

# An Analysis of Trend, Pattern, and Determinants of Abortion, Miscarriage, and Stillbirths in Odisha, India

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## Abstract

The study aimed at examining the prevalence of pregnancy termination by Abortion, Miscarriage, and Stillbirths (AMS) and its determinants in the state of Odisha, India. The NFHS-IV data have been used for this analysis. GIS mapping has been used for the spatial distribution of outcome variables at the district level. Univariate analysis (chi-square) and a multivariable logistic model have been used to identify the potential factors associated with AMS. Out of 8,484 pregnancy cases registered, 969 (11.4%) cases had met with pregnancy termination by AMS. Jagatsinghpur, Jajapur, Subarnapur, Kendrapara, Nayagarh, and Puri have been identified as high prevalent districts. The age group of 30-34 years is more likely of pregnancy termination than the age group 15-19 years (OR=1.254). Women who have completed secondary education have 1.568 times higher odds of pregnancy termination by AMS than those who are illiterate. Pregnancy complications show significantly higher odds (OR=1.091) of pregnancy termination. Among the trio of reasons for pregnancy termination, miscarriage cases are the most prevalent, followed by abortion and stillbirths. Potential factors like age, education, wealth index, place of delivery, and anemia are significant for AMS ( $p$  value<0.05). Hence, a robust program must be developed to reduce adverse pregnancy outcomes.

## Keywords

Abortion; logistic model; miscarriage; spatial mapping; stillbirths

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## Introduction

Women's and Children's health is of paramount importance to every civilized society. Despite historical achievements made in the past 15 years (Blencowe et al., 2016), 2.6 million women have still suffered from the death of their babies as stillbirths in the last trimester of pregnancy or during labor. The World Health Organization (WHO) considers stillbirth as a major public health issue. Stillbirth refers to the death of a fetus inside the womb at or after 28 weeks of pregnancy (Cousens et al., 2011). The women and children's health also suffers from issues such as miscarriage and abortions. Miscarriage (i.e., early pregnancy loss) refers to when a baby dies in the womb (uterus) before 20 weeks of pregnancy. As many as half of all pregnancies end in miscarriages, yet the exact number is unknown because a miscarriage may happen before a woman even knows she is pregnant. However, most women who miscarry have a healthy pregnancy later. On the other hand, an abortion, the deliberate termination of a human pregnancy, is most often performed during the first 24 weeks of pregnancy (Ahmed et al., 1998). The term abortion refers to the termination of a pregnancy, either natural or induced. The trio of abortions, miscarriage, and stillbirths (hereafter AMS) are poised to cause havoc on women and children's health if these individuals are not timely and properly checked. The situation is alarming in almost all the underdeveloped countries, being universal in all the African and developing countries. One of the major reasons these issues have failed to attract global attention is the lack of formalized agendas and actions.

There is a spectrum of terms, including threatened abortion, or inevitable or missed abortion, that describes different states of pregnancy loss. Recently, the American College of Obstetricians and Gynecologists (ACOG, 2015) had estimated that abortion is the most common form of pregnancy loss, with as many as 26% of all pregnancies end in miscarriage and up to 10% in clinically recognized pregnancies. Most miscarriages (i.e., early pregnancy loss) happen in the first trimester or before the 12th week of pregnancy. Being absent from the Millennium Development Goals (MDG) and presently missing in the Sustainable Development Goals (SDG), stillbirths continue to be a neglected public health issue, invisible in policies and programs, underfinanced, and in urgent need of attention (WHO, 2016). In 2015, mostly in low- and middle-income countries, 18.4 babies were stillborn for every 1000 total births. In high-income countries, the rates varied from 1.3 to 8 per 1,000 births, a variation that indicates that further improvements are possible (Blencowe et al., 2016).

Various studies have revealed the associated factors related to the termination of pregnancy by AMS. Some of these factors are the age of mother at first birth, wealth index, birth order number, and preceding birth interval in months (Lakew et al., 2017), maternal infections, non-communicable diseases, nutrition and lifestyle, maternal age, and prolonged pregnancies (Lawn et al., 2016). Increased age of the mother, and underweight, and obesity are also contributing factors for the same (Feodor Nilsson et al., 2014). Similarly, the social environment, lifestyle, and mental health of the mother also have an impact on the unfavorable outcome of the pregnancy (Keeping et al., 1989). Other modifiable risk factors for pregnancy complications are alcohol consumption, lifting of more than 20 kg daily, and working at night. For abortion, the major associated factors identified are education, religion, age, knowledge about legal abortion, and safe places to undergo abortions (Yogi et al., 2018), civil status, race or color, the prevalence of lower levels of education, and age less than 20 years (Santos et al., 2016). Yi et al. (2015) found that unwanted pregnancies are the single biggest reason behind abortions. Studies (see Altijani et al., 2018; Bhati, 2013; Dandona et al., 2017; Kochar et al., 2014; Newtonraj et al., 2017) conducted in India also revealed the same

factors along with sociocultural and medical complications. Moreover, recently, Hossain et al. (2019) observed that maternal occupation, level of education, place of residence, and modes of delivery are statistically significant factors associated with perinatal mortality.

However, the health issues of AMS have failed to attract the required attention due to the scarcity of quality data (de Bernis et al., 2016) and the availability of such information (Cousens et al., 2011). AMS represents a devastating pregnancy outcome, and there is a need for increased efforts to identify the causes and implement preventive measures. Knowledge of the relative importance of the different causes of AMS in developing countries is still lacking. Hence, this study is conducted in the state of Odisha to fill the gap in the existing literature. The objective of the study is to know the prevalence of pregnancy outcomes from AMS among the registered women in the state of Odisha, India, and its determinants.

We focus on Odisha, which is situated along the eastern coast of India. It is one of the poorest states in the country. Close to 60 percent of the state's population is below the poverty line. Slightly over 80 percent of the population lives in the rural area of the state. Poverty, coupled with a lack of rapid economic development, is reflected in the state's health and social indicators. As per the report "Healthy States – Progressive India" (NITI Aayog, 2019) released by NITI Aayog in partnership with the Ministry of Health and Family Welfare, Government of India and the World Bank, health index score of states, six out of eight EAG states are low performing states. Odisha is one of the least performing states in many important health indicators, as detailed in Table 1 below.

**Table 1:** Health Indicators of the State of Odisha

Parameter	Reference year	Odisha	Best performing state	Status of best-performing state
Neonatal mortality (Per 1000 live births)	2016	32	Kerala	6
Under-five mortality rate (Per 1000 live births)	2016	50	Kerala	11
The proportion of Low Birth Weight among newborns	2017-2018	18.2	Jammu & Kashmir	5.5
Full immunization coverage	2017-2018	59.8	Jammu & Kashmir	100
The proportion of institutional deliveries	2017-2018	70.9	Telangana	91.7
Total case notification rate of tuberculosis (per 100,000 population during a specific year)	2017	159	Kerala	67
The average occupancy of a District Chief Medical Officer (CMO) or equivalent post (heading District Health Services full-time) (in months) in last three years	2015-2018	13.5	Gujarat	19
Vacancy of Medical Officers at PHCs	2017-2018	31.9	Kerala	2.4
Vacancy of Specialists at district hospitals	2017-2018	27.4	Kerala	13.5
The proportion of facilities functional as First Referral Units	2017-2018	69.1	Jammu & Kashmir	220
The proportion of functional 24x7 PHCs	2017-2018	26.4	Chhattisgarh	111.4
Cardiac Care Units in districts	2017-2018	33.3	Tamil Nadu	90.6
The proportion of CHCs with the grading of 4 points or above	2017-2018	46.4	Andhra Pradesh	87.4

*Note: Report titled "Healthy States – Progressive India, 2019" (NITI Aayog, 2019).*

Table 1 shows that in each of the parameters mentioned herein, Odisha has miles to go to catch up with the best-performing state in the country. This reflects that Odisha is one of the most fragile states in terms of the bodily well-being of its people. Thus, it is imperative to understand the factors associated with one of the major health issues facing today's women (i.e., abortion, miscarriage, and stillbirth) in this state. It may help policymakers and program planners to initiate strategies to improve women's health.

## Materials and Methods

The data for this study has been obtained from the Demographic and Health Surveys (DHS) Program (<https://dhsprogram.com/data/available-datasets.cfm>). The most recent DHS data for India is the National Family Health Survey (NFHS 4) conducted during 2015-2016. The survey was coordinated by the International Institute for Population Sciences (IIPS), Mumbai, under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. The survey follows a multi-stage sampling design to select the eligible woman for the interview. The sample is representative at the national and sub-national levels. A detailed description of the methodology has been explained in the NFHS-4 report.

For analysis, a combined individual data set of married women who have registered pregnancies are considered for establishing the prevalence of pregnancy outcome AMS. Hence the target population is 'pregnancy registered married women' aged between 15-49 years. A total of 8,484 women were found to be eligible for the analysis. The pregnancy outcome by AMS is recoded as '1' for 'yes or pregnancy termination occurred' and '0' for 'no or pregnancy termination not occurred,' which numbers were 969 and 7,515, respectively.

Statistical analysis was executed with SPSS version 20. To determine the socioeconomic and maternal factors associated with the outcome variable (pregnancy end by AMS), we used univariate analysis by chi-square test and Fisher's exact test, whichever was applicable, and multivariate analysis by a logistic regression model. The logistic regression model is defined as

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 * Age + \beta_2 * Education + \dots + \beta_n * Anemia \dots \dots (1)$$

Where  $p=P(Y_{i=1})$  is the value of dichotomous outcome variable identified as 'Pregnancy ended by AMS,' and  $\beta_i$  's are regression coefficients.

In all cases, the  $p$ -value ( $p<0.05$ ) is considered statistically significant. A Geographic Information System (GIS) map was performed to get information about the nature of the spatial distribution of outcome variables at the district level in the state of Odisha.

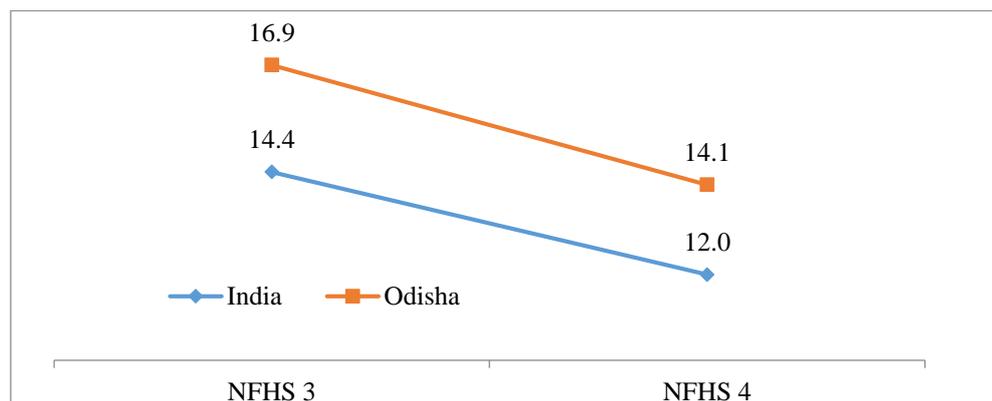
## Results

### Trend and pattern

For the current study on loss of pregnancies due to AMS, we have extensively used databases sourced from NFHS 3 (2005-2006) and NFHS 4 (2015-2016). The reason behind not considering data from NFHS 1 and NFHS 2 rounds was the unavailability of relevant data of our outcome of interest. It is pertinent to mention here that the data available in both the database pertains to 'percentage of women age 15-49 years whoever had non-live births include AMS' (International Institute for Population Sciences, 2007, 2017).

Figure 1 shows that during the survey period of NFHS-4, 12 percent of women aged between 15-49 years had experienced AMS in their lifetime, compared with 14.4 percent during NFHS-3 at the national level. The state of Odisha also had a similar decreasing trend wherein pregnancy loss on account of AMS during the survey periods declined from 16.9 percent during NFHS 3 to 14.1 percent in NFHS 4. The reason behind the decreasing trend may be due to the implementation of various programs and schemes envisaged by the government.

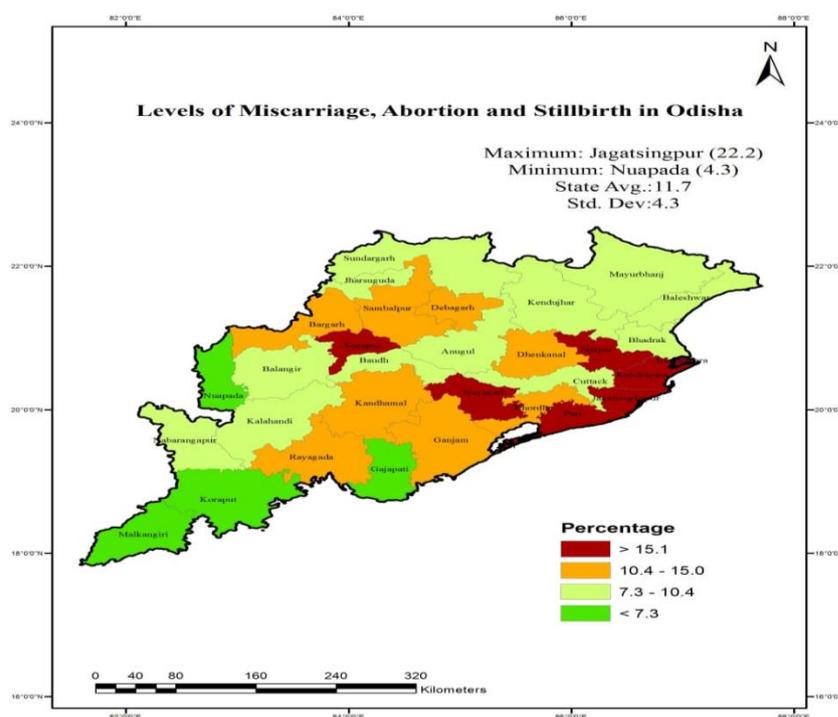
**Figure 1:** Trend and Pattern of Pregnancy Ended in Abortion, Miscarriage, and Stillbirths (in %), India vs. Odisha



Note: NFHS round 3 (2005-2006) and NFHS round 4 (2015-2016) reports, IIPS, Mumbai

A total number of 8,484 pregnancy cases were registered in the state of Odisha. Out of which, a total of 969 (11.4%) cases were reported to have met pregnancy termination due to any of the three reasons representing AMS. It was observed that miscarriages contributed the greatest (58.1%) of the total pregnancy termination cases, followed by abortion (32.8%), and then stillbirths (9.1%). It is also interesting to note that pregnancy ends by AMS are the most prominent (13%) in the age group of 25-29-year-old women. The same is the lowest (3.5%) for the 45-49-year-old age group of women.

**Figure 2:** Levels of Abortion, Miscarriage, and Stillbirth in Districts of Odisha



Note: Authors

In Figure 2 above, the geospatial map reflects the prevalence of pregnancy termination by AMS at all district levels of the state of Odisha. This map has been presented through a Geographic Information System (GIS) taking with state average (11.7), and standard deviation (4.3), four categorized levels of percentage (deep red '>15.1', orange '10.4-15.0', lite green '7.3-10.4', deep green '<7.3') have been used for a straightforward interpretation of spatial distribution. It is observed that the districts Jagatsinghpur (22%), Jajapur (19%), Subarnapur (Sonpur) (19%), Kendrapara (18%), Nayagarh (18%), and Puri (17%) have a high prevalence of AMS.

## Univariate analysis

Table 2 shows the results of various socioeconomic and maternal factors associated with the occurrence and non-occurrence of pregnancy termination by AMS. This finding indicates that the occurrence of pregnancy termination and maternal age groups are statistically significant ( $p$ -value=0.000). The pregnancy termination rate is higher (13%) among women with a secondary educational level than other educational qualifications ( $p$ -value=0.000). In the case of the wealth index, those belonging to the middle and rich category had more (13%) pregnancy terminations than those who are poor ( $p$ -value=0.020). A higher proportion of pregnancy termination by AMS is observed in private sector health facilities (14%) compared to the public sector health facility (12%) and at home (8%). This study also reveals that women who have anemia (11%) show significant results in pregnancy termination ( $p$ -value=0.047). But the place of residence, religion, and knowledge about pregnancy complications are not statistically significant with the termination of pregnancy ( $p$ -value>0.05).

**Table 2:** Variables Related to Pregnancy Ended in Abortion, Miscarriage, and Stillbirth

Variables	Categories	Pregnancy ended in abortion, miscarriage, or stillbirth		Chi-square	p-value
		Yes (%)	No (%)		
Age (in yrs.) group	15-19	24 (9.1)	239 (90.9)	26.847	0.001
	20-24	294 (11.8)	2,201 (88.2)		
	25-29	407 (13)	2,727 (87)		
	30-34	178 (10.5)	1,516 (89.5)		
	35-39	53 (8)	606 (92)		
	40-44	11 (6)	171 (94)		
	45-49	2 (3.5)	55 (96.5)		
Education	No education	193 (8)	2,196 (92)	42.691	0.001
	Primary	132 (11)	1,073 (89)		
	Secondary	587 (13)	3,813 (87)		
	Higher	57 (12)	433 (88)		
Wealth Index	Poor	587 (11)	4,894 (89)	7.781	0.020
	Middle	208 (13)	1,416 (87)		
	Rich	174 (13)	1,205 (87)		
Place of Delivery	At Home	95 (8)	1,043 (92)	16.738	0.001
	Public Health Facility	761 (12)	5,786 (88)		
	Private Health Facility	113 (14)	686 (86)		
Place of Residence	Urban	178 (13)	1,198 (87)	3.724	0.054
	Rural	791 (11)	6,317 (89)		
Religion	Hindu	904 (11)	6,990 (89)	0.103	0.749
	Others	65 (11)	525 (89)		
Told about pregnancy Complication	Yes	709 (12)	5,390 (88)	0.887	0.346
	No	260 (11)	2,125 (89)		
Anemia	Yes	506 (11)	4,179 (89)	3.989	0.047
	No	463 (12)	3,336 (88)		

## Multivariate analysis

Table 3 reports the results of the logistic regression model. The socio-demographic and maternal related variables, e.g., age, education, place of delivery, and anemia, are found to be significantly associated with pregnancy termination ( $p$ -value<0.05). The women in the age group of 30-34 years are 1.254 times more likely of pregnancy termination than the 15-19 age group. In the case of mothers' education, pregnancy terminations among women who have completed primary and secondary education have 1.304 and 1.568 higher odds, respectively, than those who have no education. The women who have the place of delivery in the private sector health facility have a significantly higher odds ratio of pregnancy termination (OR= 1.412). This study also finds that women who have pregnancy complications show significantly higher odds of pregnancy termination (OR=1.091).

**Table 3:** Association of Pregnancy Termination Related Variables Using Binary Logistic Regression

Variables	Category	Estimate(B)	z-score	p-value	Odds ratio
Age (in yrs.) group	15-19	<i>ref.</i>			
	20-24	0.274	1.225	0.221	1.315
	25-29	0.416	1.876	0.061	1.515
	30-34	0.226	0.985	0.033	1.254
	35-39	-0.028	-0.108	0.914	0.972
	40-44	-0.218	-0.573	0.566	0.804
	45-49	-0.749	-0.995	0.320	0.473
Education	No education	<i>ref.</i>			
	Primary	0.266	2.199	0.028	1.304
	Secondary	0.450	4.576	0.001	1.568
	Higher	0.264	1.429	0.153	1.302
Wealth Index	Poor	<i>ref.</i>			
	Middle	-0.022	-0.239	0.811	0.978
	Rich	-0.106	-0.911	0.363	0.900
Place of Delivery	Home	<i>ref.</i>			
	Public health facility	0.181	1.514	0.130	1.199
	Private health facility	0.345	2.110	0.035	1.412
Place of Residence	Rural	<i>ref.</i>			
	Urban	-0.115	-1.173	0.241	0.892
Religion	Others	<i>ref.</i>			
	Hindu	0.034	0.249	0.803	1.035
Pregnancy Complication	Yes	0.087	0.477	0.034	1.091
Anemia	Yes	-0.075	-1.078	0.281	0.928
	Constant	-2.600	-7.122	0.001	0.074

## Discussion and conclusions

We have identified the determinants associated with pregnancy termination by AMS. The peculiarity of our study is that we have considered women with pregnancies registered for the analysis. Among the trio of pregnancy termination, miscarriage cases were highest, followed by abortion and then stillbirths. A recent study by Fukuta et al. (2020) highlighted cervical polyps during pregnancy as one of the major causes creating a high-risk factor for miscarriage. In our study, there is an unavailability of data on cervical polyps. Nonetheless, many studies have identified cervical polyps as one of the major causes of miscarriage. Although the government has implemented various schemes, the anomaly is that improvement in women and children's health outcomes is not balanced across the districts in the state. Our study explored the districts of Jagatsinghpur, Kendrapara, Nayagarh, Jajpur, Puri, and Subarnapur (Sonpur) that have a high incidence of newborn deaths on account of AMS. It can be noted that there is a high prevalence of AMS, mainly in the coastal belt of the state except the Sonpur district. The finding is similar to the recent study in Bangladesh, which states that high salt intake during pregnancy generates a high-risk factor for miscarriage and pregnancy abnormality (Hossain, 2020). Other similar studies have also hinted at a link between high salt intake during pregnancy and the occurrence of miscarriage (Abdoli, 2016; Duley et al., 2005). Before we investigate the reason behind the high prevalence of AMS in the

Sonpur district, let us first look at various features associated with this district. Sonpur is one of the most undeveloped districts in the country, as identified by the central government under the Backward Regions Grant Fund Programme (BRGF). Moreover, as per census 2011, 91.82% of the population lives in rural areas. The district's perceived backwardness has resulted in a lack of awareness about healthy pregnancy and its benefit. As a result, it provides an abnormality of pregnancy outcome. Another finding is that there is a declining trend of pregnancy termination in Odisha, higher than the national level as per the NFHS-4 report. The evidence at the national level suggests that the launch of NRHM in 2005 has brought about a surge in institutional deliveries, which has resulted in a remarkable decrease in fatalities caused by complications during delivery (Vora et al., 2009).

A closer look at the significantly associated factors reveals that women in the age group of 30-34 years are more likely to experience loss of pregnancy on account of AMS ( $p$ -value=0.033). Many empirical studies have also found the same probability of pregnancy-related complications rises manifold in the higher age groups (see Feodor Nilsson et al., 2014; de La Rochebrochard & Thonneau, 2002; Lawn et al., 2016; Magnus et al., 2019; Rai & Regan, 2006).

Concerning the level of education as a significant factor for loss of a pregnancy, it has been found that women with primary education ( $p$ -value=0.028) or with secondary education ( $p$ -value=0.001) are more likely to have a loss of pregnancy due to the three factors of AMS. This is because, in India, the secondary level of education does not explicitly refer to women and children's health in its syllabus, which incapacitates the students for the complex understanding of pregnancy and related aspects (NITI Aayog, 2019). However, women with higher education are exposed to the understanding of complex aspects of women and children's health along with pregnancy-related aspects that place them in a better position. In conformity with foreign and other studies in India have also identified that the level of education impacts pregnancy outcome (Santos et al., 2016; Yogi et al., 2018). We have also found a statistically significant relationship between the wealth index of mothers and pregnancy loss by AMS. Other studies (Flenady et al., 2016; Lakew et al., 2017) have also supported these findings.

Our result also reiterates concern related to the choice of place of delivery as a significant factor contributing to the loss of pregnancy due to AMS. It is observed that women opting for private health care facilities are more likely to have a loss of pregnancy ( $p$ -value=0.035). It is mainly because, in India, public health care facilities are prohibited from carrying out any kind of abortion, except when mandated by court order (Duggal, 2004; Hirve, 2004). However, there are private hospitals in the country that clandestinely allow for abortions, leading to increased reported numbers (Lavelanet et al., 2018). However, we would like to clarify that in India, abortions are not viewed positively. Hence, there is less likelihood of correct reporting of information about abortions. The above finding suggests a higher incidence of loss of pregnancy due to AMS for the people approaching private hospitals may need to be corroborated with more studies with a greater sample size interlinking other socio-cultural reasons behind abortions (Babu et al., 1998).

The finding shows that anemia, a medical complication of the mother, has a statistically significant relationship with pregnancy outcomes. This is corroborated with several studies showing that anemia during pregnancy is associated with the increasing risk of pregnancy termination (Dandona et al., 2017; Kaushalya et al., 2005; Levy et al., 2005).

It is worth mentioning the limitation of our study that the cross-sectional nature of the data prevents elucidating the direction of the cause-and-effect relationship of the independent

variables with the pregnancy outcome. We have also considered Odisha data for the analysis; thus, a strict generalization of our findings for the whole country needs utmost care and further conformity.

Based on the above discussion, we may conclude that the factors like age, education, wealth index, place of delivery, pregnancy-specific complications, and mothers having anemia are significantly associated with AMS. In contrast, the place of residence and religion were not statistically significant. Hence, considering these significant factors, a robust program must be developed to improve maternal, fetal, and neonatal health, ultimately reducing adverse pregnancy outcomes. Moreover, there is a need for further research on family and community-level factors that influence pregnancy outcomes.

## Ethical clearance

The study is based on the individual level data available in the DHS data repository and can be accessed upon request; therefore, no ethical review board clearance is required for this work.

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