BMJ Public Health

Spatial distribution and determinants of early postnatal discharge among vaginally delivered mothers in Ethiopia: spatial and multilevel analysis of Ethiopian demographic survey data

Desalegn Anmut Bitew ,[1] Mihret Getnet ,[2,3] Lemlemu Maru ,[2] Dagnew Getnet Adugna ,[4] Ephrem Tesfaye [5]

To cite: Bitew DA, Getnet M, Maru L, *et al*. Spatial distribution and determinants of early postnatal discharge among vaginally delivered mothers in Ethiopia: spatial and multilevel analysis of Ethiopian demographic survey data. *BMJ Public Health* 2024;**2**:e001060. doi:10.1136/bmjph-2024-001060

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/bmjph-2024-001060).

Received 17 February 2024
Accepted 5 November 2024

For numbered affiliations see end of article.

Correspondence to
Desalegn Anmut Bitew;
Desalegn1227@gmail.com

ABSTRACT

Background Postnatal hospital care is aimed to detect any complications for both mother and child. Postnatal care should start as early as possible, especially during the first 24 hours. No study assessed the hotspot areas of early postnatal discharge and its community and individual level determinants in Ethiopia. Therefore this study aimed to fill the mentioned gap.

Methods This study used the Ethiopian demographic and health survey 2016. A total of 2443 delivered mothers were included in the analysis. The non-spatial analysis was conducted using Stata V.14. A mixed-effect multilevel logistic regression model was fitted. Model comparison was done using Akaike's information criterion and log-likelihood ratio. Global Moran's index, spatial autocorrelations and spatial scan statistics were conducted. Multicollinearity was checked. P values <0.25 and 0.05 were used as a cut-off point to declare statistical significance for the bivariable and multivariable regression models, respectively.

Results The early postnatal discharge was spatially clustered (Moran's index=0.077, p<0.05). Hotspots of early postnatal discharge were detected in most parts of Benishangul Gumuz, central Amhara, north east Southern Nations, Nationalities, and Peoples' Region (SNNPR) and western Oromiya. Being literate, no media exposure, having three to four antenatal care visits, size of child and history of abortion were statistical significant determinants of early postnatal discharge.

Conclusions Hotspot areas of early postnatal discharge were detected in parts of central Amhara region, Benishangul gumz, the northeastern parts of SNNPR and western Oromiya. Sociodemographic and reproductive related factors determine early postnatal discharge.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Magnitude and individual level determinants of early postnatal discharge were identified.

WHAT THIS STUDY ADDS

⇒ Hotspot areas identified and community level determinants assessed.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Gave insight for researcher and programmers to prioritise the hotspot areas in research and investigate determinants in the hotspot areas. It will also help the healthcare programmers to give priority for the identified hot spot areas and determinants.

INTRODUCTION

The primary goals of a postnatal hospital care is to detect any complications for both mother and child; and to give the new mother the assistance she needs to go home.[1] Postnatal care should start as early as possible in the postnatal period, especially during the first 24 hours, then again within 2–3 days following delivery.[2] Early hospital discharge following childbirth usually means that the woman and infant have been discharged from the hospital within 48 hours of giving birth.[3]

There are different recommendations regarding the length of hospital stay after delivery. The US government recommend hospital stays for 48 hours after vaginal birth.[4] Spanish Association of Pediatrics advised healthy babies to be released from the hospital 48 hours after delivery.[5] WHO advises healthy women and newborns to stay in the hospital for at least 24 hours.[6] Some data points to the discharge of low-risk mothers and infants 4–6 hours after giving birth.[7 8] Studies showed that, the threshold lines for 'early discharge' vary from 12 to 72 hours among nations.[9] The average stay was 1.5, 2.8 and 1.7 days in UK, Australia and Canada, respectively.[10] One evidence from UK also showed that low-risk

mothers and infants were being discharged 4–6 hours after giving birth.[11]

The large gap in postnatal care coverage is evident in a recent analysis of Demographic and Health Surveys in 23 African countries. Approximately one-third of women in sub-Saharan Africa give birth in facilities, and no more than 13% receive a postnatal care visit within 2 days of delivery.[2 12]

The negative effects of early discharge include unfavourable health consequences, higher expenses, a lack of time for the detection, diagnosis and treatment of complications, higher rates of morbidity and mortality and lack of enough time to educate or encourage women in facilities depression or dissatisfaction with care.[13–23] Extended periods of stay could also increase the risk of nosocomial infections, sleep disruption or inadequate support for breastfeeding infants.[16 17] Conversely, some have proposed that an early release from a medical facility fosters family-centred care, affords families more time to reunite at home and is an efficient and safe means of providing postpartum care.[24 25]

In Ethiopia, there are many maternal health programmes and initiatives like quality and equitable antenatal care, quality and evidence-based labour and delivery service, postnatal care 24 hours stay, emergency obstetric and newborn care, maternal and perinatal death surveillance and response system, obstetric and gynaecological problems referral and network system, prevention and management of obstetric fistula and pelvic organ prolapse, expansion of maternity waiting homes at each public health facilities.[26] Despite this, only 17% women had a postnatal check during the first 2 days after birth and nearly four in five women did not receive a postnatal check.[27]

Even though Ethiopia had very low postnatal care (PNC) coverage, no prior study assessed the hotspot areas of early postnatal discharge, community and individual level determinants of early postnatal discharge and its spatial distribution in Ethiopia.

Therefore this study was aimed to assess the spatial distribution and individual level and community level factors associated with early postnatal discharge in Ethiopia. The evidence from this study will allow policymakers, programme managers and clinicians to improve quality of postnatal care. It will also give an insight for researchers to investigate reason of early discharge in the hotspot areas.

METHODS

Study setting, study design, period

Secondary data analysis was performed in Ethiopia using evidence from the Ethiopian Demographic and Health Survey (EDHS) 2016 dataset. EDHS was cross-sectional survey conducted from 18 January 2016 to 27 June 2016.[27] Ethiopia is the second most populous country in Africa next to Nigeria. It is federally decentralised into 0 regions and two city administrations.[27] Ethiopia has a total estimated population of 118 977 453.[28]

Public and patient involvement statement

Since this study used secondary data from DHS, the study participants did not directly involve. During the EDHS data collection, the major DHS applied cross-sectional study design. The study participants were informed about the purpose of the study, the method of data collection and the dissemination plan. Informed consent was obtained from the participants. Since, we did not use any specimen from the study participants, the procedure was non-invasive. The data were collected anonymously.[27]

Data source, study population and sampling

We have used individual record (IR) dataset of EDHS 2016 for this study. The sample for DHS survey was designed to represent all regions and administrative cities in the country. The survey participants were selected using stratified and two stage sampling methods: enumeration areas (EAs) in the first stage and households in the second stage. Each region was stratified into urban and rural areas. For the 2016 DHS, 645 EAs were selected. From this, 202 EAs were from urban and 443 were from rural areas. The data were accessed from measure DHS website (http://www.measuredhs.com). During the EDHS data collection, 10 641 delivered mothers were interviewed. Of whom 3681 mothers gave birth at health facility. After excluding the caesarean section deliveries and incomplete data, a total of 2443 mothers who gave birth vaginally were included for the final analysis.

The summary of the sampling technique was described as follows (see online supplemental figure 1).

Variables and measurements

The outcome variable was early postnatal discharge after vaginal birth. It was dichotomised as yes/no. In EDHS, women who gave birth in health facilities were asked '***How long after (NAME of the new born) was delivered did you stay there?***' The responses were recorded in hours (if less than a day), days (if less than a week) and weeks (if less than a month). We dichotomised the outcome variable based on WHO recommendation as early discharge (yes) if length of stay in the health facility was <24 hours and not early discharge (no) if length of stay was ≥24 hours.[29]

The independent variables were sociodemographic characteristics such as maternal age, educational level, marital status, wealth index, religion and working status and obstetric characteristics like place of delivery, pregnancy type, size of the child, birth order, age at first sex, age at first marriage, decision on marriage, wantedness of pregnancy, history of abortion, frequency of antenatal care (ANC) utilisation and media exposure. As well as community-level variables such as place of residence, region,

community-level education, community-level literacy, community-level media exposure, community-level wealth index and community-level proportion of early marriage.

Operational definition

Individual-level variables

Educational status of women

This variable was divided into four categories: no education, primary education, secondary education and higher education.

Wealth index

In the dataset, the categories for wealth index were presented as Poorest, Poorer, Middle, Richer and Richest.[27] In our study, a new variable was generated which had three categories 'Poor', 'Middle' and 'Rich' by merging poorest with poorer and richest with richer.

Religion

In the 2016 EDHS, religion had subcategories of Orthodox, Muslim, Protestant, Catholic, traditional followers and others.[27] In our study, the former three were encoded independently and Catholic and traditional religion followers were merged to others category.

Media exposure

Media exposure is created from three variables: reading newspapers, watching TV and listening to the radio. If a woman has exposure to at least one type of media, she is considered exposed to media.[30]

Community-level variables

Community-level variables were computed by aggregating the individual level women's characteristics into clusters. Then the proportion was calculated by dividing subcategories by the total. Distributions of the proportion of aggregate variables were checked using the Shapiro-Wilk normality test and were not normally distributed. Therefore, these aggregate variables were categorised in low and high proportion using the median value. Five community-level variables were generated. Place of residence and region were taken as a community-level variables. Therefore a total of seven community-level variables were tested (residence, region, community-level education, community-level literacy, community-level media exposure, community-level wealth index and community-level proportion of early marriage).

Data processing and multilevel analysis

This study used the extracted data from EDHS 2016 IR file folder. The data extraction was done using STATA V.14 software. Before analysis, data were cleaned. Since DHS data have hierarchical nature which means delivered mothers were nested within-cluster, the classical logistic regression model assumptions might be violated. Therefore, a multilevel binary logistic regression model which includes four models was fitted. The first model was model I (a model without explanatory variables) which was used to assess the variability of early discharge across the cluster. The second model (model II) was fitted including individual-level variables whereas the third model (model III) included community-level variables. In the fourth model (model IV), both individual and community-level variables were fitted simultaneously with the magnitude of early discharge). The log likelihood and AIC were used for model comparisons and the model with the highest log likelihood and the lowest AIC was selected as the best fitted model. The variance inflation factor (VIF) was used to detect multicollinearity, and age of respondents had above 10 VIF and was excluded in the model and the mean VIF value of the final model was 3.2. Variables with p value ≤0.25 in the bivariable regression analysis were included into the multivariable regression analysis. The adjusted odds ratio (AOR) with 95% CI was computed. Variables with a p value of <0.05 in the final model were declared as statistically significant predictors of the early discharge.

RESULT

Individual-level characteristics of the respondents

Two thousand four hundred forty three mothers were involved in this study. About 30% of mothers were within the age range of 25–29. The educational status of study participants ranged from 9.05% (higher education) to 37.78% (no education). Majority (44.82%) of mothers were orthodox religion followers. Around 60% of mothers were in the rich economic class. Nearly 91% of mothers were married. More than half (51.00 %) of the mothers were not working. One thousand one hundred five (45.23%) of mothers had three to four ANC visit. Majority of the respondents (55.38%) had first sexual experience between 15 and 18 years old. Nearly 20% of respondents married before their 15th birth day. Nearly 92.67% of mothers gave birth in public health facilities. About 91% of the mothers had history of abortion (**table 1**).

Community-level characteristics of respondents

One thousand three hundred seventy nine (56.45%) of mothers were rural residents. Nearly half (49.65%) of the respondents were from the community with high proportion of poorness. Around 54% of respondents were from the community with high proportion of illiteracy. About 462 (18.91%) participants are from Tigray region which constitute greater proportion compared with others region dwellers (table 2).

Spatial analysis of early postnatal discharge in Ethiopia

The distribution of early discharge was spatially clustered in Ethiopia (Moran's I=0.077, p<0.05). Hence, further spatial analysis techniques were required to detect the local level spatial clustering (Hotspots) of early discharge (see online supplemental figure 2).

The red discolouration indicates significant hotspot areas of early postnatal discharge among women. Those regions include Benishangul Gumuz, central Amhara,

Table 1 Individual-level characteristics of mothers in the study of spatial distribution of early postnatal discharge after childbirth and associated factors (n=2443), Ethiopia, 2024

Variables	Categories	Frequency (%)	Time to discharge (%)	
			≥24 hours (%)	<24 hours (%)
Age	15–19	154 (6.30)	47 (30.52)	107 (69.48)
	20–24	596 (24.40)	205 (34.40)	391 (65.60)
	25–29	716 (29.31)	189 (26.40)	527 (73.60)
	30–34	494 (20.22)	145 (29.35)	349 (70.65)
	35–39	349 (14.29)	99 (28.37)	250 (71.63)
	40–44	105 (4.30)	26 (24.76)	79 (75.24)
	45–49	29 (1.19)	9 (31.03)	20 (68.97)
Education	No education	923 (37.78)	281 (30.44)	642 (69.56)
	Primary	893 (36.55)	261 (29.23)	632 (70.77)
	Secondary	406 (16.62)	117 (28.82)	289 (71.18)
	Higher	221 (9.05)	61 (27.60)	160 (72.40)
Religion	Orthodox	1095 (44.82)	296 (27.03)	799 (72.97)
	Protestant	935 (38.27)	288 (30.80)	647 (69.20)
	Muslim	382 (15.64)	124 (32.46)	258 (67.54)
	Others	31 (1.27)	12 (38.71)	19 (61.29)
Wealth index	Poor	668 (27.34)	231 (34.58)	437 (65.42)
	Middle	312 (12.77)	94 (30.13)	218 (69.87)
	Rich	1463 (59.89)	395 (27.00)	1068 (73.00)
Marital status	Not married	224 (9.17)	67 (29.91)	157 (70.09)
	Married	2219 (90.83)	653 (29.43)	1566 (70.57)
Literacy	Literate	1195 (48.92)	345 (28.87)	850 (71.13)
	Illiterate	1248 (51.08)	375 (30.05)	873 (69.95)
Working status	Not working	1246 (51.00)	382 (30.66)	864 (69.34)
	Working	1197 (49.00)	338 (28.24)	859 (71.76)
ANC visits	≤2	434 (17.77)	147 (33.87)	287 (66.13)
	3–4	1105 (45.23)	298 (26.97)	807 (73.03)
	≥4 visits	904 (37.00)	275 (30.42)	629 (69.58)
Age at first sex	Before 15	411 (16.82)	127 (30.90)	284 (69.10)
	15–18	1353 (55.38)	394 (29.12)	959 (70.88)
	Above 18	679 (27.79)	199 (29.31)	480 (70.69)
Age at first marriage	Before 15	459 (19.05)	134 (29.19)	325 (70.81)
	15–18	1090 (45.25)	327 (30.00)	763 (70.00)
	Above 18	860 (35.70)	247 (28.72)	613 (71.28)
Decision on marriage	My self	1281 (52.44)	385 (30.05)	896 (69.95)
	Parents	1077 (44.09)	308 (28.60)	769 (71.40)
	Others*	85 (3.48)	27 (31.76)	58 (68.24)
Media exposure	Not exposed	1055 (43.18)	345 (32.70)	710 (67.30)
	Exposed	1388 (56.82)	375 (27.02)	1013 (72.98)
Birth order	1–3	1623 (66.43)	481 (29.64)	1142 (70.36)
	3–6	564 (23.09)	164 (29.08)	400 (70.92)
	>6	256 (10.48)	75 (29.30)	181 (70.70)
Place of delivery	Public health facilities	2264 (92.67)	664 (29.33)	1600 (70.67)
	Private health facilities	179 (7.33)	56 (31.28)	123 (68.72)

Continued

Table 1 Continued

Variables	Categories	Frequency (%)	Time to discharge (%)	
			≥24 hours (%)	<24 hours (%)
	Larger	819 (33.52)	267 (32.60)	552 (67.40)
	Average	1070 (43.80)	265 (24.77)	805 (75.23)
Size of child	Smaller	554 (22.68)	188 (33.94)	366 (66.06)
	Single birth	2404 (98.40)	704 (29.28)	1700 (70.72)
Pregnancy type	Twin birth	39 (1.60)	16 (41.03)	23 (58.97)
	Then	1924 (78.76)	579 (30.09)	1345 (69.91)
	Later	384 (15.72)	102 (26.56)	282 (73.44)
Pregnancy wanted	No more	135 (5.53)	39 (28.89)	96 (71.11)
	No	2221 (90.91)	657 (29.58)	1564 (70.42)
Abortion history	Yes	222 (9.09)	63 (28.38)	159 (71.62)

ANC, antenatal care.

north east Southern Nations, Nationalities, and Peoples' Region (SNNPR) and western Oromiya, while the cold spot areas detected in regions of Gambella, Tigray, Afar, Harari, Addis Ababa, Dire Dawa, Somalia, most parts of Oromiya and southern SNNPR. High-risk clusters are called hotspot areas. This shows consistent findings with

Table 2 Community-level characteristics of mothers in the study of spatial distribution of early discharge after childbirth and associated factors (n=2443: weighted), Ethiopia, 2024

Variables	Categories	Frequency (%)	Time to discharge (%)	
			≥24 hours (%)	<24 hours (%)
	Urban	1064 (43.55)	277 (26.03)	787 (73.97)
Residence	Rural	1379 (56.45)	443 (32.12)	936 (67.8)
	Tigray	462 (18.91)	136 (29.44)	326 (70.56)
	Afar	83 (3.40)	40 (48.19)	43 (51.81)
	Amhara	193 (7.90)	32 (16.58)	161 (83.42)
	Oromiya	236 (9.66)	91 (38.56)	145 (61.44)
	Somalia	155 (6.34)	60 (38.71)	95 (61.29)
	Benishangul	165 (6.75)	30 (18.18)	135 (81.82)
	SNNPR	265 (10.85)	70 (26.42)	195 (73.58)
	Gambela	194 (7.94)	59 (30.41)	135 (69.59)
	Harari	99 (8.15)	73 (36.68)	126 (63.32)
	Addis Ababa	276 (11.30)	88 (31.88)	188 (68.12)
Region	Dire Dawa	215 (8.80)	41 (19.07)	174 (80.93)
	Low proportion of poor	1230 (50.35)	330 (26.83)	900 (73.17
Community wealth	High proportion of poor	1213 (49.65)	390 (32.15)	823 (67.85)
	Low proportion No education	1107 (45.31)	317 (28.64)	790 (71.36)
Community education	High proportion no education	1336 (54.69)	403 (30.16)	933 (69.84)
	Low proportion of marriage	1217 (49.82)	351 (28.84)	866 (71.16)
Community early marriage	High proportion of marriage	1226 (50.18)	369 (30.10)	857 (69.90)
	Low proportion of literate	1124 (46.01)	349 (31.05)	775 (68.95)
Community literacy	High proportion of literate	1319 (53.99)	371 (28.13)	948 (71.87)
	Low proportion of media exposure	1227 (50.23)	398 (32.44)	829 (67.56)
Community media exposure	High proportion of media exposure	1216 (49.77)	322 (26.48)	894 (73.52)

SNNPR, Southern Nations, Nationalities, and Peoples' Region.

the Geti's Ord Gi* hotspot analysis. For hotspot analysis, we used both Sat Scan analysis and the Geti's Ord Gi* statistics. We got consistent findings with Z-score >1.96 considered as hotspot/high risk areas compared with other clusters (see online supplemental figures 3, 4).

Most likely clusters were detected in different regions. There were 84 primary clusters which are located at (11.289182 N, 36.420957 E) and radius of 266.43 km with RR of 1.21, log likelihood ratio (LLR) of 14.960592 and p value <0.001. There were 21 secondary clusters located at (9.588833 N, 41.865733 E) and radius of 2.36 km with RR 1.29, LLR 11.782727 and p value <0.01. Most likely clusters are primary clusters detected by the saTScan statistics found within the circle of the primary clusters of analysis. These were clusters with highest RR, LLR and lowest and significant p value. We aggregated the number of women having early discharge (a case file), and the number of women who respond no early discharge as controls. Then we used the case and control file as impute datasets to conduct the purely saTScan statistics. The observed number of cases were directly aggregated from the data we imputed for analysis in a given primary or secondary clusters while the expected number of cases was generated by the software considering the imputed data through the likelihood estimation approach. Primary and secondary clusters are the most high risk areas that should be considered for intervention. The primary clusters are these areas with the highest risk of early postnatal discharge (

see online supplemental figure 4).

Model selection

Multilevel mixed-effect logistic regression model was fitted. The measures of variations or random effects were reported using intraclass correlation (ICC), a proportional change in variance (PCV) and median odds ratio (MOR). The ICC was used to show how much the observation within one cluster resembled each other and it was generated directly from each model using 'estat ICC' command following regression. The PCV shows the variation in early discharge among delivered mothers explained by factors. PCV was computed asPCV = $\frac{Vnull - VA}{Vnull}$[31] and MOR is defined as the median value of the OR of early discharge between the area at the highest risk and the area at the lowest risk when randomly picking out two clusters. It was used as a measure of unexplained cluster heterogeneity and it was calculated using the formula MOR = $e^{0.95\sqrt{VA}}$[31] where 'VA' represents the area or cluster level variance for each model. The model comparison was done using Akaike's information criterion (AIC). The model with smallest AIC was selected. Therefore, model IV was the best fit model with AIC 2388.77 (table 3).

Multilevel analysis of determinant of early postnatal discharge

In the final model, literacy, media exposure, frequency of ANC follow-up, size of the child and respondent's history of abortion were significantly associated with early discharge.

The odds of early discharge among literate mothers was decreased by 37%% (literate: AOR=0.63; 95% CI=0.43, 0.94) compared with illiterate mothers. The odds of early discharge among mothers who did not exposed to media was reduced by 36% (not exposed: AOR=0.64; 95% CI=0.47, 0.86) compared with mothers exposed to media. The odds of early discharge among mothers who had three to four ANC visits was increased by 50% (three to four ANC visits: AOR=1.49; 95% CI=1.13, 1.97) compared with mothers who had above four ANC visits.

The odds of early discharge among mothers who gave birth to average size child was increased by 53% (average size child: AOR=1.53; 95% CI= 1.16, 2.02) compared with mothers who gave birth for larger size child.

The odds of early discharge among mothers who had no history of abortion was reduced by 37% (no abortion hx: AOR=0.63; 95% CI=0.40, 0.97) compared with mothers who had history of abortion (online supplemental table 4).

Table 3 Random effect and model of two-level mixed effect logistic regression models predicting early discharge, Ethiopia 2016

Parameters	Model I	Model II	Model III	Model IV
Community variance (SE)	1.59 (0.26)	1.57(0.27)	1.48 (0.25)	1.51 (0.26)
AIC	2458.589	2395.584	2460.445	2388.77
BIC	2470.191	2557.619	2562.379	2506.853
ICC	32.55%	32.30%	31.70%	31.30%
PCV	Reference	1.3	6.9	5.03
MOR	3.26	3.24	3.15	3.18
Log likelihood	−1227.29	−1169.7922	−1222	−1164.385

AIC, Akaike's information criterion; BIC, Bayesian Information Criterion; ICC, intraclass correlation; MOR, median odds ratio; PCV, proportional change in variance.

DISCUSSION

In our study, we found that significant hotspot areas of early postnatal discharge were Benishangul Gumuz, central Amhara, north east SNNPR and western Oromiya. The significant associated factors of the early discharge were found to be literacy, media exposure, frequency of ANC follow-up, size of the child and respondent's history of abortion.

In our study, illiterate mothers were discharged earlier than the literate mothers. This study was supported by findings from India[32] and Nepal[33] which stated that mothers who are illiterate stay shorter duration in health facilities. The possible explanation might be, illiterate mothers are not well informed about the health risks associated with childbirth, they lack awareness about the benefit of staying more in the hospital and cannot anticipate further complications.[32] This implies that programmes, projects and policies aimed at increasing the postnatal care service utilisation and improving adequate length of facility stay should give special attention to illiterate mothers.

Compared with mothers of larger-sized newborns, women who give birth to average babies tend to stay shorter. This finding was supported by another additional research from Ethiopia[34] and South Africa.[35]Studies showed that macrocosmic neonates are at risk of developing numerous health complications such as hypoglycaemia, dyspnoea, birth asphyxia and trauma. Thus, they may require extended hospitalisation.[36 37] Consequently, mothers of newborns with larger birth weights will have to wait longer for their child to recover from complications. This finding implies, clinicians should strictly follow newborns with normal range birth weight.

Another finding of our study showed that mothers who had less than four ANC visits had shorter stay at health facility compared with mothers who had above four ANC visits. This find is supported by evidences from India,[32 38] University of Carolina,[39] Maharashtra and Uganda.[40] The possible explanation would be more ANC visits offer healthcare professionals a great chance to enhance women's understanding of potential postpartum difficulties and the advantages of early postnatal care services by providing appropriate counselling regarding postnatal risk signs and symptoms.[40] Therefore, women who attend the four or more prenatal care visits have a higher likelihood of using early postnatal care services in comparison to women who attend fewer than four visits.[41]

As our finding showed, mothers who have not exposed to mass media stayed longer in the hospital. This finding contradicted with other study findings from Bangladesh[42] and Nigeria.[43] Media exposure enhances the health seeking behaviour of mothers. As a result, there would be less chance of birth complications. As it is evidenced by the descriptive result of our study, most of the mothers who did not have media exposure are from rural (83%), poor economic status (50%), non-educated (57%) and low ANC utilisation (50%). Most of the time, non-educated and poor mothers from rural area have low maternal health services utilisation[43 44] and visit health facilities when there is severe health complication. As a result, they need more time to recover and stay longer in the hospital.

Thus, health education via various media platforms may raise women, their families and communities' knowledge, which may result in a rise in the use of maternal health services including institutional delivery thereby reduce the birth complication.

Limitation and strength

The results are more representative. Because, weighted national data with a large sample were used. Advanced models (spatial and multilevel) were also used in this investigation. However, the survey data on which our conclusions were based could have been skewed by recollection bias. Furthermore, factors related to the facility, the provider and the family-related factors were not included in the EDHS data, which could have significant impact on the length of stay.

CONCLUSION

A significant percentage of moms in Ethiopia have been discharged early, even though the first 24 hours following childbirth offer a critical window of opportunity to address the majority of maternal and newborn morbidities and fatalities. Hotspots of early postnatal discharge were detected in most parts of Benishangul Gumuz, central Amhara, north east SNNPR and western Oromiya. Illiteracy, not being exposed to mass media, size of the child at birth, frequency of ANC visits and history of abortion were identified as the most significant determinants of early postnatal discharge.

Author affiliations
[1]Department of Reproductive Health, Institute of Public Health, University of Gondar, Gondar, Ethiopia
[2]Department of Human Physiology, University of Gondar, Gondar, Ethiopia
[3]Department of Epidemiology and biostatistics, University of Gondar, Gondar, Ethiopia
[4]Department of Human Anatomy, University of Gondar, Gondar, Ethiopia
[5]Department of Medical Physiology, School of Biomedical Sciences, Madda Walabu University Goba Referral Hospital, Bale-Robe, Southeast Ethiopia, Bale Robe, Ethiopia

Acknowledgements We would like to sincerely thank the measure DHS program for providing access to the EDHS dataset and granting us permission to use it for this research.

Contributors DAB conceived the research idea, performed the measurements and wrote the manuscript. MG, LM, DGA and ET were involved in planning and supervised the work. DAB, MG, LM, DGA and ET performed the analysis, drafted the manuscript and designed the figures. All authors discussed the results and commented on the manuscript. Each author contributed sufficiently to the project and accepted accountability for the relevant parts of the writing. DAB is the principal investigator and the corresponding author who is guarantor of this research work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

its authorities. This map is provided without any warranty of any kind, either express or implied.

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 Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data used to generate this evidence is found in the hands of the corresponding author. Thus, the data is freely available upon request

ORCID iDs
Desalegn Anmut Bitew http://orcid.org/0000-0003-0718-4597
Mihret Getnet http://orcid.org/0000-0001-7553-1429
Lemlemu Maru http://orcid.org/0009-0002-8173-7751
Dagnew Getnet Adugna http://orcid.org/0000-0002-3670-4953
Ephrem Tesfaye http://orcid.org/0000-0001-6273-7727

REFERENCES

1 Sainz Bueno JA, Romano MR, Teruel RG, *et al*. Early discharge from obstetrics-pediatrics at the Hospital de Valme, with domiciliary follow-up. *Am J Obstet Gynecol* 2005;193:714–26.
2 Warren C, Daly P, Toure L, *et al*. Postnatal care" in opportunities for africa's newborns. In: *Joy Lawn and Kate Kerber(Cape Town, South Africa: Partnership for Maternal, Newborn and childhealth, Save the children*. UNFPA, UNICEF, USAID, WHO and partners, 2006: 80–90.
3 Papile SJ, American Academy of Pediatrics ACoOaGCotnIK. Guidelines for perinatal care. American Academy of Pediatrics: Elk Grove Village, n.d.: 347–403.
4 Medicare Cf, Services M. Newborns' and mothers. In: *Health Protection Act (NMHPA*). Centers for Medicare & Medicaid Services website,
5 Rite Gracia S, Pérez Muñuzuri A, Sanz López E, *et al*. Criteria for hospital discharge of the healthy term newborn after delivery. *Anales Pediatr (Engl Ed)* 2017;86:289.
6 WH Organization. WHO recommendations on postnatal care of the mother and newborn: world health organization. 2014.
7 TRCoMPppcphwroug-icp-pam. 2015.
8 Knight MKS, Brocklehurst P, Neilson J, *et al*. Saving Lives, Improving Mothers' Care—Lessons Learned to Inform Future Maternity Care from the UK and Ireland Confidential Enquires into Maternal Deaths and Morbidity 2009-2012. Oxford: National Perinatal Epidemiology Unit, University of Oxford, 2014.
9 Benahmed N, San Miguel L, Devos C, *et al*. Vaginal delivery: how does early hospital discharge affect mother and child outcomes? A systematic literature review. *BMC Pregnancy Childbirth* 2017;17:289.
10 Campbell OMR, Cegolon L, Macleod D, *et al*. Length of Stay After Childbirth in 92 Countries and Associated Factors in 30 Low- and Middle-Income Countries: Compilation of Reported Data and a Cross-sectional Analysis from Nationally Representative Surveys. *PLoS Med* 2016;13:e1001972.
11 Knight M, Kenyon S, Brocklehurst P, *et al*. Improving mothers' care. saving lives, improving mothers' care: lessons learned to inform future maternity care from the uk and ireland confidential enquiries into maternal deaths and morbidity 2009-2012. 2017.
12 Chervenak FA, McCullough LB, Brent RL, *et al*. Planned home birth: the professional responsibility response. *Am J Obstet Gynecol* 2013;208:31–8.
13 Gupta P, Malhotra S, Singh DK, *et al*. Length of postnatal stay in healthy newborns and re-hospitalization following their early discharge. *Indian J Pediatr* 2006;73:897–900.
14 Britton JR, Britton HL, Beebe SA. Early Discharge of the Term Newborn: A Continued Dilemma. *Pediatrics* 1994;94:291–5.
15 Braveman P, Egerter S, Pearl M, *et al*. Problems associated with early discharge of newborn infants. Early discharge of newborns and mothers: a critical review of the literature. *Pediatrics* 1995;96:716–26.
16 Brown S, Bruinsma F, Darcy M, *et al*. Early discharge: no evidence of adverse outcomes in three consecutive population-based Australian surveys of recent mothers, conducted in 1989, 1994 and 2000. *Pediatr Perinat Epid* 2004;18:202–13.
17 Brown S, Small R, Argus B, *et al*. n.d. Early postnatal discharge from hospital for healthy mothers and term infants. *Cochrane Database Systematic Reviews*2002:CD002958–CD.
18 Seidman DS, Stevenson DK, Ergaz Z, *et al*. Hospital readmission due to neonatal hyperbilirubinemia. *Pediatrics* 1995;96:727–9.
19 Malkin JD, Garber S, Broder MS, *et al*. Infant Mortality and Early Postpartum Discharge. *Obstetrics & Gynecology* 2000;96:183–8.
20 Braveman P, Egerter S, Pearl M, *et al*. Early Discharge of Newborns and Mothers: A Critical Review of the Literature. *Pediatrics* 1995;96:716–26.
21 Danielsen B, Castles AG, Damberg CL, *et al*. Newborn discharge timing and readmissions: California, 1992-1995. *Pediatrics* 2000;106:31–9.
22 Lain SJ, Roberts CL, Bowen JR, *et al*. Early Discharge of Infants and Risk of Readmission for Jaundice. *Pediatrics* 2015;135:314–21.
23 Jones E, Stewart F, Taylor B, *et al*. Early postnatal discharge from hospital for healthy mothers and term infants. *Cochrane Database Syst Rev* 2021;6:CD002958.
24 Waldenström U, Sundelin C, Lindmark G. Early and late discharge after hospital birth. Health of mother and infant in the postpartum period. *Ups J Med Sci* 1987;92:301–14.
25 Madden JM, Soumerai SB, Lieu TA, *et al*. Effects of a law against early postpartum discharge on newborn follow-up, adverse events, and HMO expenditures. *N Engl J Med* 2002;347:2031–8.
26 Overview of Maternal Health in Ethiopia. Ethiopia: Moh, 2017.
27 Central Statistical Agency - CSA/Ethiopia, ICF. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia: CSA and ICF, 2017.
28 Available: https://www.worldometers.info/world-population/ethiopia-population/
29 WH Organization. WHO recommendations on maternal health: guidelines approved by the who guidelines review committee. WHO; 2017.
30 Teshale AB, Tesema GA. Magnitude and associated factors of unintended pregnancy in Ethiopia: a multilevel analysis using 2016 EDHS data. *BMC Pregnancy Childbirth* 2020;20:329.
31 Belay DG, Getnet M, Akalu Y, *et al*. Spatial distribution and determinants of bottle feeding among children 0-23 months in Ethiopia: spatial and multi-level analysis based on 2016 EDHS. *BMC Pediatr* 2022;22:120.
32 Kumar P, Dhillon P. Length of stay after childbirth in India: a comparative study of public and private health institutions. *BMC Pregnancy Childbirth* 2020;20:181.
33 Ikeda S, Shibanuma A, Silwal R, *et al*. Factors associated with the length of stay at health facilities after childbirth among mothers and newborns in Dhading, Nepal: a cross-sectional study. *BMJ Open* 2021;11:e042058.
34 Biru YB, Lemelem GA, Solomon N. Length of stay in health facilities after childbirth and associated maternal and neonatal factors in Ethiopia: a cross-sectional study from a national survey. *BMJ Open* 2021;11:e055327.
35 Mahovo R, Velaphi S. Duration of Hospital Stay and Factors Associated with Prolonged Hospital Stay in Very Low Birth Weight Infants Surviving to Hospital Discharge. *J Pediatr Perinatol Child Health* 2020;03:208–20.
36 Said AS, Manji KP. Risk factors and outcomes of fetal macrosomia in a tertiary centre in Tanzania: a case-control study. *BMC Pregnancy Childbirth* 2016;16:1–8.
37 Turkmen S, Johansson S, Dahmoun M. Foetal Macrosomia and Foetal-Maternal Outcomes at Birth. *J Pregnancy* 2018;2018:4790136.
38 Nipte D, Dhayarkar S, Pawar S, *et al*. Determinants of early discharge of mothers from hospitals after delivery in Beed block of Beed District, Maharashtra, India 2014. *Clin Epidemiol Glob Health* 2015;3:S26–33.

39 Margolis LH, Kotelchuck M, Chang H-Y. Factors Associated With Early Maternal Postpartum Discharge From the Hospital. *Arch Pediatr Adolesc Med* 1997;151:466.
40 Ndugga P, Namiyonga NK, Sebuwufu D. Determinants of early postnatal care attendance: analysis of the 2016 Uganda demographic and health survey. *BMC Pregnancy Childbirth* 2020;20:163.
41 Show KL, Aung PL, Maung TM, *et al*. Early postnatal care contact within 24 hours by skilled providers and its determinants among home deliveries in Myanmar: Further analysis of the Myanmar Demographic and Health Survey 2015-16. *PLoS One* 2023;18:e0289869.
42 Sheba IT, Sarker AR, Tasnim A. Factors Associated with Post-Natal Care Utilization among the Women of Reproductive age Group: Evidence from Bangladesh Demographic and Health Survey 2017-18. *Health Serv Res Manag Epidemiol* 2022;9:23333928221136393.
43 Agho KE, Ezeh OK, Issaka AI, *et al*. Population attributable risk estimates for factors associated with non-use of postnatal care services among women in Nigeria. *BMJ Open* 2016;6:e010493.
44 Tarekegn SM, Lieberman LS, Giedraitis V. Determinants of maternal health service utilization in Ethiopia: analysis of the 2011 Ethiopian Demographic and Health Survey. *BMC Pregnancy Childbirth* 2014;14:161.