BMC Pregnancy and Childbirth

RESEARCH

Open Access

Completion of maternal and child health continuum of care and associated factors in West Gondar Zone, North West Ethiopia, 2023: a community based cross sectional study

Asrat Mekonnen Tegegne[1*], Yohannes Ayanaw Habitu[1], Yeshiwas Ayale Ferede[2] and Elsa Awoke Fentie[1]

Abstract

Background The maternal and child health continuum of care integrates services from pre-pregnancy through childhood to enhance maternal and child outcomes. It is crucial for reducing maternal and child mortality by focusing on comprehensive health interventions. Despite its significance, comprehensive studies on the continuum remain limited. This study aimed to assess the completion of the maternal and child health continuum of care and associated factors among mothers with index children aged 12–23 months in the West Gondar Zone, Northwest Ethiopia, in 2023.

Methods A community-based cross-sectional study was conducted from May 1–30, 2023, by interviewing mothers of 12-23-month-old children in West Gondar zone. A simple random sampling method was used to select 1,019 mothers. Data were collected via KoboCollect and analyzed in Stata version 14.0. Binary logistic regression was used to examine associations between independent variables and the continuum of care. Variables with a *p* value < 0.2 in bi-variable analysis were included in the multivariable model. Finally, adjusted odds ratios (AOR) with 95% confidence intervals (CI) and *p* values < 0.05 were used to determine statistical significance. The Hosmer and Lemeshow goodness-of-fit test was computed.

Results The overall rate of completion of the maternal and child health continuum of care was 6.19% (95% CI: 4.69–7.68). The factors associated were having the first ANC visit before 16 weeks of pregnancy [AOR: 4.25 (CI: 2.14–8.47)], birth preparedness and complication readiness [AOR: 3.02 (CI: 1.41–6.46)], history of modern contraceptive use [AOR: 2.34 (CI: 1.16–4.73)], intended pregnancy [AOR: 3.25 (CI: 1.63–6.48)], receiving maternal services during ANC visits [AOR: 2.69 (CI: 1.07–6.80)], and the health facility being less than an hour away from home [AOR: 2.53 (CI: 1.06–6.03)].

Conclusions The maternal and child health (MCH) continuum of care in West Gondar was low. Key factors affecting completion included birth preparedness and complication readiness, early ANC initiation, planned pregnancy,

*Correspondence:
Asrat Mekonnen Tegegne
asrmekonn@gmail.com

Full list of author information is available at the end of the article

family planning use, proximity to health facilities, and maternal health services provided during ANC. Efforts should target these factors and ensure services at each stage of the continuum to stay mothers along the path of the MCH continuum of care.

Keywords Continuum of care, Maternal and child health, West Gondar, Ethiopia

Introduction

Minimizing preventable maternal mortality and morbidity is a global priority, especially through improvements along the maternal and child health continuum of care [1]. The maternal and child health continuum of care integrates services from prepregnancy to childhood, ensuring continuous, evidence-based interventions. This approach improves maternal and child health by organizing cares across lifecycles and healthcare settings. Ensuring care from pregnancy to the postnatal period is critical, as it can significantly reduce the global toll of half a million maternal, 4 million neonatal, and 6 million child deaths [2].

Globally, maternal mortality remains a significant challenge. In 2020, an estimated 287,000 mothers died from complications related to pregnancy and childbirth, with 800 mothers dying daily, mainly in low- and middle-income countries [3]. However, the status of the continuum of care in these regions shows declining service utilization as mothers move from antenatal care (ANC) to childbirth and postnatal care (PNC). The largest gap often lies between institutional delivery and PNC. The completion status differs from country to country [4].

In the United States, only around 75–80% of mothers receive adequate prenatal care, with postnatal services being notably underutilized, especially among low-income and minority groups impacting both maternal and infant health outcomes [5]. The growing issue of hospital and labor & delivery closures in rural areas across the U.S disrupt the maternal and child health (MCH) continuum by limiting access to essential prenatal, delivery, and postpartum care [6]. In Europe, findings highlight that, complex interaction of social and structural issues impact access to adequate maternal healthcare [7].

A study conducted in Nepal showed that about 41% of mothers received comprehensive care, including ANC, institutional delivery, and PNC [8]. Cambodia fared better, with 60% of mothers receiving all three services [9]. However, only 17% of pregnant mothers in India and 6.8% in Lao PDR completed the continuum of care [10, 11]. Approximately 52.6% of mothers in Indonesia continue to receive three levels of services: maternal, neonatal and child health (MNCH) [12].

In sub-Saharan Africa (SSA), the completion rates are even lower, with only 3.4% of women in 17 SSA countries receiving the full range of maternal and child health care services [13]. However, a multi-country analysis of recent demographic and health surveys in SSA showed that the pooled prevalence of completion of the maternity continuum of care was 35.81% [14]. The lack of adequate care at all levels of the continuum has been associated with poor maternal and child health outcomes [2, 15]. In SSA, only 25% of mothers received all components of care from ANC to PNC, with regional variations ranging from 17.9% in East Africa to 51.5% in southern Africa [16]. In Kenya and Uganda, around 23% of neonatal deaths are attributed to gaps in the continuum of care [17].

The studies across various African countries reveal significant disparities in the completion of the maternal continuum of care. In Zambia, 38% of mothers completed the full continuum [18], while Ghana and Nigeria reported much lower rates at 7.9% and 6.5%, respectively [19, 20]. Another study conducted in Tanzania, only 10% of mothers received the recommended care package [21]. In Rwanda and Egypt showed higher rates, with 33.8% and 50.4% of mothers, respectively, completing the continuum of care [22, 23].

In Ethiopia, the completion of maternity care services is also low. The 2016 Ethiopia Demographic and Health Survey (EDHS) showed that only 9.1% of mothers completed the continuum of care [24]. The studies across different regions reveal significant gaps. Studies from southern Ethiopia show low rates of women completing the maternal continuum of care. Only 15.5% of women in Arba Minch Zuriya, 11.3% in Hadiya, and 15.5% in Guragie completed all components [25–27]. In the Amhara region, completion rates also varied, ranging from 6.9% in Gondar Zuriya and Wogera to 45% in Enemay district, East Gojjam [28–33]. Generally, in Ethiopia, only 32% of mothers had at least four ANC visits during their last pregnancy, only 26% used institutional delivery, and 17% of mothers and 13% of newborns received PNC, suggesting high dropout rates between each care level [34]. However, maternal and health care utilization is still low in relation to the effort taken, and the completion of CoC status is not well known [4].

Studies have shown that socio-demographic factors are significantly associated with all elements of the continuum of maternal health care [35]. The mothers age [21, 23], residence [10, 17, 21, 26, 36], educational status [10, 13, 14, 17, 18, 22, 23, 26, 28, 33, 37], marital status [22, 24], socioeconomic status [19, 21–24, 26, 36], employment status [24, 25, 37, 38], and exposure to media [10, 13, 17, 22–24, 27, 33, 36] and mothers' autonomy in decision-making [13, 14, 17, 26, 28, 36, 38] significantly contributed to the utilization of a continuum of maternal

health care services. The maternal and child health continuum of care was determined by different maternal and child health service-related factors. Previous studies revealed that distance to the health facility [13, 14, 17, 21, 22, 24, 27, 33, 36], previous health provider counseling [21], maternal health service provision during pregnancy [23, 38, 39], newborn immunization [39], pregnancy complication status [14, 24, 26, 28, 38] and health insurance coverage [13, 22, 33, 38] also affect the continuity of care. Moreover, obstetric-related factors such as early initiation of antenatal care visits [13, 14, 18, 25–28, 36, 37, 40], a history of pregnancy termination [14], maternal complications during pregnancy [19, 22–24, 26, 41], parity and birth order [22, 23, 26] and complicated delivery [21] also affect the continuum of care. Prepregnancy contraceptive utilization, birth preparedness and complication readiness, and having a planned pregnancy were significantly associated with the completion of maternity continuum care in Ethiopia [25–28, 36, 37, 40].

Global initiatives like the World Health Organization and United Nations Population Fund's (UNFPA) "Ending Preventable Maternal Mortality Initiative" by 2025 aim to reduce maternal deaths by strengthening maternal health responses through the continuum of care [42, 43]. However, globally, progress toward Sustainable Development Goals (SDGs) 3.1 and 3.2, targeting maternal and child mortality reduction by 2030, remains off track. Hence, the maternal and child continuum of care offers a structured framework for delivering effective interventions during pregnancy, childbirth, and the postpartum period across different levels of healthcare [44]. Emphasizing this continuum for maternal and child health services, both before and after birth, is crucial to reducing adverse health outcomes for mothers, infants, and children [45].

Completion of maternal CoC is very low, and nonadherence to the continuum of care remains a significant challenge in Ethiopia [33]. This number is very low compared to findings from most resource-limited settings [33, 46]. Although studies have been carried out on the level of the continuum of care, most studies have focused only on maternal health services [16, 29, 30, 33, 41, 46], and the completion of the comprehensive MCH continuum of care is not well known. It is crucial to obtain evidence about the status of the MCH continuum of care and contributing factors to strengthen health systems for a holistic approach to reduce adverse maternal and child health impacts.

Maternal and child health services are inseparably linked, and an integrated approach to care is essential [9]. The maternal and child health continuum of care is an essential approach for considering mothers and children as units rather than as separate individuals [47]. As a result, it is imperative to assess the completion of the MCH continuum of care by considering additional maternal and child health continuums of care measurement indicators, such as childhood immunization, breastfeeding practices for children and modern family planning methods for mothers. Successful program implementation to improve the continuum of care relies on a better understanding of the level of maternal and child health continuum of care, identifying where the gaps are in seeking care along the pathway and what factors contribute to the gaps [9]. The identification of possible factors for the completion of the MCH continuum of care in the area will have a greater impact on the design of different programs that are effective at increasing awareness of risk factors for the community and improving the completion of the MCH continuum of care. Therefore, this study aimed to assess the comprehensive maternal and child health continuum of care and associated factors among mothers who had children aged 12–23 months in the West Gondar Zone, Northwest Ethiopia.

Methods

Study design and period

A community-based cross-sectional study was conducted by interviewing mothers of 12-23-month-old index children living in the West Gondar Zone, Northwest Ethiopia, from May 1–30, 2023.

Study area

The study was conducted in selected districts of the West Gondar Zone of the Amhara Region, Northwest Ethiopia. According to the annual report of the Zone's Health Department of 2022, the Zone has four districts, three town administrations and 90 kebeles (82 rural and 8 urban kebeles). Its administrative town, Genda Wuha, is located 150 km from Gondar, 393 km from Bahir Dar in the West and 868 km from Addis Ababa (Fig. 1). According to the projected population in 2022/23, the total population of a zone is estimated to be 462,271. The estimated reproductive age group of women (15–49 years) and the number of children younger than two years of age will be 109,003 and 23,345, respectively. The Zone has 101 public health facilities (1 general hospital, two primary hospitals, 18 health centers and 80 health posts). It also has 22 private-owned facilities (6 private clinics and 16 pharmacies).

Populations

All mothers with index children who were 12–23 months old and who resided in the West Gondar zone were the source population for the study. All mothers with 12-23-month-old index children living in selected districts of the West Gondar zone composed the study population. All mothers with 12-23-month-old children who lived for at least 6 months in selected kebeles in a district in the West Gondar zone were included in the study.

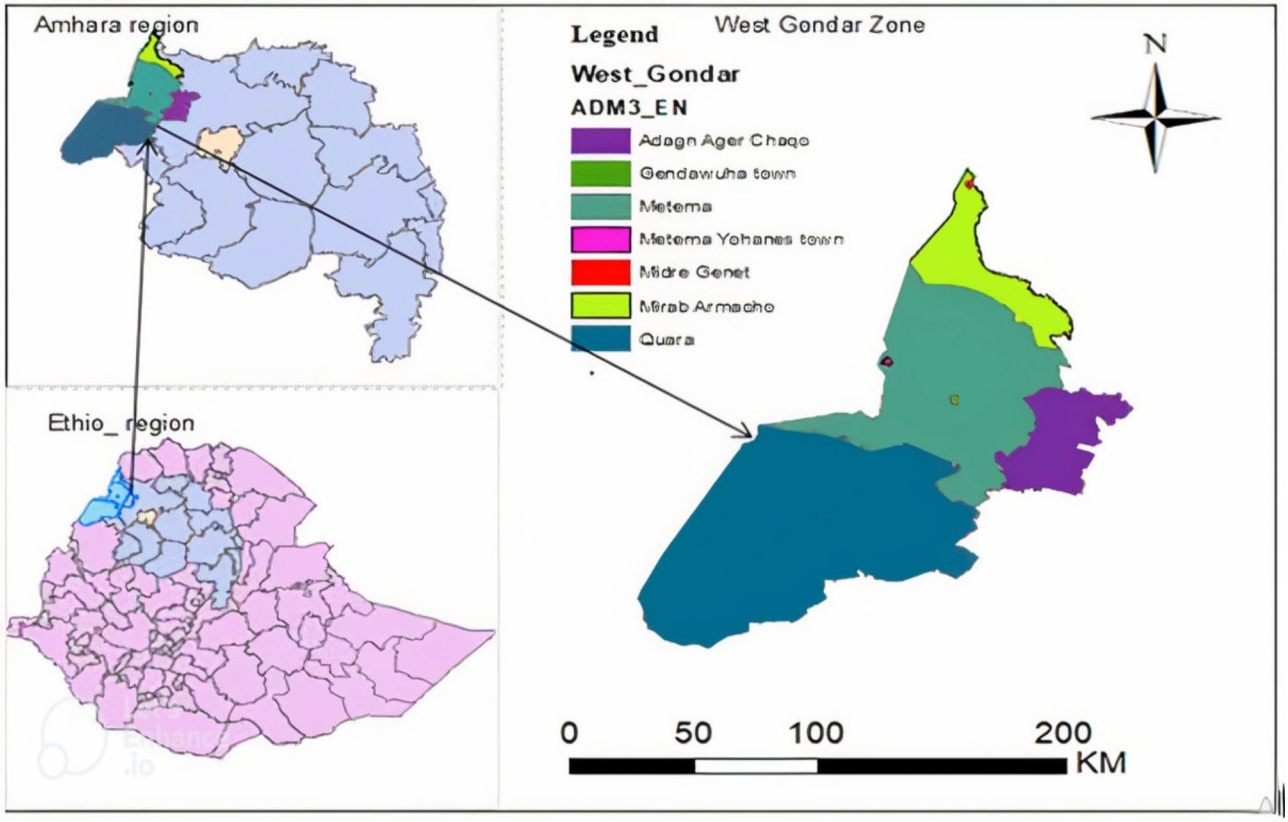

Fig. 1 Map of the West Gondar Zone and its respective districts

Mothers who were critically ill or unable to respond at the time of data collection were excluded from the study.

Sample size determination

The sample size for this study was determined considering its two objectives. The sample size for the first objective (completion of the MCH continuum of care) was calculated using a single population proportion formula considering a 6.9% proportion of mothers who were retained fully on the continuum of care during pregnancy [33], a significance level of 95% (α=0.05), a 2% margin of error (d) and a design effect of 1.5. To compensate for non-respondent study participants, we used a 10% nonresponse rate. Then, let p be the proportion of the continuum of care completion for maternal and child health care services, and q is 1-p. Therefore, the sample size (n) was determined as follows.

$$n = \frac{(Z\alpha/2)^2 p(1-p)}{(d)^2}$$

$$n = \frac{(1.96)^2 * 0.069 * 0.931}{(0.02)^2}$$

$$n = 617$$

The sample size calculated by considering a design effect of 1.5 and a 10% nonresponse rate was 1019 participants.

The sample size for the second objective (factors associated with the level of maternal child continuum of care) was determined using a double population formula in Epi Info ™ version 7.2.5.0 with power (80%), a confidence interval (95%), a level of significance (α=5%) and statistically significant variables from previous studies. According to a study conducted in the Ebinat district, South Gondar zone media exposure status and the distance of health facilities were found to be factors in the completion of a continuum of care [32]. In another study conducted in Enemay District, the desire for pregnancy in the East Gojjam Zone and women's autonomy in decision making to obtain health care were determinants of CoC [31]. Considering 10% no response, the sample size for the study based on the second objective was 234 (Table 1).

Therefore, the largest sample size is computed using a single population formula. Therefore, the final estimated sample size for this study was 1019 study participants.

Table 1 Calculated sample size for factors associated with the MCH continuum of care

S.no	Study variables	Outcome in exposed (%)	Outcome unexposed (%)	OR	Sample size	With 10%	Sample size considering design effect
1	Intention to pregnancy [32]	50.5	22.7	3.3	106	117	234
2	Distance from health facilities [33]	62.9	26.5	4.7	68	75	150
3	Decision making autonomy [32]	53.7	15.5	4	58	64	128
4	Media exposure [33]	71.1	21.6	8.89	38	42	84

Sampling procedures and technique

In this study, two districts were randomly selected from four districts and one town administration. From each selected district, 30% of the kebeles were chosen, along with one center from the district town. All households with women who had given birth between 12 and 23 months prior to the data collection were identified from family folders at the respective kebele health posts, using the community health information system (CHIS) or family folders as the sampling frame. The total sample size was proportionally allocated to each kebele based on the number of mothers who had given birth within one to two years. A simple random sampling technique, specifically the lottery method, was used to select women from the CHIS list in each kebele. In cases where a household had more than one eligible woman, one was randomly selected using the same method. The age of the infant was determined by reviewing the birth certificate card if he or she had, otherwise the infant was asked the mother if he or she did not (Fig. 2).

Study variables

The completion of the MCH continuum of care was an outcome variable in this study. **Independent variables were;**

- **Socio-demographic/economic variables**: religion, age of mother, marital status, residence, occupation, maternal education, parental educational status, maternal occupation, monthly income, media exposure, woman autonomy in decision-making about her own healthcare, and women's employment status.
- **Maternal and child health service-related factors**: having community health insurance, distance from the health facility and health worker counseling.
- **The obstetric factors** included parity, obstetric complications, history of pregnancy termination, ANC follow-up and counseling, ANC attendance, PNC use, place of delivery, mode of delivery, pregnancy intention, ANC initiation, birth preparedness and complication readiness.

Operational definitions

- A complete continuum of maternal and child healthcare was considered when a woman reported having the following 12 care interventions. These preventive and curative interventions include at least four ANCs: birth protection against neonatal tetanus (TTN), facility delivery (FD), skilled birth attendance, PNC, family planning (FP), BCG vaccine, DPT-HepB-Hib (diphtheria, pertussis, tetanus- hepatitis B- haemophilus influenza type B), polio vaccine (PL), measles vaccine and age-appropriate breastfeeding (AABF) [48]. Mothers were asked whether they received each service, and their answers were coded as 'yes' or 'no'. Finally, the complete MCH continuum of care was constructed into a binary variable that was completely coded as 1 and incompletely coded as 0.
- Birth preparedness and complication readiness (BPCR) was measured by asking whether mothers were informed about the place of birth, supplies needed for birth, emergency transportation, money/emergency funds, preparing people to support during/after birth and potential blood donors [34]. A mother was considered "prepared" for BPCR when she reported that she had at least two or more components of birth preparedness and complication readiness; otherwise, she was considered "not well prepared" [49].
- Birth protection against neonatal tetanus (TTN) was measured by whether or not mothers had two tetanus toxoid doses during the last pregnancy or had received at least TT2 [50].
- PNC for mothers: women who had a postnatal check during the first two days after birth [48].
- Facility delivery: Mothers were asked whether their most recent delivery was in a health facility (hospital, health center, clinic or health post) or not [34].
- SBA: Mothers were asked whether their most recent birth was delivered with the assistance of doctors, nurses/midwives, health officers, and HEWs [34].
- Health worker counseling: This information was ascertained by asking mothers about ANC, SBA, PNC, immunization, family planning and nutritional counseling status during their antenatal visit.

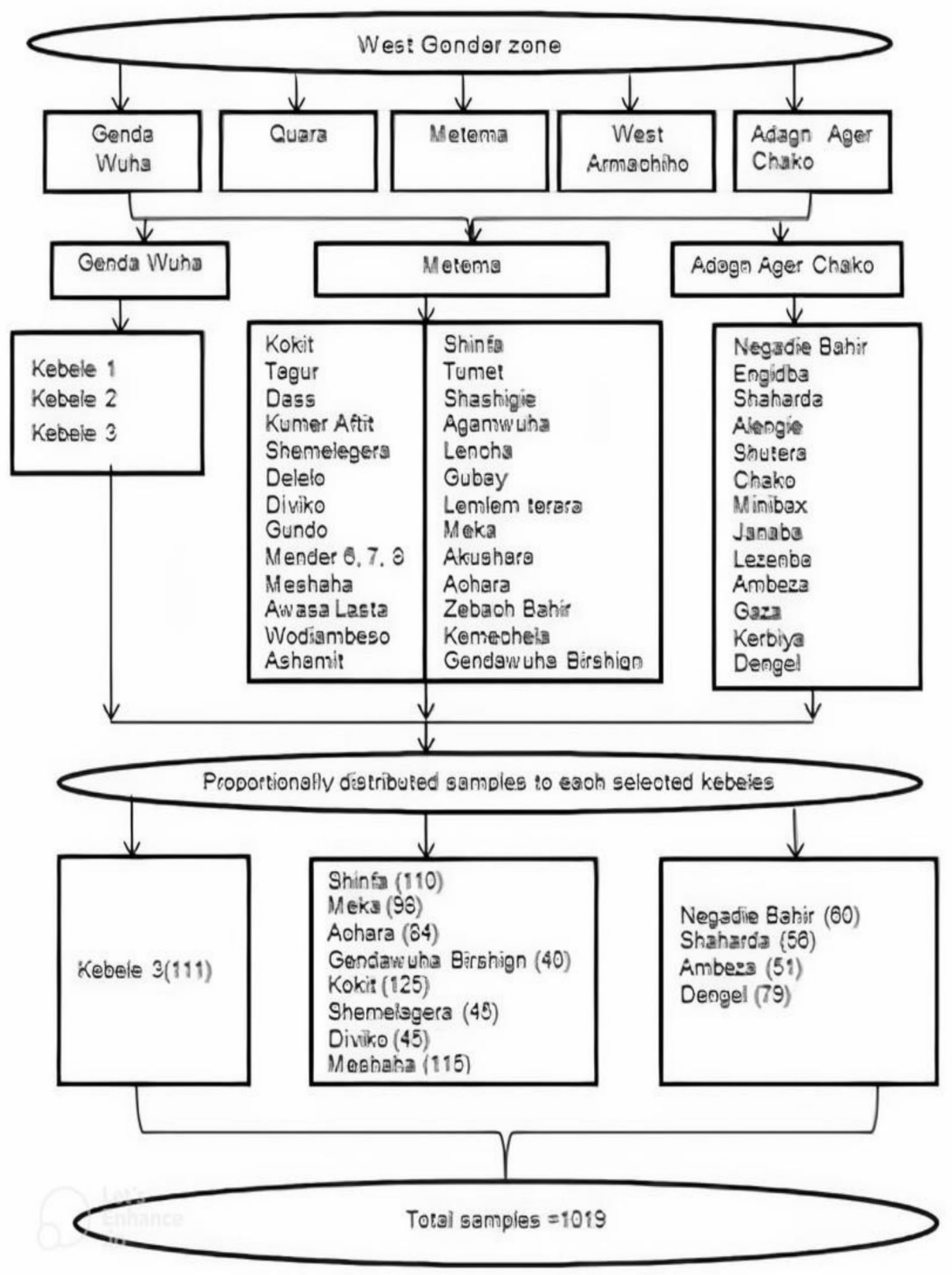

Fig. 2 Schematic representation of the sample selection process in the West Gondar Zone, Northwest Ethiopia, 2023

- Immunization indicators were assessed after one dose of BCG, three doses of DPT-HepB-Hib, three doses of polio vaccine, or one dose of measles vaccine [48].
- Age-appropriate breastfeeding (AABF): assessed by considering complementary feeding of 3–4 times daily for 12–24 months with additional snacks offered 1–2 times per day, as desired [51] and currently on breast feeding.
- The ANC status of maternal health services provisions was assessed by asking about blood pressure measurements, blood and urine samples, and iron and folic acid supplementation during ANC follow-up.
- Pregnancy intentions were assessed by asking a mother whether she planned to become pregnant just before the time of conception. If pregnancy occurred when no more children were desired or pregnancy occurred earlier than desired, it was considered an unintended pregnancy; otherwise, it was considered intended [52].
- Women's autonomy in maternal and child health (MCH) care decision-making was assessed by asking who decides on their healthcare, including ANC, delivery at a health institution, PNC, service locations, family planning, and continuation or cessation of maternal health services. A woman was considered autonomous if she usually made these decisions alone or jointly with her husband [53].
- Media exposure: Mothers were asked how often they read a newspaper, listened to the radio, or watched television. Those who responded at least once a week were considered to be regularly exposed to that form of media [34].
- The distance to health facilities was assessed by asking mothers if they had difficulties due to the distance when obtaining MCH services. A facility was considered distant if a mother reported traveling ≥ 5 km on foot. Participants were also asked if the estimated time to reach a health facility was less than 1 h–1 h or more [54].
- Wealth index: Mothers are assigned scores based on the consumer goods they own (such as household items, transportation means, agricultural land, and livestock) and housing characteristics (like the source of drinking water, toilet facilities, and flooring materials). These scores are calculated using principal component analysis. The wealth quintiles are then created by assigning the household score to each member, ranking them by score, and dividing the distribution into five equal categories, each representing 20% of the population [34].

Data collection methods and procedures

The data were collected electronically with structured and interviewer-administered questionnaires developed from previous related studies [2, 26, 28, 33, 41, 45, 48] by using KoboCollect v2022 4.4. Vaccination status was assessed through vaccination cards or vaccination history from the mother or caregiver. If a card was available, data collectors recorded the vaccines administered as per the EPI schedule. In the absence of a card, probing questions ensured comprehensive vaccination data. For BCG, mothers were asked about an injection in the right arm and the presence of a scar. For polio, they were asked about drops in the mouth and frequency. For pentavalent vaccines, the query focused on injections in the left thigh and their frequency. For measles, mothers were asked about a vaccine given in the left upper arm at 9 months or later [55]. A total of thirteen data collectors (six diploma nurses, three diploma midwifery and four health officers) and two health officers as field supervisors participated in the data collection.

Data quality control

To maintain data quality, the questionnaire was initially prepared in English, first translated into the Amharic language, and then translated back into English to check its consistency. Pretests were conducted on 5% of the total sample (51 study subjects) in the same districts but not on selected kebeles for the study. Questions that posed difficulty or were unclear were rephrased and corrected. Supervisors, along with the principal investigator, were checked for completeness and consistency of the collected questionnaires daily as well as for spot checks. The data collectors and supervisors will be trained for one day to ensure data quality, the content of the questionnaire, how to approach participants and the data collection process and methods, as well as to ensure data confidentiality. Daily in-person or telephone communication was held to discuss the progress and problems faced in the actual fieldwork.

Data processing and analysis

The data were checked for consistency and completeness, coded, cleaned and edited for errors/omissions before analysis. Then, the data were exported in Excel, and the responses were converted to numeric values and imported to Stata version 14.0 for analysis. A summary of the MCH CoCs is presented as percentages/proportions with their respective 95% CIs, tables and figures. The household wealth status of the study mothers was constructed using principal component analysis (PCA). The satisfaction of assumptions for PCA was assessed by the Kaiser–Meyer–Olkin measure of sampling adequacy (>=0.6). Initially, bi-variable binary logistic regression was used to examine the associations between the

independent variables and the CoC. Variables with a *p*value < 0.2 in the bi-variable logistic regression analysis were chosen for the multivariable logistic regression model. We employed a multivariable logistic regression model to account for the effects of multiple independent variables simultaneously on the outcome variable (the continuum of care). This approach allows us to control for potential confounding factors and better isolate the relationship between the independent variables and the outcome. By including relevant variables in the model, we aim to provide a more accurate estimation of the odds of being on the continuum of care, while adjusting for other influences that may affect this relationship. Finally, an adjusted odds ratio (AOR) with a 95% confidence interval (CI) and a *p*value < 0.05 were considered to indicate statistical significance. We assessed multi-collinearity among the independent variables to ensure that our model provides reliable estimates and valid inferences regarding the relationships between the independent variables and the continuum of care. This assessment helps to identify any potential issues with highly correlated predictors, which could lead to inflated variance in the coefficient estimates and complicate the interpretation of their individual effects on the outcome. To evaluate model fitness, the Hosmer and Lemeshow goodness-of-fit test was used.

Table 2 Socio demographic characteristics of mothers with children aged 12–23 months in West Gondar, 2023

Variables	Category	Frequency	Percent
Maternal age	15–24	116	11.58
	25–29	341	34.03
	30–34	284	28.34
	35–49	261	26.05
Marital status	Currently married	975	97
	Currently not in union	27	3
Residency	Rural	736	73.45
	Urban	266	26.55
District	Adagn Ager Chako	246	24.55
	Metema	645	64.37
	Geneda Wuha	111	11.08
Maternal occupational status	Farming	444	44.31
	Housewife	433	43.21
	Merchant	86	8.58
	Gov't employed	19	1.90
	Other	20	2.00
Educational level of mother	No formal education	451	45.01
	Primary education	461	46.01
	Secondary education	50	4.99
	Above secondary	40	3.99
Educational level of father	No formal education	202	20.16
	Primary education	608	60.68
	Secondary education	123	12.28
	Above secondary	69	6.89
Wealth index	Poorest	215	21.46
	Poorer	191	19.06
	Middle	206	20.56
	Richer	204	20.36
	Richest	186	18.56
Media exposure	Yes	210	20.96
	No	792	79.04
Autonomy of decision making	Yes	827	82.53
	No	175	17.47

Results

Socio-demographic characteristics

The study was conducted among a total of 1002 mothers, for a response rate of 98%. The median age of the mothers was 30 years (IQR 27, 35). Almost all 975 (97%) mothers were in a union, and the majority (736, 73.45%) lived in rural areas. Approximately 451 (45%) mothers had not completed formal education, and 215 (21.46%) mothers lived in the poorest household wealth quintile (Table 2).

Characteristics related to obstetrics and health services

Approximately 331 (33%) mothers initiated their first ANC visit before 16 weeks of pregnancy. Moreover, approximately 233 (23.25%) mothers had birth preparedness and complication readiness plans for safe birth and for emergencies. There were 433 (43%) mothers who utilized modern family planning methods before the birth of their current child, and 644 (64.27%) respondents intended to become pregnant with their current child. The majority 916 (91%) of mothers were counseled about ANC, place of birth, PNC, family planning and immunization (Table 3).

Among mothers who received ANC, 973 (97%) had their blood pressure measured, 876 (87%) had iron-folic acid supplementation, 849 (84%) had a blood sample taken, and 699 (70%) had a urine sample taken during their ANC visit during pregnancy. However, 61.58% of mothers received all these MCH services during their ANC follow-up (Fig. 3).

Completion of maternal and child health care

The overall percentage of participants who completed the MCH CoC among all the study participants was 6.19% (95% CI: 4.69–7.68). Among the mothers, 434 (43.31%) attended ANC for four or more visits (ANC4+) during their pregnancy. The majority of mothers 814 (81.24%) were vaccinated with at least two tetanus toxoid (TT) dose during pregnancy. Approximately 590 (58.88%) mothers had delivered their current child in the health facilities, and 603 (60.7%) deliveries were made by skilled delivery attendant (SDA). However, only 33.73% (95% CI:

Table 3 Maternal health characteristics among mother with index children 12–23 months in West Gondar Zone, 2023

Variables	Category	Frequency	Percent
ANC visit	Before 16 weeks of pregnancy	331	33.03
	After 16 weeks of pregnancy	671	66.97
Birth status	Single	985	98.30
	Twin or more	17	1.70
Parity	Multiparity	678	67.66
	Grand multiparity	324	32.34
Intention of pregnancy	Intended	644	64.27
	Not intended	358	35.73
Birth preparedness & complication readiness	Yes	233	23.25
	No	769	76.75
History of termination of pregnancy	Yes	71	7.09
	No	931	92.91
History of modern family planning utilization	Utilized	433	43.21
	Not utilized	569	56.79
Pregnancy related complications	Had Complications	57	5.69
	Had no complications	945	94.31
Mode of delivery	SVD	959	95.71
	Cesarean section	43	4.29
Counseling on MCH services during ANC	Yes	916	91.42
	No	86	8.58
Estimated distance from health facility	Travel ≥ 5 km–1 h on foot	516	51.50
	Travel < 5 km–1 h on foot	486	48.5
Community based health insurance	Yes	926	92.42
	No	76	7.58
Availability of ambulance during labor	Yes	623	62.18
	No	379	37.82

30.8–36.7) of mothers and 31.54% of newborns received postnatal care within two days after birth. Approximately 894 (89.22%), 903 (90.12%), 885 (88.32%), and 924 (92.21%) mothers were vaccinated with BCG, three doses of polio, three doses of DPT-HepB-Hib, and measles (MCV), respectively. Currently, approximately 477 (47.6%) mothers utilize family planning methods and about 72% of children received age appropriate breast feeding (AABF) (Fig. 4).

Approximately 877 (87.52%) mothers had initiated breast feeding for their child within one hour of delivery, whereas 951 (94.91%) of the children were on breast feeding, and only 598 (59.68%) mothers exclusively breastfed for the first six months. Approximately 723 (72.16%) of the children received appropriate breastfeeding (Table 4).

Factors of the MCH continuum of care

According to the bivariate logistic regression, maternal educational status, occupation, wealth index, health facility distance, pregnancy intentions, complications during pregnancy, mode of delivery for the preceding pregnancy, history of modern family planning utilization in the preceding pregnancy, ANC visit initiation, birth preparedness and complication readiness and maternal services during ANC were associated with the MCH continuum of care. Further analysis of all these significant variables was conducted via multivariable logistic regression analysis. Therefore, multivariable logistic regression revealed that distance from the health facility, intention to become pregnant, history of modern family planning utilization in the preceding pregnancy, timing of the first ANC visit initiation, birth preparedness and complication readiness and maternal services during ANC were determinants affecting the MCH continuum of care. The odds of MCH completion were approximately four times greater for those who started their first ANC visit before 16 weeks of pregnancy than for their counterparts [AOR: 4.17 (CI: 2.08–8.35)]. Similarly, the odds of completing the MCH continuum of care were 2.83 times greater among mothers who were well prepared for birth preparedness and complication readiness during pregnancy than among mothers who were not well prepared [AOR: 2.83 (CI: 1.43–5.61)]. Moreover, the odds of completing the MCH continuum were 3.61 times greater among mothers who had a history of modern contraceptive utilization immediately before becoming pregnant for their current child than among their counterparts [AOR: 3.61 (CI: 1.85–7.04)]. The odds of a continuum of care for the MCH continuum of care were more than four times greater for mothers who intended to become pregnant for this child than for mothers who had unintended pregnancies [AOR: 4.25 (CI; 2.11–8.57)]. Mothers who received maternal health services during their ANC visit were also more likely to complete ANC services than mothers who did not receive all maternal services [AOR: 2.37 (CI: 1.07–5.97)]. Mothers who lived near a health facility that took less than one hour to reach were 2.43 times more likely to be on the path of the MCH continuum of care than those who lived far from a health facility that took more than one hour to reach a health facility [AOR: 2.43 (CI; 1.06–5.90)] (Table 5).

Discussion

The maternal and child continuum of care has become one of the key program strategies for improving maternal and child health and wellbeing [2]. An effective continuum of care connects essential maternal and child health packages throughout adolescence, pregnancy, childbirth, postnatal periods, and childhood [56].

This finding revealed that only 6.19% of mothers in the West Gondar zone completed 12 MCH components along the continuum of care. The overall completion of the MCH continuum of care was lower than that reported in previous studies in Ethiopia (47% [41], 37.6%

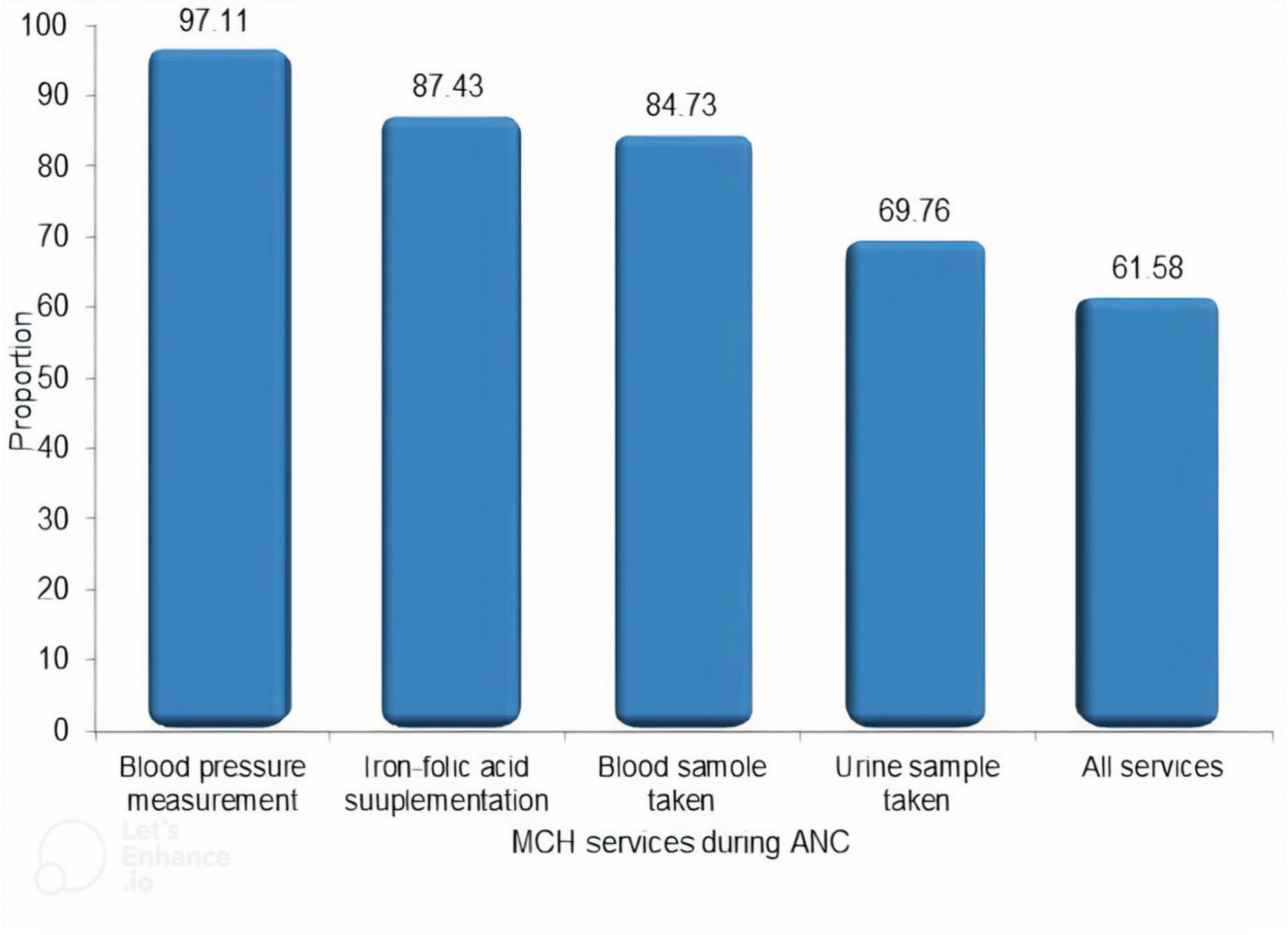

Fig. 3 Maternal health services during ANC follow-up among mothers with an index child aged 12–23 months in the West Gondar Zone, 2023

[32], 21.60% [29], 11.2% [30] and 37.2%, respectively) [28]. This variation may be due to differences in indicators for the measurement of the MCH continuum of care; previous studies considered the maximum continuity of MCH up to PNC follow-up [28–30, 32, 41], while others considered the ANC to be an indicator of at least one visit [32]. However, our study considers 12 currently modified indicators to measure the completion of continuity of MCH care [48]. The current coverage of the MCH continuum of care is greater than that reported by the EDHS 2016 [57]. This might be justified as a governmental commitment by designing a health sector transformation plan through expanding access to MCH services and improving the provision of quality and equitable comprehensive health services at all levels [58]. The percentages of patients who completed MCH care in the current study were relatively greater than those who completed the continuum of maternal, newborn, and child health care in 17 sub-Saharan African countries, for which 3.3% [13] and 1.8% of mothers completed MNCH, respectively, as reported in the Gambia [48]. This may be due to socio-demographic differences between the study areas and variations in the timing of the study. Other findings in Rwanda (33.8%), Tanzania (10%) and Uganda (10.7%) showed greater completion of the maternal and child health continuum of care [22, 59, 60]. This inconsistency was because those findings used national demographic health survey data. On the other hand, the lower completion rate of the maternal and child health (MCH) continuum of care (CoC) in Ethiopia compared to Uganda, Rwanda, and Tanzania can be largely attributed to disparities in Universal Health Coverage (UHC). Ethiopia faces several challenges that limit its progress toward UHC, which in turn affects the quality, accessibility, and affordability of maternal and child health services. Ethiopia's healthcare system is less developed, especially in rural areas, where infrastructure, transportation, and health facility coverage are limited. This affects timely access to antenatal care (ANC), delivery services, and postnatal care. In contrast, countries like Rwanda and Uganda have made more significant investments in expanding health services and ensuring that facilities are more accessible to rural and urban populations alike [61]. However, these

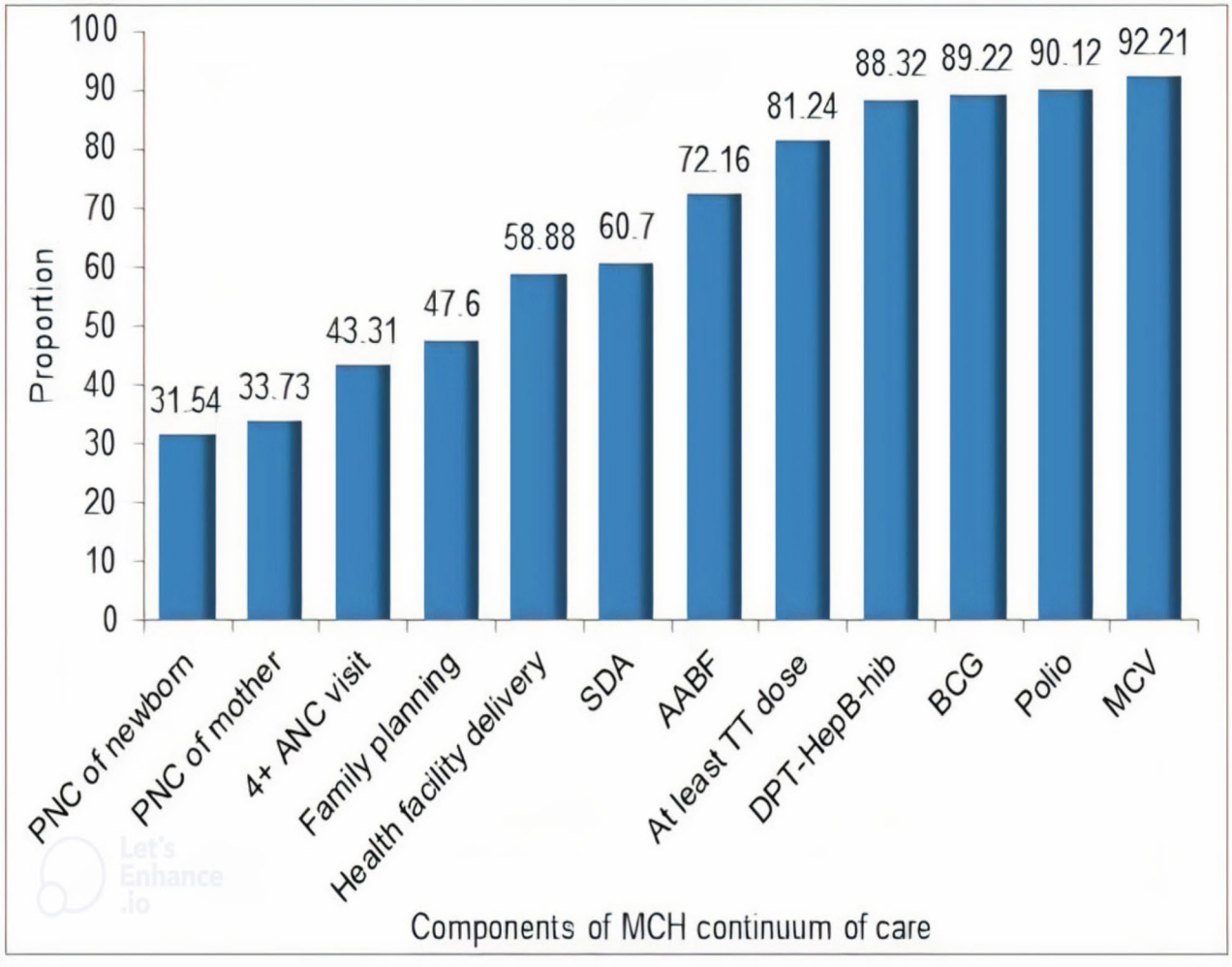

Fig. 4 Components of the MCH continuum of care among mothers with index children 12–23 months old living in the West Gondar zone, 2023. ($n = 1002$)

Table 4 Child health characteristics related to breastfeeding among 12-23-month-old children living in the West Gondar Zone, 2023

Variables	Category	Frequency	Percent
BF initiation	Initiated BF within 1 h	877	87.52
	Initiated BF after 1 h	125	12.48
Duration of EBF	For the first six months	598	59.68
	For less than six months	404	40.32
Current breast feeding status	On breast feeding	951	94.91
	Not on breast feeding	51	5.09
Complementary food initiation at age of 6 months	Had received complementary feeding	855	85.33
	Not received CF	147	14.67
Frequency of complementary feeding	Appropriate Complementary feeding	764	76.25
	Inappropriate Complementary feeding	239	23.85

findings are in line with studies conducted in Nigeria (6.5%) and Cambodia (5.0%) [20, 62].

This study revealed that the percentage of mothers utilizing PNC was 33.73%. This finding was in line with reported findings in South Gondar (36.4%) [63] and pooled estimate utilization of the PNC (32%) in Ethiopia [64]. The first 48 h after delivery is a critical period during which a large proportion of maternal and neonatal deaths occur [34]. As a result, prompt postnatal care for mothers and newborns is important for treating any complications arising from delivery and providing mothers with important health information for further continuous care.

Our study revealed that the prevalence of current modern family planning utilization among mothers who delivered before 12 to 23 months of age was 47%, which is in line with a study conducted in Arba Minch (44.4%) [65]. However, this percentage was lower than that in Debre Tabor town, which was 63% [66]. This difference

Table 5 Multivariable logistic regression on continuum of care factors among mothers with children aged 12–23 months in West Gondar, 2023

Variables	Category	MCH CoC		OR(95% CI)	
		Yes (%)	No (%)	COR	AOR
Wealth index	Poorest	2(1)	213(99)	1.0	1.0
	Poorer	7(4)	184(96)	4.05(0.83–19.74)	3.75 (0.70-20.15)
	Middle	7(3.6)	189(96.4)	3.94(0.81–19.22)	3.20 (0.60–17.20)
	Richer	16(8)	188(92)	9.06(2.06–39.94)	2.90 (0.56–14.53)
	Richest	30(5)	166(85)	19.2(4.53–81.69)	1.83 (0.34 - 9.93)
Maternal educational level	No formal education	13(3)	438(97)	1.0	1.0
	Primary education	31(7)	430(93)	2.43(1.25–4.70)	1.40(0.63–3.04)
	Secondary education	10(20)	40(80)	8.41(3.47–20.42)	2.80(0.93–8.48)
	Higher	8(20)	32(80)	8.42(3.25–21.80)	1.62(0.49–5.40)
Timing first ANC initiation	First trimester	49(5)	282(85)	8.79(4.69–16.47)	4.17(2.08–8.35)***
	2nd trimester & above	13(2)	658(98)	1.0	1.0
Intention to pregnancy	Intended	48(7)	596(93)	2.00(1.08–3.64)	4.25(2.11–8.57)***
	Not intended	14(4)	344(96)		
Obstetric complications	Yes	10(18)	47(82)	3.65(1.75–7.64)	1.16 (0.50–2.90)
	No	52(6)	893(94)	1.0	1.0
BPCR	Prepared	40(17)	193(83)	7.04(4.08–12.12)	2.83(1.43–5.61) **
	Not well prepared	22(3)	747(97)	1.0	1.0
Mode of delivery	Cesarean section	7(16)	36(84)	3.20(1.36–7.50)	2.40 (0.90–6.27)
	SVD	55(8)	904(92)	1.0	1.0
History of family planning utilization	Yes	47(11)	386(89)	5.46(2.92–10.19)	3.61(1.85–7.04)***
	No	15(3)	554(97)	1.0	1.0
Time to reach health facilities	Less than 1 h	53(11)	427(89)	7.07(3.45–14.51)	2.43(1.06–5.90)*
	1 h and more	9(2)	513(98)	1.0	1.0
MCH services	No	56(9)	561(91)	6.30(2.69–14.78)	2.37 (1.07–5.97)*
	Yes	6(2)	379(98)	1.0	1.0

* *P* value < 0.05, ** *P* value < 0.01, *** *P* value < 0.001

could be because the majority of our study participants were rural residents, and mothers who reside in urban areas were 1.7 times more likely to utilize family methods than rural residents [67]. The importance of preconception interventions for improved maternal, perinatal, and neonatal health outcomes is increasingly being recognized [68]. The use of these interventions to meet unmet needs for family planning and the optimization of interpregnancy intervals are important approaches that can be used across a range of possible platforms [69]. Moreover, the integration of maternal healthcare services with family planning services is also required to ensure the MCH continuum of care [70].

In this study, the timing of the first ANC visit initiation, birth preparedness and complication readiness, distance from health facility, intention to pregnancy, history of modern family planning utilization in preceding pregnancy and maternal services during ANC were found to be determinants that were significantly associated with the MCH continuum of care.

Mothers who had initiated their first ANC visit before 16 weeks of pregnancy were more likely to complete the MCH continuum of care. The possible justification could be that mothers who had started early ANC visits receive counseling on the MCH continuum of care that triggers them to continue the next level of the continuum of care. This study is supported by findings from North Gondar, Ebinat, East Gojjam, Hadiya, Arba-Minch and SSA [16, 25, 26, 29, 32, 41]. The first visit, which is expected to screen and treat anemia and syphilis, screen for risk factors and medical conditions that can best be dealt with in early pregnancy, and initiate prophylaxis if required (e.g., for anemia and malaria), is recommended to be held by the end of the fourth month [71]. Several studies have shown that women who started ANC early and attended frequently were more likely to be assisted during childbirth by skilled attendance than were those who initiated ANC late and attended only a few visits [72]. Mothers who delayed the initiation of ANC visits according to WHO recommendations did not receive adequate information and counseling services on the importance of maternal, neonatal and child health services [73].

Our study also revealed that birth preparedness and complication readiness during pregnancy are significantly associated with the completion of the MCH continuum of care. Therefore, the odds of completing the MCH continuum of care were greater among women who were well prepared for birth preparedness and

complication readiness during pregnancy than among those who were not well prepared. The findings of this study are consistent with previous studies in Ethiopia [25]. A systematic review and meta-analysis conducted on preparedness and complication readiness (BPCR) interventions in developing countries revealed that BPCR interventions were associated with an increased likelihood of using care in the event of newborn illness, clean cutting of the umbilical cord and initiation of breastfeeding in the first hour of life [74]. The BPCR is important for improving the use and effectiveness of key maternal and neonatal services because it reduces delays in deciding to seek care in two ways. First, it motivates people to plan to have a skilled provider at every birth, and second, complication readiness raises awareness of danger signs, thereby improving problem recognition and reducing the delay in deciding to seek care [49]. Therefore, increased efforts to ensure the implementation of the BPCR have been made by strengthening focused antenatal care, which emphasizes the counseling of women on the elements of this strategy, such as identifying a skilled birth attendant, identifying the location of the closest appropriate care facility, providing funds for birth-related and emergency expenses, transporting to a health facility for birth and obstetric emergency, and identifying compatible blood donors in case of emergency.

Mothers who lived near health facilities that take less than one hour are more likely to complete the MCH continuum of care than are those who lived in health facilities that take more than one hour on foot. This finding is in line with different studies in Ethiopia [29, 30]. Studies conducted in sub-Saharan Africa [13, 14] and the Lao PDR [11] showed similar findings. A possible reason might be that women who live closer to health facilities may not be challenged by the barriers of the second delay and may easily reach health facilities after the onset of labor. The findings revealed that the greater the distance to the closest health center, the less likely it is that a woman will receive appropriate maternal healthcare services [75]. The findings in Burkina Faso showed that a one kilometer increase in distance to the closest health center reduces the odds that a mother will receive four or more antenatal care by 0.05 and reduces the odds that she will deliver her baby with the assistance of a skilled birth attendant by 0.267 [75]. A study conducted in rural Ghana revealed that facility delivery was less likely among mothers living 1 km away from a health facility than among mothers living within 1 km of a facility [76].

This study also showed that a history of modern family planning utilization in preceding pregnancy contributes to the continuation of the MCH continuum of care. This finding is also supported by studies conducted in different regions of Ethiopia [25, 26, 28, 36, 37, 40]. This could be explained by the fact that practicing contraception during the postpartum period reduces the risk of short birth intervals, thereby increasing the likelihood of breastfeeding and mothers remaining on track of the MCH continuum of care [77].

The continuum of care for MCH services was three times greater for those who intended to become pregnant for their child. Similarly, this study is supported by findings in Arba Minch, Ethiopia and SSA [16, 25, 36]. In a study performed in Oklahoma, breastfeeding was significantly less likely among unwanted births, and breastfeeding for at least 6 months was significantly less likely among seriously mistimed births [78]. Therefore, mothers were more likely to receive inadequate prenatal care when the pregnancy was unintended (compared with when it was intended). They were also more likely to give birth at home. Similarly, newborns with unintended pregnancies are more likely to receive inadequate immunization and to remain stunted [79]. In addition, findings in Bangladesh explain that there was a decrease in the continuum of care by half (5.6%) from the overall continuum of care (12%) among mothers whose pregnancies were unwanted at conception [70].

Maternal health services provided during ANC visits, such as iron folic acid supplementation, blood pressure measurement, and urine and blood sample taken are significantly associated with improving the continuity of MCH care. Therefore, mothers who received maternal services during their ANC visit were also more likely to complete ANC than mothers who did not receive all maternal services during ANC. This study is in line with studies conducted in Ethiopia [38, 39, 73] and Egypt [23]. This could be justified because interactions with the formal health system and perceived need for future services appear to be important factors for retention on the continuum of care [21]. Routine supplementation of iron and folic acid (IFA) during pregnancy not only is important for the prevention of anemia but also increases the satisfaction level of the client with maternal and newborn health services and promotes health-seeking behaviors [73]. Health facilities should provide all recommended services by improving the availability and accessibility of all maternal health service packages to retain mothers along the path of the MCH continuum of care.

The study's findings have significant implications for clinical practice and public health in maternal and child health (MCH) service delivery. Clinically, the low rate of MCH continuum of care completion highlights the importance of early antenatal care (ANC) initiation to identify risks and educate mothers on comprehensive care. Healthcare providers should promote birth preparedness and complication readiness, as these strategies improve maternal outcomes by reducing delays in accessing skilled care. Public health interventions should focus on expanding access to MCH services in rural areas,

addressing barriers like transportation and distance from health facilities. Policymakers should prioritize enhancing transportation, infrastructure, and the establishment of maternity waiting homes in underserved regions. Community-level education and outreach, particularly through health extension workers, can raise awareness and increase participation in ANC and postnatal care. Addressing these systemic challenges through targeted policies can improve maternal and neonatal outcomes, reducing mortality rates. Researchers are also encouraged to conduct prospective cohort studies for stronger evidence in maternal and child health interventions. Ultimately, these findings call for a more integrated and accessible health system that prioritizes the MCH continuum of care to reduce maternal and neonatal mortality.

Strengths and limitations

This study, conducted in a community with a relatively large sample size, included three home visits to enhance response rates among mothers. Despite employing various probing techniques, recall bias may have influenced mothers' ability to accurately remember maternal and child health services received. Social desirability bias, stemming from self-reported information, may also have affected data validity. Difficulties in identifying specific services provided, like syphilis or HIV testing was also other limitation. Additionally, recall bias could have skewed reported timings of ANC initiation and breastfeeding practices. Comparisons with other studies were challenging due to limited literature resembling our study's context and design.

Conclusions

Maternal and child health services are critical for the well-being and survival of both mothers and children. In West Gondar, however, the overall continuum of care remains low, with significant gaps observed. Many mothers do not meet recommended ANC visit numbers, and skilled attendance at delivery and postnatal care utilization are inadequate. Tetanus toxoid vaccination rates for neonatal tetanus prevention are also below recommended levels. Suboptimal breastfeeding practices persist, despite improvements in childhood vaccination coverage. Addressing these challenges requires enhancing factors such as birth preparedness, early ANC initiation, intention to conceive, family planning utilization, proximity to health facilities, and the quality of maternal health services during ANC visits. Strengthening lower-level health facilities, like health posts, to provide accessible maternal and child health services is crucial. By focusing on these enabling factors, West Gondar Zone can improve the maternal and child health continuum of care, ensuring better health outcomes for mothers and children across the zone.

Abbreviations

AABF	Age Appropriate Breast Feeding
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
BPACR	Birth Preparedness and Complication Readiness
CMHS	Continuum of Maternal Health care Services
CI	Confidence Interval
COC	Continuum of Care
COR	Crude Odds Ratio
EDHS	Ethiopian Demographic Health Survey
EPI	Expanded Program of Immunization
EPMM	Ending Preventable Maternal Mortality
LMICs	Low and Middle Income Countries
MCH	Maternal and Child Health
MNCH	Maternal Newborn and Child Health
PNC	Postnatal Care
RMNCH	Reproductive Maternal Newborn and Child Health
SBA	Skill Birth Attendance
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
UNFPA	United Nations Population Fund
WHO	World Health Organization

Acknowledgements

We would like to express our deepest appreciation to the University of Gondar, College of Medicine and Health Sciences, Institute of Public Health. We would also like to express our heartfelt thanks to the West Gondar Zone Health Department, Adagn Ager Chako and Metema districts, and Genda Wuha town health offices and their respective health posts. The authors' cordially thank the health extension workers who were working with the respective health posts selected for the study and the tough full data collectors. Finally, our appreciation also extends to our colleagues for their valuable support during this thesis work and for their willingness to help and give us invaluable ideas from the very beginning.

Author contributions

AMT, YAH, YAF and EAF were involved in conceptualization, Methodology, and review and approve final manuscript. AMT, YAH, and EAF were involved in formal analysis. YAH, and EAF were involved in Supervision, Writing review & editing. AMT and YAF were involved in Visualization. YAF was involved in investigation. AMT was involved in writing the original draft.

Funding

No funding for this study.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the University of Gondar, College of Medicine and Health Sciences, Institute of Public Health, Institutional Review Board (Rif.no: IPH/2521/2023), and permission was granted from the involved bodies. Moreover, written informed consent was obtained from all study participants. For minor participants, informed consent was obtained from a parent and/or legal guardian, and assent was obtained from mothers younger than 18 years. The confidentiality and privacy of their information were de-identified, and they were actively protected throughout the research process. The data were anonymized, and the data collected did not include any identifying information such as the name or address of the person on the questionnaire.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details
[1]Department of Reproductive Health, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia
[2]Department of Reproductive Health, Teda Health Science College, Gondar, Ethiopia

Received: 29 June 2024 / Accepted: 4 November 2024
Published online: 08 November 2024

References

1. World Health Organization. Strategies towards ending preventable maternal mortality (EPMM). 2015.
2. Kerber KJ, de Graft-Johnson JE, Bhutta ZA, Okong P, Starrs A, Lawn JE. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. Lancet. 2007;370(9595):1358–69.
3. World Health Organization. Trends in maternal mortality 2000 to 2020 22 February 2023 [https://www.who.int/publications/i/item/9789240068759. Accessed 15 March 2023.
4. Kitila SB, Feyissa GT, Olika AK, Wordofa MA. Maternal healthcare in low- and middle-income countries: a scoping review. Health Serv Insights. 2022;15:11786329221100310.
5. Zundel RS. Inadequate maternal health care for women in the United States. Ballard Brief. 2022;2022(2):10.
6. Garcia KK, Hunter SK. Proposed solutions for improving maternal health care in Rural America. Clin Obstet Gynecol. 2022;65(4).
7. Delvaux T, Buekens P, Godin I, Boutsen M. Barriers to prenatal care in Europe. Am J Prev Med. 2001;21(1):52–9.
8. Khatri RBKR, Durham J, Assefa Y. Continuity of care and its determinants of routine maternal and newborn health visits in Nepal: evidence from a nationally representative household survey. 2021.
9. Wang W, Hong R. Levels and determinants of continuum of care for maternal and newborn health in Cambodia-evidence from a population-based survey. BMC Pregnancy Childbirth. 2015;15(1):1–9.
10. Gandhi S, Gandhi S, Dash U, Suresh Babu M. Predictors of the utilisation of continuum of maternal health care services in India. BMC Health Serv Res. 2022;22(1):602.
11. Sakuma S, Yasuoka J, Phongluxa K, Jimba M. Determinants of continuum of care for maternal, newborn, and child health services in rural Khammouane, Lao PDR. PLoS ONE. 2019;14(4):e0215635.
12. Andriani H, Rachmadani SD, Natasha V, Saptari A. Continuum of care in maternal, newborn and child health in Indonesia: evidence from the Indonesia Demographic and Health Survey. J Public Health Res. 2022;11(4):22799036221127619.
13. Seidu A-A, Ahinkorah BO, Aboagye RG, Okyere J, Budu E, Yaya S. Continuum of care for maternal, newborn, and child health in 17 sub-saharan African countries. BMC Health Serv Res. 2022;22(1):1–10.
14. Hunie Asratie M, Belay DG. Pooled prevalence and determinants of completion of maternity continuum of care in Sub-Saharan Africa: a multi-country analysis of recent demographic and health surveys. Front Glob Womens Health. 2022;3:869552.
15. Requejo JH, Bhutta ZA. The post-2015 agenda: staying the course in maternal and child survival. Arch Dis Child. 2015;100(Suppl 1):S76–81.
16. Alem AZ, Shitu K, Alamneh TS. Coverage and factors associated with completion of continuum of care for maternal health in sub-saharan Africa: a multicountry analysis. BMC Pregnancy Childbirth. 2022;22(1):1–12.
17. Arunda MO, Agardh A, Asamoah BO. Determinants of continued maternal care seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health surveys data. BMJ Open. 2021;11(12):e054136.
18. Sserwanja Q, Musaba MW, Mutisya LM, Olal E, Mukunya D. Continuum of maternity care in Zambia: a national representative survey. BMC Pregnancy Childbirth. 2021;21:1–10.
19. Shibanuma A, Yeji F, Okawa S, Mahama E, Kikuchi K, Narh C, et al. The coverage of continuum of care in maternal, newborn and child health: a cross-sectional study of woman-child pairs in Ghana. BMJ Global Health. 2018;3(4):e000786.
20. Oyedele OK, Fagbamigbe AF, Akinyemi OJ, Adebowale AS. Coverage-level and predictors of maternity continuum of care in Nigeria: implications for maternal, newborn and child health programming. BMC Pregnancy Childbirth. 2023;23(1):1–19.
21. Mohan D, LeFevre AE, George A, Mpembeni R, Bazant E, Rusibamayila N, et al. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health Policy Plan. 2017;32(6):791–9.
22. Sserwanja Q, Gatasi G, Musaba MW. Evaluating continuum of maternal and newborn healthcare in Rwanda: evidence from the 2019–2020 Rwanda demographic health survey. BMC Pregnancy Childbirth. 2022;22(1):781.
23. Hamed A, Mohamed E, Sabry M. Egyptian status of continuum of care for maternal, newborn, and child health: Sohag Governorate as an example. Int J Med Sci Public Health. 2018;7(6):1.
24. Muluneh AG, Kassa GM, Alemayehu GA, Merid MW. High dropout rate from maternity continuum of care after antenatal care booking and its associated factors among reproductive age women in Ethiopia, evidence from demographic and health survey 2016. PLoS ONE. 2020;15(6):e0234741.
25. Haile D, Kondale M, Andarge E, Tunje A, Fikadu T, Boti N. Level of completion along continuum of care for maternal and newborn health services and factors associated with it among women in Arba Minch Zuria Woreda, Gamo Zone, Southern Ethiopia: a community based cross-sectional study. PLoS ONE. 2020;15(6):e0221670.
26. Ahmed R, Sultan M, Abose S, Assefa B, Nuramo A, Alemu A, et al. Levels and associated factors of the maternal healthcare continuum in Hadiya Zone, Southern Ethiopia: a multilevel analysis. PLoS ONE. 2022;17(10):e0275752.
27. Tenaw SG, Tsega D, Zewudie BT, Chekole B, Eniyew MA, Mesfin Y. Completion of the maternal continuum of care and its association with antenatal care attendance during previous pregnancy among women in rural areas of the Gurage Zone, Southwest Ethiopia: a community-based cross-sectional study. BMJ open. 2022;12(11):e066536.
28. Tizazu MA, Sharew NT, Mamo T, Zeru AB, Asefa EY, Amare NS. Completing the continuum of maternity care and associated factors in Debre Berhan town, Amhara, Ethiopia, 2020. J Multidisciplinary Healthc. 2021:21–32.
29. Atnafu A, Kebede A, Misganaw B, Teshome DF, Biks GA, Demissie GD et al. Determinants of the continuum of maternal healthcare services in Northwest Ethiopia: findings from the primary health care project. Journal of pregnancy. 2020;2020.
30. Cherie N, Abdulkerim M, Abegaz Z, Walle Baze G. Maternity continuum of care and its determinants among mothers who gave birth in Legambo district, South Wollo, northeast Ethiopia. Health Sci Rep. 2021;4(4):e409.
31. Shitie A, Assefa N, Dhressa M, Dilnessa T. Completion and factors associated with maternity continuum of care among mothers who gave birth in the last one year in Enemay district, Northwest Ethiopia. Journal of Pregnancy. 2020;2020.
32. Tsega D, Admas M, Talie A, Tsega TB, Birhanu MY, Alemu S et al. Maternity continuum care completion and its associated factors in Northwest Ethiopia. Journal of Pregnancy. 2022;2022.
33. Hailemariam T, Atnafu A, Gezie LD, Tilahun B. Why maternal continuum of care remains low in Northwest Ethiopia? A multilevel logistic regression analysis. PLoS ONE. 2022;17(9):e0274729.
34. Csa I. Central Statistical Agency (CSA)[Ethiopia] and ICF. Ethiopia Demographic and Health Survey, Addis Ababa. Central Statistical Agency; 2016.
35. Owili PO, Muga MA, Chou YJ, Hsu YE, Huang N, Chien LY. Relationship between women's characteristics and continuum of care for maternal health in Kenya: Complex survey analysis using structural equation modeling. Women Health. 2017;57(8):942–61.
36. Mose A, Haile K, Timerga A. Prevalence of completion of maternity continuum of care and its associated factors in Ethiopia: a systematic review and meta-analysis. BMJ open. 2022;12(11):e062461.
37. Addisu D, Mekie M, Melkie A, Abie H, Dagnew E, Bezie M, et al. Continuum of maternal healthcare services utilization and its associated factors in Ethiopia: a systematic review and meta-analysis. Women's Health. 2022;18:17455057221091732.
38. Chaka EE, Parsaeian M, Majdzadeh R. Factors associated with the completion of the continuum of care for maternal, newborn, and child health services in Ethiopia. Multilevel model analysis. Int J Prev Med. 2019;10.
39. Zelka MA, Yalew AW, Debelew GT. Completion and determinants of a continuum of care in maternal health services in Benishangul Gumuz region: a prospective follow-up study. Front Public Health. 2022;10:1014304.
40. Emiru AA, Alene GD, Debelew GT. Women's retention on the continuum of maternal care pathway in west Gojjam Zone, Ethiopia: multilevel analysis. BMC Pregnancy Childbirth. 2020;20(1):1–14.
41. Asratie MH, Muche AA, Geremew AB. Completion of maternity continuum of care among women in the post-partum period: magnitude and associated factors in the northwest, Ethiopia. PLoS ONE. 2020;15(8):e0237980.

42. World Health Organization. New global targets to prevent maternal deaths 5 October 2021 [https://www.who.int/news/item/05-10-2021-new-global-targets-to-prevent-maternal-deaths. Accessed 02 April 2023.
43. World Health Organization and UNFPA. Ending Preventable Maternal Mortality (EPMM). A renewed focus for improving maternal and newborn health and well-being 2021 [https://www.who.int/initiatives/ending-preventable-maternal-mortality. Accessed 05 April 2023.
44. Tiruneh GT, Demissie M, Worku A, Berhane Y. Predictors of maternal and newborn health service utilization across the continuum of care in Ethiopia: a multilevel analysis. PLoS ONE. 2022;17(2):e0264612.
45. Zelka MA, Yalew AW, Debelew GT. The effects of completion of continuum of care in maternal health services on adverse birth outcomes in Northwestern Ethiopia: a prospective follow-up study. Reproductive Health. 2022;19(1):1–15.
46. Dadi TL, Medhin G, Kasaye HK, Kassie GM, Jebena MG, Gobezie WA, et al. Continuum of maternity care among rural women in Ethiopia: does place and frequency of antenatal care visit matter? Reproductive Health. 2021;18:1–12.
47. Seidu A-A, Ahinkorah BO, Aboagye RG, Okyere J, Budu E, Yaya S. Continuum of care for maternal, newborn, and child health in 17 sub-saharan African countries. BMC Health Serv Res. 2022;22(1):1394.
48. Oh J, Moon J, Choi JW, Kim K. Factors associated with the continuum of care for maternal, newborn and child health in the Gambia: a cross-sectional study using demographic and health survey 2013. BMJ open. 2020;10(11):e036516.
49. Hailu M, Gebremariam A, Alemseged F, Deribe K. Birth preparedness and complication readiness among pregnant women in Southern Ethiopia. PLoS ONE. 2011;6(6):e21432.
50. World Health Organization. The global health obserbatory; Neonates protected at birth against neonatal tetanus [https://www.who.int/data/gho/indicator-metadata-registry/imr details/3207#:~:text=%E2%80%9CProtection at birth%3A%E2%80%9D For,level and protection against tetanus. Accessed 18 March 2023.
51. World Health Organization. Complementary feeding 2023 [https://apps.who.int/nutrition/topics/complementary_feeding/en/index.html. Accessed 20 March 2023.
52. Bearak JM, Popinchalk A, Sedgh G, Ganatra B, Moller A-B, Tunçalp Ö, et al. Pregnancies, abortions, and pregnancy intentions: a protocol for modeling and reporting global, regional and country estimates. Reproductive Health. 2019;16(1):36.
53. Kassahun A, Zewdie A. Decision-making autonomy in maternal health service use and associated factors among women in Mettu District, Southwest Ethiopia: a community-based cross-sectional study. BMJ open. 2022;12(5):e059307.
54. Zegeye K, Gebeyehu A, Melese T. The role of geographical access in the utilization of institutional delivery service in rural Jimma Horro District, Southwest Ethiopia. Prim Health Care: Open Access. 2014;4(1):1–7.
55. Etana B, Deressa W. Factors associated with complete immunization coverage in children aged 12–23 months in Ambo Woreda, Central Ethiopia. BMC Public Health. 2012;12(1):1–9.
56. Owili PO, Muga MA, Chou Y-J, Hsu Y-HE, Huang N, Chien L-Y. Associations in the continuum of care for maternal, newborn and child health: a population-based study of 12 sub-saharan Africa countries. BMC Public Health. 2016;16(1):1–15.
57. Gebremedhin AF, Dawson A, Hayen A. Determinants of continuum of care for maternal, newborn, and child health services in Ethiopia: analysis of the modified composite coverage index using a quantile regression approach. PLoS ONE. 2023;18(1):e0280629.
58. Mullan Z. Transforming health care in Ethiopia. Lancet Global Health. 2016;4(1):e1.
59. Sserwanja Q, Mukunya D, Nabachenje P, Kemigisa A, Kiondo P, Wandabwa JN, et al. Continuum of care for maternal health in Uganda: a national cross-sectional study. PLoS ONE. 2022;17(2):e0264190.
60. Mohan D, LeFevre AE, George A, Mpembeni R, Bazant E, Rusibamayila N, et al. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health Policy Plann. 2017;32(6):791–9.
61. World Bank Group. Universal Health Coverage (UHC) in Africa: a framework for action : Main report (English).
62. Kikuchi K, Yasuoka J, Nanishi K, Ahmed A, Nohara Y, Nishikitani M, et al. Postnatal care could be the key to improving the continuum of care in maternal and child health in Ratanakiri, Cambodia. PLoS ONE. 2018;13(6):e0198829.
63. Fenta SM, Moyehodie YA, Belay AT, Biresaw HB, Fentaw KD, Yalew MM, et al. Postnatal care utilization coverage and its associated factors among mothers in South Gondar Zone, Northwest Ethiopia: a cross-sectional study. SAGE Open Nurs. 2022;8:23779608221140312.
64. Chaka EE, Abdurahman AA, Nedjat S, Majdzadeh R. Utilization and determinants of postnatal care services in Ethiopia: a systematic review and meta-analysis. Ethiop J Health Sci. 2019;29(1).
65. Wassihun B, Wosen K, Getie A, Belay K, Tesfaye R, Tadesse T, et al. Prevalence of postpartum family planning utilization and associated factors among postpartum mothers in Arba Minch town, South Ethiopia. Contracept Reproductive Med. 2021;6(1):1–8.
66. Taye EB, Mekonen DG, Debele TZ. Prevalence of post partum modern family planning utilization and associated factors among postpartum mothers in Debre Tabor town, North West Ethiopia, 2018. BMC Res Notes. 2019;12(1):1–7.
67. Demeke CA, Kasahun AE, Belay WS, Chekol AN, Getaneh RA, Yimenu DK. Utilization pattern of long-acting and permanent family planning methods and associated factors: a community-based cross-sectional study in Ethiopia. Open Access J Contracept. 2020;11:103–12.
68. Dean SV, Imam AM, Lassi ZS, Bhutta ZA. Importance of intervening in the preconception period to impact pregnancy outcomes. Maternal Child Nutrition: First 1 000 Days. 2013;74:63–73.
69. Bhutta ZA, Das JK, Bahl R, Lawn JE, Salam RA, Paul VK, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? Lancet. 2014;384(9940):347–70.
70. Khan MN, Harris ML, Loxton D. Assessing the effect of pregnancy intention at conception on the continuum of care in maternal healthcare services use in Bangladesh: evidence from a nationally representative cross-sectional survey. PLoS ONE. 2020;15(11):e0242729.
71. Wehby GL, Murray JC, Castilla EE, Lopez-Camelo JS, Ohsfeldt RL. Prenatal care effectiveness and utilization in Brazil. Health Policy Plann. 2009;24(3):175–88.
72. Gross K, Alba S, Glass TR, Schellenberg JA, Obrist B. Timing of antenatal care for adolescent and adult pregnant women in south-eastern Tanzania. BMC Pregnancy Childbirth. 2012;12:1–12.
73. Zelka MA, Yalew AW, Debelew GT. Effects of continuity of maternal health services on immediate newborn care practices, Northwestern Ethiopia: multilevel and propensity score matching (PSM) modeling. Heliyon. 2022;8(12):e12020.
74. Soubeiga D, Gauvin L, Hatem MA, Johri M. Birth preparedness and complication readiness (BPCR) interventions to reduce maternal and neonatal mortality in developing countries: systematic review and meta-analysis. BMC Pregnancy Childbirth. 2014;14(1):129.
75. Tanou M, Kamiya Y. Assessing the impact of geographical access to health facilities on maternal healthcare utilization: evidence from the Burkina Faso demographic and health survey 2010. BMC Public Health. 2019;19(1):1–8.
76. Nesbitt RC, Lohela TJ, Soremekun S, Vesel L, Manu A, Okyere E, et al. The influence of distance and quality of care on place of delivery in rural Ghana. Sci Rep. 2016;6(1):30291.
77. Ahmed S, Ahmed S, McKaig C, Begum N, Mungia J, Norton M, et al. The effect of integrating family planning with a maternal and newborn health program on postpartum contraceptive use and optimal birth spacing in rural Bangladesh. Stud Fam Plann. 2015;46(3):297–312.
78. Lindberg L, Maddow-Zimet I, Kost K, Lincoln A. Pregnancy intentions and maternal and child health: an analysis of longitudinal data in Oklahoma. Matern Child Health J. 2015;19(5):1087–96.
79. Singh A, Singh A, Thapa S. Adverse consequences of unintended pregnancy for maternal and child health in Nepal. Asia Pac J Public Health. 2015;27(2):NP1481–91.

Publisher's note