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Maternal delays and unfavourable newborn outcomes among skilled deliveries in public hospitals of Hadiya Zone, Southern Ethiopia: a case–control study

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ABSTRACT

Object We assessed maternal delays and unfavourable newborn outcomes among skilled deliveries in public hospitals of Hadiya Zone, Southern Ethiopia using 'the three maternal delays' framework.

Design A case–control study was conducted.

Setting Public hospitals in Hadiya Zone, southern Ethiopia.

Participants Sample of 57 cases and 121 controls participated from 4 September 2019 to 30 October 2019. Consecutive dead newborns at discharge or admitted newborns for more 24 hours after delivery were selected as cases. Two consecutive controls were selected from none cases discharged within 24 hours of skilled delivery.

Results Total of 57 cases and 121 controls participated with 97.3% response rate. Forty-eight (84.2%), 46 (80.7%) and 51 (89.5%) of cases had first, second and third maternal delay, respectively. Eighty-six (71.1%), 18 (14.9%) and 69 (53.7%) of controls had first, second and third maternal delay, respectively. Cases with second maternal delay were 23.9 times more likely to have unfavourable newborn outcome when compared with controls. The first and third delays and wealth index were not significantly associated with newborn outcome in this study.

Conclusions First, second and third maternal delays were higher in cases than controls. 'Delay in reaching health facility' was determinant for unfavourable newborn outcome in this study. However, 'delay in decision-making to seek care' and 'delay in receiving care' were not significantly associated with new born outcome. Government should work to improve labouring mother transportation.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study measured the economic status of participants by wealth index.
⇒ The potential limitation of this study was using fetal movement as a sign of life to manage the happening of fetal death before maternal delay that exposes to self-section.
⇒ Another limitation could be social desirability with care providers resulting from an institution-based study setting.
⇒ The third maternal delay was assessed by a questionnaire responded to by mothers that might be subjective.

INTRODUCTION

Obstacles to skilled birth care were depicted in the 'three maternal delays framework' model. The model includes delays: in the decision to seek care (first delay); in reaching health facilities (second delay) and in receiving treatment for obstetric complications (third delay).[1] The first and second delays are associated with decision making in the family, distance from health facilities, socioeconomic status and area of residence. The third one is due to delays in receiving adequate care.[2] However, the contribution of this model to newborn care is still unclear.

Globally, over one-third of neonatal death typically occurs within 24 hours of delivery. In sub-Saharan Africa, intrapartum complications cause most of the adverse newborn outcomes. In Ethiopia, two out of three neonatal deaths are due to prematurity and preventable asphyxia. Poor perinatal management leads to birth asphyxia and sepsis of newborn that might cause death.[3–6] The sector-wide approach of the healthcare delivery system has improved the utilisation of skilled delivery services due to decreased maternal delays in this approach.[6] However, the association between maternal delays and the unfavourable newborn outcome is not well assessed.

Maternal delays are complicating skilled delivery service provision resulting in poor newborn outcomes including hospital stays. More than half of the mothers with potentially life-threatening conditions (maternal near-miss) have any kind of these maternal delays. Delays in the decision to seek healthcare and longer travel time to hospital are resulting in complications of the perinatal period with hospital stay and lately started caesarean section (C/S).[2 7–9] However, the causal relationship between maternal delays and the unfavourable newborn outcome is not adequately assessed. Therefore, this study assessed the maternal delays and unfavourable newborn outcomes of skilled delivery in public hospitals of Hadiya Zone using the maternal delay framework.

METHODS

Study design, area and period

From 4 September 2019 to 30 October 2019, a case–control study was done at public hospitals in Hadiya Zone, Ethiopia. According to the 2007 census data projection for 2019/2020, the Hadiya zone has a 1 814 000 population. The Zone has two district hospitals and one teaching referral hospital. Patients are referred to hospitals by health centres or come directly from their homes for skilled delivery services. Antenatal care, skilled birth care and C/S services are all available at these facilities. Gynaecologists perform C/S at the teaching referral hospital. This service is provided by emergency surgery professionals at the district hospitals. Each district hospital provides 10 per day, whereas the teaching referral hospital provides 20 deliveries services per day on average.

Patient and public involvement

There were no patients and public involvement in the design and conduct of the study, choice of outcome measures or recruitment to the study.

Populations

The source populations were all newborns delivered in Hadiya Zone public hospitals. The study populations were all newborns delivered in public hospitals within the study period.

Inclusion and exclusion criteria

To manage the happening of the case (fetal death) before exposure (maternal delay), we used fetal movement as a sign of life. The mother's perception of fetal movement within 48 hours before labour was considered as inclusion criteria. The study excluded newborns delivered by elective induction of labour or elective C/S or whose mother died during the perinatal period. The newborns admitted to the hospital for maternal admission were also excluded from the study.

Sample size calculation

Since there is a shortage of literature in a similar setting, preliminary data from the pre-test was used to calculate the sample size. The pretest was conducted among 25 participants (21 controls and 4 cases) in Halaba Hospital. Eleven (52%) of controls and three (75%) of cases had experienced third maternal delays. 'Open-Epi Collection of Epidemiological Calculators V.3.01'[10 11] was used to calculate the sample size using the result from the pretest. One to two ratios of cases to controls was used for sample size calculation. The power of 80% power was also considered to detect the difference in newborn outcomes with a confidence level of 0.95. By adding 5% for no response, the final sample size of 61 cases and 122 controls was calculated.

Sampling and data collection procedures

Consecutive dead newborns at discharge or admitted newborns for further care in hospital for more than 24 hours of delivery were selected as cases. Admitted newborns with admission criteria of altered consciousness, required therapeutic hypothermia, neurological symptom and chest compression required during resuscitation were included in the study. The death of cases occurred either during labour and delivery or within the 24 hours after delivery.

Two consecutive controls were selected from none cases discharged within 24 hours of hospital admission. The sample size was proportionally allocated to each hospital considering their average monthly skilled delivery services. Six-degree holder midwiferies were recruited to collect the data out of working hospitals. Three MSc holder health professionals had supervised the data collection process. The data on starting time of labour, decisions to seek care for the labour, maternal delays and the newborn outcome was assessed using a pretested and structured tool that was developed after reviewing different literature.[3 4 9] The first maternal delay had 10 questions; the second maternal delay has 9 questions and third maternal delay has 10 questions on five points Likert scale. Initially interviewer read each question for the respondents with the option to choose by saying strongly disagree, disagree, neutral, agree and strongly agree for each question.

Data quality control

The instrument was prepared in English language and translated into the local language, Hadiyisa and Amharic for data collection. The data were collected by a structured, interviewer-administered questionnaire. Pretesting was conducted in 25 (4 cases and 21 controls) participants for the necessary modifications and corrections. Data collectors and supervisors were trained for 1 day by the principal investigator on the consent form, study instrument and procedures. The data collection process was supervised daily for completeness and consistency of the filled questionnaires. Epidata V.3.1 was used for data entry to minimise entry errors.

Data processing and analysis

Data entry was conducted by Epidata and analysed using SPSS V.21.0 statistical software. Different descriptive summaries were used to describe the study variables. The

Likert scale questions that contained 10 items for the first maternal delay; 9 for second maternal delay and 10 for third maternal delay were used to assess the delays. The respondents choose the appropriate answer for each item by saying strongly disagree, disagree neutral, agree and strongly agree during data collection. At the time of data entry, numeric data were prepared to cod strongly disagree as 1; disagree as 2; neutral as 3; agree as 4 and strongly agree as 5. Summation of item score under each maternal delay was calculated for each respondent. Then mean score was calculated for each maternal delay from the summation of items score. For each maternal delay, participants scoring above the mean score were considered as having that maternal delay.

The wealth index was calculated by principal component analysis (PCA) from 32 variables for a total sample of 178. Sample adequacy was checked by KMO=0.741- which is >60%. Eight components were extracted for these variables. The cumulative sum of rotational squared loadings and minimum 'Eigenvalues' at the eighth component was 69% and 1.037. By removing complex structures, six PCs remained explaining a total variance of 66.76% with 'Eigenvalues' of 1.121 at the sixth component. When we interpret the rotated loading, three components had at least three variables with significant loading measuring different constructs. Finally, 10 variables were represented by three PCs. The first PC had high loading on four variables like having a television; Couch (sofa—a piece of furniture for seating multiple people); electronics sound amplifier (Jepaz) and a living room dresser (control bife). This PC was specified as 'home furniture'. The second PC was marked by high loading on three variables like having a bedroom dressing box, home phone and computer. The second PC was specified as 'facilities'. The third was marked by high loading on three variables namely; using different 'ageda' for fuel (using woods for a cooking meal); having a goat and collecting drinking water from a spring that can be specified as 'assets and access'. The Cronbach's alpha was greater than 0.60 for each of the three PCs. Finally, the composite index was constructed and categorised into five quintile to detect family economic status.

Independent variables with a p value less than 0.25 in bivariate analysis were considered as a candidate for multivariate analysis. Variables having a p value less than 0.05 in multivariate analysis were considered a significant determinant of the newborn outcome. Accordingly, first, second and third maternal delays; antenatal care (ANC) follow-up, and the wealth index were entered into the multivariate analysis. The fitness of the model was tested by Hosmer and Lemeshow model test with p>0.05.

Variables

Outcome variables

Newborn outcomes.

Determinant variables

Included sociodemographic characteristics, pregnancy-related characteristics and three maternal delays. The sociodemographic variables were age, educational level, involvement in income-generating activities and household wealth index. The delays were first maternal delay (delay in the decision to seek care); second maternal delay (delay in reaching a healthcare facility) and third maternal delay (delay in receiving treatment for obstetric complications). Three delay variables are composite variables with a 5-point Likert scale. The first maternal delay includes variables like knowledge about the labour, knowledge about where to seek care, traditional beliefs/cultural norms, concerns about accessibility and cost of care, and availability of decision-maker. The second delay had variables like distance to the nearest health facility, means of transportation, transport costs, travel time to reach the health facility, costs of the services and referral conditions. The third delay variables were the availability of equipment, supplies and trained staff were considered.

Operational definitions

Cases

Newborn with unfavourable neonatal outcome.

Controls

Newborn with a favourable outcome.

Child birth-related complication in previous pregnancies

Positive response of respondents for none vertex presentation or multiple births or excessive bleeding or emergency C/S or convulsion or abortion.

The child-birth related complication in this pregnancy (during the current labour and delivery)

Positive response of respondents for the presence of none vertex presentation or multiple births or excessive bleeding or emergency C/S or deteriorated fetal heartbeat or decreased/ceased labour or amniotic fluid passage 12 hours before the labour.

Child-birth related traditional beliefs/cultural norms faced at home

If the mother responds as she had experienced one or more of the following: 'Thinking that going to the health facility before facing complication is unnecessary'; 'Fear of opening my body for healthcare providers'; 'Considering giving birth out of home is being unlucky' and 'Fear of going out while being in the labour'.

Community ambulance

A local stretcher that is used for the transportation of pregnant mothers and patients from their homes to health facilities in rural areas.

Newborns with the unfavourable outcome

Admitted newborns for care in hospitals for more than 24 hours after delivery or dead newborns.

Newborn with the favourable outcome

Alive newborn discharged within 24 hours of delivery.

Time to decide to go to a health institution

It is a decision time to go to the health facility for the skilled delivery service. If a mother report as she decides immediately to go to the health facility when she feels pushing-down pain, it was considered an immediate decision. If she did not decide immediately to go to a health institution for pushdown pain, considered a late decision. If she had decided before the start of pushing down pain, it was considered a decision before the start of labour.

Traditional home practice

Response of 'yes' for question assessing traditional/herbal medicine use; or applying and massaging abdomen with butter was considered as having traditional home practice.

First maternal delay

A mother who gave birth in a public hospital scoring above the mean for the calculated mean of the five-point Likert scale questionnaire of delay in seeking care.

Second maternal delay

A mother who gave birth in a public hospital scoring above the mean for the calculated mean of the five-point Likert scale questionnaire of delay at reaching care.

Third maternal delay

A mother who gave birth in a public hospital scoring above the mean for the calculated mean of the five-point Likert scale questionnaire of delay at receiving care.

RESULT

Sociodemographic and pregnancy-related characteristics

Data were collected from a total of 178 participants (57 cases and 121 controls) giving a response rate of 97.3%. Four cases and one control had refused to respond to the study. Most of the cases (56.1%) were rural residents, but only 48.8% of controls were from rural areas. More than half, 95 (53.4%), of the participants were protestant religion followers. The mean age of cases and controls was 29.7 and 28.9, and most of them were in the age group of 25–30 years. A majority, 20 (35.1%) of cases does not attend formal education; however, 50 (41.3%) of controls attend grade 1–8. All participants were married and 35 (61.4%) of cases and 82 (67.8%) of controls were housewives by their occupation. Husband's occupation is the farmer for the majority (29.8%) of cases, but merchant for the majority (31.1%) of the controls. The husband was an attendant (labouring mothers' relative who was responsible to care for her at hospitals) for 45 (78.9%) of cases and 84 (69.4%) of controls. Most of the participants (52.6% of cases and 64.5% of controls) decided by themselves to come to health the facility. Thirty (24.8%) of controls were in the first percentile while only 6 (10.5%) of the cases were in the same wealth index category (table 1).

Twenty-seven (47.4%) of cases and 90 (74.4%) controls had attended four or more ANC follow-ups. Fifteen (26%) of cases and 25 (20.7%) of controls had a history of childbirth-related complications in the past. However, more (31.6%) cases had reported complications in the current pregnancy. The average duration of labour in the cases was 13.9 hours, but it was lower for controls. Mode of delivery was assisted-vaginal delivery for 61.4% of cases and 53.7% of controls (table 2).

Maternal delays

Seventeen (29.8%) of cases and 39 (32.2%) of controls made an immediate decision to come to a health facility. Four (7%) of cases and five (4.1%) of controls had tried traditional practice to manage the labour and applying butter was the main practice. Twenty-two (38.6%) of cases and 25 (20.7%) of controls have faced childbirth-related traditional beliefs. Frequently listed childbirth-related traditional belief was thinking going to the health facility before having a complication is unnecessary. The majority (40.4% of cases and 38.8% of controls) of participants have used the ambulance as a means of transportation followed by Bajaj or three tiers of public transportation. A majority, 28 (49.1%), of cases were referred by health centres while the majority (43.0%) of controls were self-referred. For the first maternal delay, the mean score was 21.8 for cases and 19, for controls. The second maternal delay mean score was 28.2 for cases and 16.3 for controls. The third maternal delay mean score was 21.9 for cases and 18.1 for controls. The frequency of maternal delays in cases was 48 (84.2%), 46 (80.7%) and 51 (89.5%) for the first, second and third maternal delays. Among controls, 86 (71.1%), 18 (14.9%) and 69 (53.7%) had experienced first, second and third maternal delays (table 3).

Participants with second maternal delay were 24.9 times more likely to experience an unfavourable newborn outcome when compared with its counterpart with 95% CIs (8.9 to 69.4). Wealth index; ANC follow-up; first maternal delay and second maternal delay were candidates for the multivariate analysis, but they are not significantly associated with the newborn outcome in this study (table 4).

DISCUSSION

In this study, 84.2% of cases had experienced first maternal delay. This is higher than first delay experienced by the controls (71.1%). However, a lower level of first maternal delay was reported in a maternal death audit study done in Myanmar.[2] This shows first maternal delay is more frequent in the poor newborn outcome than maternal mortality. The previous study assessed maternal delay prevalence in maternal mortality cases by interviewing relatives of deceased mothers. In this study, maternal delay data were collected from the mothers who gave birth.

In this study, 80.7% of cases had second maternal delay while only 14.9% of controls experienced it. Research findings from Myanmar reported an 18% of second delay in maternal mortality.[2] This reflected the high frequency of the second maternal delay in the newborn outcome

Table 1 Distribution of sociodemographic characteristics of the study participants in the Hadiya zone public hospitals, Ethiopia, 2019

Characteristics		Case	Control	Total	
		No (%)	No (%)	No (%)	χ2 (95% CI)
Residence	Rural	32 (56.1)	59 (48.8)	91.0 (51.1)	1.34 (0.71 to 2.53)
	Urban	25 (43.9)	62 (51.2)	87.0 (48.9)	1
Religion	Muslim	5 (8.8)	18 (14.9)	23.0 (12.9)	1
	Orthodox	19 (33.3)	23 (19.0)	42.0 (23.6)	1.2 (0.1 to 14.2)
	Protestant	29 (50.9)	66 (54.5)	95.0 (53.4)	0.44 (0.04 to 4.63)
	Catholic	3 (5.3)	12 (9.9)	15.0 (8.4)	0.71 (0.07 to 7.12)
	Jehovah witnesses	1 (1.8)	2 (1.7)	3.0 (1.7)	0.1 (0.1 to 17.8)
Mean age of mother		29.7	28.9	29.1 (±5.1)	
Age category	<20	2 (3.5)	8 (5.8)	9.0 (5.1)	0.43 (0.08 to 2.41)
	21–25	7 (12.3)	26 (20.7)	32.0 (18.0)	0.63 (0.11 to 3.61)
	26–30	30 (50.9)	50 (39.7)	77.0 (43.3)	0.42 (0.08 to 2.09)
	31–35	8 (10.5)	20 (15.7)	25.0 (14.0)	0.93 (0.16 to 5.40)
	>35	10 (15.8)	17 (13.2)	25.0 (14.0)	1
Educational level	No formal education	20 (35.1)	33 (27.3)	53.0 (29.8)	1
	Grade 1–8	16 (28.1)	50 (41.3)	66.0 (37.1)	2.30 (0.95 to 5.61)
	Grade 9–12	7 (12.3)	19 (15.7)	26.0 (14.6)	2 (0.66 to 6.06)
	Above grade 12	14 (24.6)	19 (15.7)	33.0 (18.5)	1.21 (0.50 to 2.95)
Marital status	Married	57 (100.0)	121 (100.0)	178.0 (100.0)	
	Not married	0	0	0.0	
Occupation	House wife	35 (61.4)	82 (67.8)	117.0 (65.7)	
	Merchant	6 (10.5)	12 (9.9)	18.0 (10.1)	
	Employee	9 (15.8)	14 (11.6)	23.0 (12.9)	
	Student	7 (12.3)	13 (10.7)	20.0 (11.2)	
Husband's occupation	Employee	13 (22.8)	41 (33.9)	54.0 (30.3)	1
	Farmer	17 (29.8)	30 (24.8)	47.0 (26.4)	0.56 (0.24 to1.33)
	Merchant	16 (28.1)	40 (33.1)	56.0 (31.5)	0.79 (0.34 to1.86)
	Daily labourer	7 (12.3)	6 (5.0)	13.0 (7.3)	0.23 (0.08 to0.96)
	Other*	4 (7.0)	4 (3.3)	8.0 (4.5)	0.32 (0.07 to1.45)
Attendant	Husband	45 (78.9)	84 (69.4)	129.0 (72.5)	1
	Sons	7 (12.3)	26 (21.5)	33.0 (18.5)	2.00 (0.80 to 4.94)
	Others relatives†	5 (8.8)	11 (9.1)	16.0 (9.0)	1.20 (0.39 to 3.60)
Decision-maker to come to the health facility	Myself	30 (52.6)	78 (64.5)	108.0 (60.7)	1
	My husband	23 (40.4)	40 (33.1)	63.0 (35.4)	0.70 (0.35 to 1.30)
	Others‡	4 (7.0)	3 (2.5)	7.0 (3.9)	0.30 (0. 06 to 1.37)
Family members living out of Ethiopia	Yes	20 (35.1)	32 (26.4)	52.0 (29.2)	1
	No	36 (63.2)	84 (69.4)	120.0 (67.4)	1.46 (0.74 to 2.88)
Wealth index	First	7 (12.3)	29 (24)	36 (20.2)	3.4 (0.7 to 15.3)
	Second	9 (15.8)	25 (20.7)	34 (19.1)	3.7 (0.9 to 15.9)
	Third	14 (24.6)	23 (19.0)	37 (20.8)	3.6 (0.8 to 17.4)
	Fourth	11 (19.3)	12 (9.9)	23 (12.9)	1.1 (0.3 to 4.2)
	Fifth	17 (29.8)	31 (25.6)	48 (27.0)	1

Continued

Table 1 Continued

Characteristics	Case No (%)	Control No (%)	Total No (%)	χ2 (95% CI)

*Others listed decision-makers to come to the health facility were religious leaders, my neighbour, father, mother, and sister.
†Other relative attendants were 'my husband's family, brother/sister/father/mother and my neighbour.
‡Other listed husband's occupation was a student and religious preacher.
§

than maternal death. Eight out of nine cases (89.5%) had experienced third maternal delay while only six out of nine controls (67.4%) experienced it. Another study showed 48.1% of third delays after hospital admission.[8] This study assessed the third maternal delay by questionnaire, responded by mothers. However, a previous study had used records to assess the third delay. Therefore, the difference in the finding might be due to measurement differences. In Ethiopia, there is a limitation of literature on the topic.

The study identified second maternal delay as a determinant for unfavourable newborn outcomes. In this study, maternal delays were a composite variable, including a set of subvariables. Even though the literature analysed these variables individually, most of them had reported significant association with newborn outcomes. Long distance to the hospital was associated with newborn death in a previous study of Ethiopia.[4] Other studies from Rwanda identified an association between longer ambulance travel time to the district hospital and poor newborn outcomes.[8]

Mothers residing in greater than 4 hours of service are associated with adverse outcomes for newborns and increased interventions in Canada.[12] The majority of cases in this study are from rural areas. Labouring mothers from rural areas are exposed to second maternal delay due to a lack of infrastructure.[13 14] The majority of participants are self-referred to hospitals where they get delivery services. This might reflect a lack of confidence in nearby health centres or health posts and might cause long-distance travel to hospitals.[13]

In this study, about 60% of cases did not use the ambulance for transportation. Instead, the majority of them used 'community ambulance' and 'three tiers commercial transportation (Bajaj)'. These might cause delays on the way because of long-distance travel to reach the hospital. Poor ambulance service dispatching system for the self-referral mothers might enforce to use of community-ambulance transportation.

In this study, newborn outcomes were not significantly associated with delays in decision making to seek care (first delay). In resource-limited settings: a shortage of

Table 2 Distribution of pregnancy-related characteristics of the study participants in the Hadiya zone public hospitals, Ethiopia, 2019

Characteristics		Case No (%)	Controls No (%)	Total No (%)	χ2 (95% CI)
ANC frequency	No ANC	5 (8.8)	6 (5)	11 (6.2)	2.79 (0.79 to 9.82)
	1–3	25 (43.9)	25 (20.7)	50 (28.1)	0.83 (0.23 to 3.09
	≥4	27 (47.4)	90 (74.4)	117 (65.7)	1
Child birth related complication in previous pregnancies	Yes	15(25)	25 (20.7)	40 (22.5)	0.73 (0.35 to 1.52)
	No	42(74)	96 (79.3)	138 (77.5)	1
Child birth-related complication in this pregnancy: during labour and delivery	Yes	18 (31.6)	20 (16.5)	38 (21.3)	0.43 (0.21 to 0.90)
	No	39 (68.4)	101 (83.5)	140 (78.7)	1
Duration of amniotic fluid passage	<12 hours	53(93)	119 (98.3)	172 (96.6)	1
	>12 hours	4 (7)	2 (1.7)	6.0 (3.4)	0.22 (0.04 to 1.25)
Mean duration of labour and delivery in hours		13.9	12.9		
Mode delivery	Assisted SVD	35 (61.4)	65 (53.6)	100 (56.2)	2.34 (0.79 to 6.96)
	SVD	14 (24.6)	45 (37.2)	59.0 (33.1)	1.35 (0.5 to 3.67)
	C/S	8 (14)	11 (9.1)	19.0 (10.7)	1
Bruises or marks of injury on baby's body	Yes	6 (10.5)	6 (5)	12.0 (6.7)	1
	No	51 (89.5)	115(95)	166 (93.3)	0.44 (0.14 to 1.44)

C/S, caesarean section; SVD, Spontaneous Vaginal Delivery.

Table 3 Distribution of maternal delays among study participants in Hadiya zone public hospitals, Ethiopia, 2019

Characteristics		Case	Controls
		No (%)	No (%)
Time to decide to go health institution	Immediately	17 (29.8)	39 (32.2)
	Late decision	34 (59.6)	72 (59.5)
	Before labour start	6 (10.5)	10 (8.3)
Traditional home practice	Yes	4 (7)	5 (4.1)
	No	53 (93)	116 (95.9)
Child birth related traditional beliefs/ cultural norms faced at home	Yes	22 (38.6)	25 (20.7)
	No	35 (61.4)	96 (79.3)
Mode of transportation	Ambulance	23 (40.4)	47 (38.8)
	Bajaj	13 (22.8)	28 (23.1)
	Public transportation	13 (22.8)	22 (18.2)
	Community ambulance	2 (3.5)	6 (5)
	On foot	5 (8.8)	11 (9.1)
	Other (my/families car)	1 (1.7)	7 (5.8)
Referral condition	Self	23 (40.4)	52 (43)
	Health centre	28 (49.1)	51 (42.1)
	Other hospital	4 (7.0)	11 (9.1)
	Health post	2 (3.5)	7 (5.8)
Calculated mean score	First delay	21.8	19
	Second delay	28.2	16.3
	Third delay	21.9	18.1
First delay	No maternal delay	9 (15.8)	35 (28.9)
	Have maternal delay	48 (84.2)	86 (71.1)
Second delay	No maternal delay	11 (19.3)	103 (85.1)
	Have maternal delay	46 (80.7)	18 (14.9)
Third delay	No maternal delay	6 (10.5)	52 (43)
	Have maternal delay	51 (89.5)	69 (57)

trained staff and supplies; lack of technical competence among staff and humble attitudes towards patients remain frequent causes of third delay.[12–15] Corresponding results were reported from France.[16] However, contradicting findings were reported from Myanmar[2] and a qualitative study conducted in Nepal.[17] These studies presented delays in seeking care emerged as a cause of newborn deaths. Contradiction to this study, analysis of previous studies included the newborn outcome of home delivery. The majority of home deliveries are characterised by first maternal delay and newborn complications. This study does not include newborn outcomes of home delivery.

Delay in receiving care (the third delay) was not the determinant factor for newborn outcomes in the current study. Contradicting findings were reported from Nepal that presented delays in the provision of adequate care emerged as a cause of newborn deaths.[17] The reason for the difference might be the nature of this study setting and respondents. In our study, the setting was a health institution which is the primary source of social desirability with care providers. Moreover, the study respondents might not have medical knowledge and cannot reveal all management given to them during service delivery.

The study showed the wealth index of the family was not the determinant factor for the unfavourable newborn outcome. A similar finding was reported from Debre Tabor Town, Ethiopia and Chitwan district in Nepal.[17 18] However, the study of Diredawa Town indicated an association between newborn death and a mother's income.[9] The discrepancy in findings might be for the difference in income measurement. In this study, the wealth index was calculated by using PCA and categorised into five levels to detect the economic status of participants.

This study had several strengths and limitations. To the best of the authors' knowledge, it was the first study that measured the association of maternal delay with newborn outcomes in sub-Saharan Africa. Previous studies assessed the association of maternal delay with the maternal outcome of skilled delivery. In the previous studies, the prevalence of maternal delay was assessed by interviewing relatives of deceased mothers.[2 14 15]

Table 4 Determinants of newborn outcomes in Hadiya zone public Hospital, Ethiopia, 2019

Variables		Newborn out comes		COR (CI 95%)	AOR (CI 95%)
		Unfavourable (n=57)	Favourable (n=121)		
		No, (%)	No, (%)		
First maternal delay	Delayed	48 (84.2)	86 (71.1)	2.2 (0.9 to 4.9)	2 (0.6 to 6.0)
	Not delayed	9 (15.8)	35 (28.9)	1	1
Second maternal delay	Delayed	46 (80.7)	18 (14.9)	23.9 (10.5 to 54.7)	24.9 (8.9 to 69.4)*
	Not delayed	11 (19.3)	103 (85.1)	1	
Third maternal delay	Delayed	51 (89.5)	69 (57)	6.4 (2.6 to 16.1)	1.5 (.4 to 5.2)
	Not delayed	6 (10.5)	52 (43)	1	1
Wealth index	First	7 (12.3)	29 (24)	1.5 (0.5 to 4.6)	3.4 (0.7 to 15.3)
	Second	9 (15.8)	25 (20.7)	2.5 (0.9 to 7.3)	3.7 (0.9 to 15.9)
	Third	14 (24.6)	23 (19)	3.8 (1.2 to 12.2)	3.6 (0.8 to 17.4)
	Fourth	11 (19.3)	12 (9.9)	2.1 (0.8 to 5.8)	1.1 (0.3 to 4.2)
	Fifth	16 (28)	32 (26.4)	1	1

Method—Backward Stepwise (likelihood ratio).
The model fitness was tested by Hosmer and Lemeshow test of model goodness (p=0.83).
*Indicates p<0.005, and absence indicates p>0.05 in the last model.

This study assessed the maternal delay from the mother's expression, which helped to get accurate data on the maternal delay. Another strength of the study was measuring the economic status of participants by wealth index. The wealth index is an appropriate parameter to assess the economic status of individuals with an irregular income source.

The potential limitation of this study was using fetal movement as a sign of life to manage the happening of fetal death before maternal delay. Since this is a subjective expression of fetal life by the mother, it might expose her to self-section. Another limitation could be social desirability with care providers resulting from institution-based study settings. In this study, non-respondents were higher in cases when compared with controls. The reason for this might be data collection within 24 hours of delivery that might affect the psychological readiness of respondents. Even though we have prepared a checklist to assess third maternal delay, the data was incomplete on procedure notes. The third maternal delay was assessed by a questionnaire responded to by mothers. The mother's perceived third delay might be subjective.

CONCLUSION

In this study first, second and third maternal delays were higher in cases when compared with controls. The study identified high maternal delay in mothers with unfavourable newborn outcomes when compared with mothers with maternal mortality from different kinds of literature. This study also identified 'delay in reaching health facilities (the second delay)' as a determinant of the unfavourable newborn outcome. However, first and third delays were not significantly associated with the newborn outcome.

Recommendation

The government should work to improve labouring mother transportation. The major area of improvement is an ambulance service dispatching system to contact the self-referral cases at their home level. It is also recommended to link 'Bajaj or three tiers public transportation' as part of community transportation for labouring mothers. Further studies that address the effect of none ambulance transportation of the labouring mother on the newborn outcome are required for clarity in a similar setting. Researchers are also recommended for further study of the effect of third maternal delay by alterative data collection methods or design. The alternative data collection methods or design should give priority to data recording on procedure notes.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s)

Ethics approval Ethical clearance was obtained from the institutional review board of Wachamo University. A formal letter, from the College of Health Science of Wachamo University, was submitted to respective hospitals. The purpose of the study was explained to the focal health professional in delivery wards to confirm cooperation by availing of necessary registration books during data collection. A clear brief was provided for participants on research purposes, procedures, participation risks and confidentiality. Final written informed consent was obtained from the mothers participating in the study. For respondents less than 16 years old, written consent was provided by a close adult relative from the attendants. Confidentiality for collecting data was ensured throughout the research process.

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