksen T. The impact of advanced maternal age and parity on obstetric and perinatal outcomes in singleton gestations. *Arch Gynecol Obstet*, 2011(284): 31-37.
12. Hsieh TT, Liou JD, Hsu JJ, Lo LM, Chen SF, Hung TH. Advanced maternal age and adverse perinatal outcomes in an Asian population. *Eur J Obstet Gynecol Reprod Biol.*, 2010. 1(148): 21-16.
13. Figuerêdo ED, Lamy FF, Lamy ZC, Silva AA. Maternal age and adverse perinatal outcomes in a birth cohort (BRISA) from a Northeastern Brazilian city. *Rev Bras Ginecol Obstet.* 20, 2014.
14. Rashed HE, Awaluddin SM, Ahmad NA, Supar NH, Lani Z, Aziz F, et al. Advanced Maternal Age and Adverse Pregnancy Outcomes in Muar, Johor, Malaysia. *Sains Malaysiana*, 2016. 10(45): 1537-1542.
15. Giri A, Srivastav VR, Suwal A, Tuladhar AS. Advanced maternal age and obstetric outcome. *Nepal Med Coll J*, 2012. 15(2):87-90.
16. Hoque ME. Advanced maternal age and outcomes of pregnancy: A retrospective study from South Africa. *Bio Med Res*, 2012; 23: 281-5.
17. Kenny LC, Lavender T, McNamee R, O'Neill SM, Mills T, et al. Advanced Maternal Age and Adverse Pregnancy Outcome: Evidence from a Large Contemporary Cohort. *PLoS ONE*, 2013. 8(2): e56583. doi:10.1371/journal.pone.0056583.
18. Mills M, Rindfuss RR, McDonald P, te Velde E. Why do people postpone parenthood? Reasons and social policy incentives. *Human Reproduction Update*, 2011. 17(6): 848-860.
19. Almeida NK, Almeida RM, Pedreira CE. Adverse perinatal outcomes for advanced maternal age: a cross-sectional study of Brazilian births. *J Pediatr (Rio J)*, 2015. 91:493-498.
20. Yu-Jin K, Hyun-Mee R, Jae-Hyug Y, Ji-Hyae L, Ji-Eun L, Moon-Young K, Jin-Hoon C. Pregnancy outcomes according to increasing maternal age. *Taiwanese Journal of Obstetrics & Gynecology*, 2012. 51:60-65.
21. Yogev Y, Melamed N, Tenenbaum-Gavish K. Pregnancy outcome at extremely advanced maternal age. *Am J Obstet Gynecol*, 2010. 203:558.
22. Carolan M. Maternal age  $\geq 45$  years and maternal and perinatal outcomes: a review of the evidence. *Midwifery*, 2013. 5(29): 479-89.
23. Gluck O, Mizrachi Y, Bar J, Barda G. The impact of advanced maternal age on the outcome of twin pregnancies. *Archives of Gynecology and Obstetrics*, 2018.

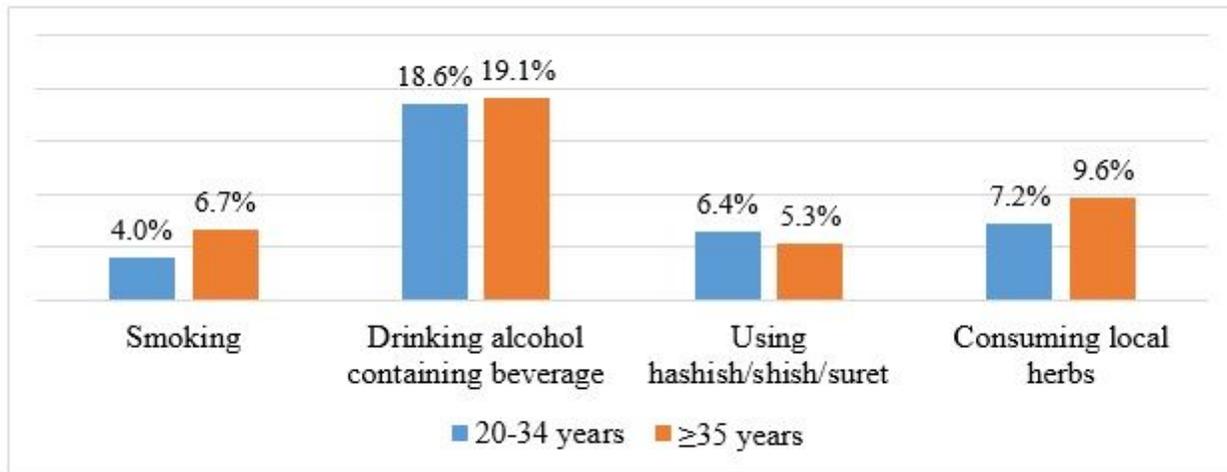
24. Ngowa JD, Ngassam AN, Dohbit JS, Nzedjom C, Kasia J. M. Pregnancy outcome at advanced maternal age in a group of African women in two teaching Hospitals in Yaounde, Cameroon. *Pan African Medical Journal*, 2013. 14:134.
25. Khalil A, Syngelaki A, Maiz N, Zinevich Y, Nicolaidis K. Maternal age and adverse pregnancy outcome: a cohort study. *Ultrasound Obstet Gynecol*, 2013(42):634-643.
26. Whiteman MK, Tepper NK, Kottke M, Curtis KM, Goedken P, Mandel MG and Marchbanks PA. Using a Checklist to Assess Pregnancy in Teenagers and Young Women. *Obstet Gynecol.*, 2014. 123(4):777-784.
27. EDHS, Central Statistical Agency (CSA) [Ethiopia] and ICF. 2016. Ethiopia Demographic and Health Survey 2016: Key Indicators Report. Addis Ababa, Ethiopia, and Rockville, Maryland, USA. CSA and ICF. 2016.
28. Coates J, Anne S, Paula B. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development, August 2007.
29. Yazdani M, Amirshahi E, Shakeri A, Amirshahi R, Malekmakan L. Prenatal and Maternal Outcomes in Advanced Maternal Age, a Comparative Study. *Women's Health Bull.*, 2015. 2(2).
30. Ludford I, Scheil W, Tucker G, Grivell R. Pregnancy outcomes for nulliparous women of advanced maternal age in South Australia, 1998 – 2008. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 2012. 52:235-241.
31. Alshami HA, Kadasne AR, Khalfan M, Iqbal SZ, Mirghani HM. Pregnancy outcome in late maternal age in a high-income developing country. *Arch Gynecol Obstet*, 2011. 5(284): 1113-1116.
32. Blomberg M, Birch Tyrberg R, Kjølhede P. Impact of maternal age on obstetric and neonatal outcome with emphasis on primiparous adolescents and older women: a Swedish Medical Birth Register Study. *BMJ Open*, 2014; 4:e005840. doi:10.1136/bmjopen-2014-005840.
33. Lisonkova S, Potts J, Muraca GM, Razaz N, Sabr Y, Chan W-S, et al. Maternal age and severe maternal morbidity: A population-based retrospective cohort study. *PLoS Med*, 2017. 14(5): e1002307. <https://doi.org/10.1371/journal.pmed.1002307>.

## Figures



**Figure 1**

Household food insecurity access scale in relation to maternal age for the study conducted in Arba Minch zuria, Gacho Baba district, southern Ethiopia, 2018/9



**Figure 2**

Habit in relation to maternal age for the study conducted in Arba Minch zuria, and Gacho Baba district, southern Ethiopia, 2018/9

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1.pdf](#)