Women’s retention on the Continuum of Maternal Care Pathway in West Gojjam Zone, Ethiopia: Multilevel Analysis

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Abstract

Background: The continuum of maternal care has been one of the effective approaches for improving the health of mothers and newborns. Although a large numbers of Ethiopian women do not use maternal health services, points of drop out along the continuum are not understood well. Understanding of a particular point of maternal care dropout on the continuum, however, helps governments make effective interventions. This study aimed to assess the extent of women's service use and the factors affecting retention on the continuum of care in West Gojjam Zone, Ethiopia. Methods: A community based survey linked to health facility data was conducted in June 2018. Data were obtained from 1281 mothers who gave birth to their last baby within the preceding 12 months from a two-stage cluster sampling. Data were collected via face-to-face interviews using a pretested questionnaire. Multilevel logistic regression models were used to examine the effects of individual and cluster-level factors on key elements of the continuum of care. The measure of fixed effects was expressed as Odds Ratio with 95% confidence interval. Results: The study revealed that only 12.1% of women completed the continuum of care (ANC4+, SBA, PNC within 48 hours after birth); while, 25.1% reported not having care at any stage for their most recent birth. There were commonalities and differences in the predictors of the three indicators of maternal health service utilization. Variables related to services received during antenatal care such as early initiation of ANC (AOR=7.53, 95%CI, 2.94, 19.29) and receiving proper contents (AOR=3.31, 95%CI, 1.08, 10.16) were among the predictors significantly associated with the completion of the continuum of care. Conclusions: The continuum of maternal care completion rate was extremely low, indicating that women were not getting the maximum possible health benefit from existing health services. Factors influencing each of the three indicators of maternal care service revealed to operate at various levels - individual, household, community, and facility. Since antenatal care is one of the basic gateways for subsequent use of maternal services, strategies that aimed to improve maternal health service utilization should target early initiation and antenatal care quality.

Background

Most of the time, motherhood is a source of joy to the family and women in particular. Yet, each pregnancy poses potential risks in low-income countries, particularly in sub-Saharan Africa (SSA), where maternal services are limited [1]. It is evidenced that the lifetime risk of maternal death in SSA countries, on average, is about 1 in 36 compared to 1 in 4,900 women in high-income countries [2]. The situation in Ethiopia is not exceptional; the high toll of maternal mortality in the country remains the single most important challenge to the health sector. The estimated maternal mortality of 412 deaths per 100,000 live births for Ethiopia[3].

To date, many strategies have been implemented in an attempt to improve maternal health outcomes [2]. Of the strategies, the continuum of maternal care (CoC) has recently received a significant recognition. The COC has been designed as a key program strategy for improving the health and wellbeing of women, and as a means to reduce the high toll of maternal morbidity and mortality[4, 5]. This program requires an integrated service delivery system that coordinates the key components of maternal services (from pre-pregnancy to delivery, and postnatal cares) with a continuous stream of quality services at each level [4].

The provision of antenatal services that are timely (first visit during the first trimester of pregnancy)[6, 7], frequent (four or more visits)[6, 8, 9], and adequate (with proper contents)[6, 8, 9] improve the uptake of subsequent maternal services. Skilled attendance at birth reduces deaths for both the mother and the newborn [8, 10]. Postnatal care, especially within the first 48 hours after birth, has been essential to ensuring women's and children's health[8]. Postpartum family planning also reduces a woman's reproductive risks associated with unintended pregnancy [4].
With regard to healthcare, Ethiopia has made a number of health reforms to carry out initiatives for safe motherhood. The government has tried to improve access to basic maternal health services through primary healthcare expansion and charge free maternal health services[11]. Besides, the ministry of health has already set 34 priority interventions along the continuum of care[12]. To this effect, 16,440 health posts, 3,547 health centers, and more than 311 hospitals have become functional [13].

In spite of these efforts, however, the use of maternal health care services along the entire cascade of maternity care (antenatal care, facility delivery, postnatal care, and family planning) is still very low compared to other Sub Saharan African (SSA) countries [14]. Currently, 22% of married women have an unmet need for family planning. Two third of mothers do not receive the recommended number of antenatal care and many of them book late; while 72.6% of births take place at home; and only 16.5% of women have postnatal checks [3]. To improve the rate of service use across the continuum of care, factors influencing women's service utilization need to be identified [1].

Several studies in Ethiopia [15-17] have treated antenatal, delivery and postnatal care as separate entities either at the design and/or the analysis stages. Nonetheless, the downside of such an artificial division is that it obscures the fact that pregnancy and post-pregnancy is a process, with each phase being critically affected by what preceded it [18]. In addition, targeting the coverage of each maternal service separately does not necessarily ensure that every woman receives a series of maternal and reproductive services continuously from pre-conception to post-delivery stages and beyond[4, 19].

Furthermore, the previous studies focused primarily on individual-level factors with little attention given to community factors and service delivery environment. The drawback is that this underestimates the significance of considering contextual factors when designing appropriate maternal health strategies in the country. In addition, many earlier studies are methodologically flawed; despite multilevel modeling is appropriate to test the social and environmental determinants of health service use, many (if any) have tended to use models that could not adequately handle those hierarchical constructs.

Therefore, for bridging all those gaps in the contemporary empirical literature, this study examined the effect of level-I (individual and household related factors) and level-II (community and facility level factors) on the utilization of the key elements of continuum of maternal care using multilevel logistic regression analysis.

**Methods**

**Study setting**

This study was conducted in the West Gojjam zone of the Amhara region. The center of the zone, Finote-Selam town, is located 395 km away from Addis Ababa, capital of Ethiopia. Administratively the zone comprises 13 rural districts and 2 town administrations with a total population of 2,611,925 people at the time of the study, of whom 615,892 (23.58%) were women in the reproductive age group [20].

With regard to the health service facilities in the zone, there were six public primary hospitals, 103 health centers, and over 374 health posts; all collectively being staffed by 51 medical doctors, 227 public health officers, 1016 nurses, 293 midwives, 266 pharmacy workers, 200 laboratory professionals, and 850 health extension workers.
addition, there were 115 private health facilities (1 general hospital and 114 clinics of different types) during the time of the survey [20].

**Study design and period**

A community based household survey linked to health facility data has been carried out in June 2018. In theory, connecting household data on care-seeking or service contact to health facility assessment data on service readiness is becoming an effective approach for improving coverage measurement [21].

**Study population and sampling**

Women in the reproductive age group who gave birth in 12 months prior to the survey date were the study population. A multistage cluster sampling was employed to reach the study population. First, the study area was stratified into 13 rural districts and 2 town administrations (Finote-selam and Burie towns), and five districts (4 rural districts and 1 town administration), were selected randomly. Second, 13 Kebeles (clusters now onwards) were selected using simple random sampling. Then, all the women who met the inclusion criteria were included in the study. The list of all births for rural women was obtained from the family folder of health extension workers while, in urban setting preliminary census was conducted in the selected kebeles before the actual data collection period to identify eligible mothers.

The required sample size was done through STATCALC program of the Epi-Info statistical package V.7.0. Both single population and double population formulas were considered in computing different sample sizes. For the single population formula assumption of; 95% confidence level, 4% margin of error, 16.5% proportion of PNC utilization[3], design effect of 2, and 10% non-response rate were considered. For the latter, the following assumptions were considered; 5% level of significance (two-sided); 90% power; 1:3 ratio of maternity service users to non-users, design effect of 2, and 10% non-response rate. Of the different computed samples, the largest sample size (that is 1294) was obtained from single population formula, which is considered in this study. However, during the time of data collection 1337 women who met the inclusion criteria were included in this study, but 1281 women responded to the questions.

Furthermore, during the house-to-house survey public health facilities (hospitals and health centers) providing at least basic maternal health services for that community were identified. To this end, all eligible public hospitals and health centers that deemed functional at least for a year prior to the survey were part of the facility survey. As a result, the survey included 15 public health facilities in all five districts.

**Variables and measurements**

**Outcome variables:** Retention on the continuum of maternal care services at three levels: I) ANC1 to ANC 4+; II) ANC 4+ to SBA; and III) from SBA to PNC within 48 hours after birth. These combined indicators were dichotomized to construct three binary variables (one for each outcome variable), “1” if the services were received, and “0” otherwise.
Outcome variable 1: Compared women received four or more antenatal care visits against those who received less than four visits. Accordingly, the number of ANC visits was dichotomized as “1” for women received at least four ANC visits and “0” otherwise. Outcome variable 2: analyzed the predictors of continuation of care from pregnancy to facility delivery among women who received four or more antenatal care. Hence, this variable is coded as ‘1’ if the respondent received at least four ANC follow-ups and facility delivery and “0” for receiving at least four antenatal care but not attended facility delivery (skilled birth attendance). Outcome variable 3: included women who received both at least four ANC visits and facility-based delivery services to identify factors associated with women retention in PNC visits within 48 hours after birth. The two categories of the outcome are “1” for receiving four or more antenatal care, skilled birth attendance, and postnatal care within 48 hours (that is completing the continuum of maternal care), and 0 for receiving at least four antenatal visits and skilled birth attendance but not postnatal care within 48 hours after birth.

Independent variables: Ranges of explanatory variables have been selected based on their theoretical and empirical relevance applied in different kinds of literatures, and they were grouped into two levels. Level 1 variables (lower-level variables) included individual and family related factors such as age, educational status of women and partners, occupation of both partners, birth order, intendedness of the index pregnancy, wealth index, previous obstetrical history, timing and contents of antenatal care, and mode of delivery. Level 2 variables (higher-level variables) included aggregation of community factors (place of residence and distance to health facility) and health facility variables (health facility to population ratio and level of readiness of healthcare facilities).

Data collection

The household data were collected via face-to-face interviews. A pre-tested structured questionnaire, developed in the local language (Amharic), was used to collect information about utilization of the key maternity services (pre-conception and postpartum family planning, antenatal, delivery and postpartum care) and reasons for not seeking maternity care. For this survey, a total of 20 data collectors and supervisors deployed after receiving a two days intensive training by the principal investigator.

In addition, health facility assessment was carried out using an observation checklist. The readiness or preparedness of a health facility to support the provision of maternity services (ANC, SBA, and PNC) have been evaluated using WHO's criteria[22]. Then the result of each facilities' readiness score was linked to the individual woman in the corresponding household survey.

Data analysis and modeling

Data analysis was done using SPSS for windows version 25. We first described the levels of use of the key maternal and reproductive service along the continuum. For each of the services, percentages of retention and drop-offs between the successive components along the continuum pathway was computed.

Women living in the same kebele (cluster) may share similar characteristics; hence, the estimates from ordinal regression that assumes all individual are independent would not be efficient. Therefore, by taking the hierarchical structure of the data into consideration, where women are nested within households and households within kebeles, a logistic multilevel modeling was fitted. This model also enables partitioning of the total variation in the outcome into within-group (in this particular case kebele) and between-group components, which allows in differentiating the relative contributions of level 1 and level 2 variables[23].
For each of the three outcome variables, we fit two multilevel logistic regression models. The first was the empty model that did not contain any explanatory variable. This model was used to determine if our data justified the decision to assess random effects at level 2 (i.e. at kebele level). The second model (the full model) included both level 1 and level 2 variables in addition to cluster (kebele) specific random effects.

During analysis, we used the same groups of predictors for the first and second outcomes. Meanwhile, variables related to services received during antenatal care (the content and timing of first ANC) and modes of delivery were included to the third outcome (CoC).

The fixed effects (measures of association) were reported in terms of odds ratios (OR) with their P-values and 95% confidence interval (CI), while the results of random effects (measures of variation) were measured using intra-class correlation (ICC)[24]. The ICC was calculated as;

\[
\text{ICC} = \frac{\sigma_1^2}{\sigma_1^2 + \pi^2/3}.
\]

Where: \( \sigma_1^2 \) and \( \pi^2/3 \) are cluster and individual level variances, respectively. Since there is no separate variance term at Level-1 for categorical variables (i.e., the residual variance at level 1 is fixed to a factor of 1.0), the variance of a logistic distribution is \( \pi^2/3 \), or approximately 3.29 [23].

**Results**

**Socio-demographic characteristics**

A total of 1281 (response rate 95.8%) reproductive aged women (15–49 years) participated in the household survey. As Table 2 shows, the majority of respondents were married 1208(94.6%), Orthodox Christian followers 1230(96.0%), and Amhara in ethnicity, 1249(97.5%).

Over three-quarters, 978(76.3%) of the women were rural residents and almost similar proportion, 993(77.5%) were multi-parous. A high number of grand multiparty, 332(25.9%) was also noted. The age distribution of the participants showed that more than half 674(52.6%) of them were between 25–34 years, and the mean (±SD) age was 30.3(±6.0) years.

With regard to the distribution of the respondents’ educational status, more than half of the women, 660 (51.5 %) had never been to school, while only a far smaller proportion, 50 (3.9 %) of them attained tertiary education. The results regarding the distribution of the women's household wealth index indicated that almost half, 631(49.3%) of them belonged to the lower two wealth quintiles (Table1, Annex 1).

*Table 1: Background characteristics of women who had birth in 12-18 months preceding the survey, West Gojjam, Ethiopia, 2018.*
| Variables | Number of women (N= 1281) | Percentage |
|-----------|---------------------------|------------|
| Age of the mother | - 15-24 years 226 | 17.6 |
| | - 25-34 years 674 | 52.6 |
| | - 35-39 years 291 | 22.7 |
| | - 40 years and above 90 | 7.0 |
| Residence | - Rural 978 | 76.3 |
| | - Urban 303 | 23.7 |
| Marital Status | - Single 9 | 0.7 |
| | - Married 1208 | 94.3 |
| | - Divorced 57 | 4.4 |
| | - Widowed 7 | 0.5 |
| Education status | - Cannot read & write 660 | 51.5 |
| | - Read and write 164 | 12.8 |
| | - Primary education 306 | 23.9 |
| | - Secondary 101 | 7.9 |
| | - Higher Education 50 | 3.9 |
| Education status | - Can NOT read and write 369 | 28.8 |
| | - Read and write 287 | 22.4 |
| | - Primary education 379 | 29.6 |
| | - Secondary Education 105 | 8.2 |
| | - Higher Education 73 | 5.7 |
| Occupation | - Employed 47 | 3.7 |
| | - Merchant 132 | 10.3 |
| | - Farmer 886 | 69.2 |
| | - Daily worker 88 | 6.9 |
| | - House wife 108 | 8.4 |
| | - Others 20 | 1.6 |
| Occupation of the husband(n=1212) | - Employed 88 | 6.9 |
| | - Merchant 161 | 12.6 |
| | - Farmer 863 | 67.4 |
| | - Daily worker 75 | 5.9 |
| | - Others 25 | 2.0 |
| Religion | - Orthodox 1230 | 96.0 |
| | - Catholic 29 | 2.3 |
| | - Muslim 19 | 1.5 |
| | - Protestant 3 | 0.2 |
| Ethnicity | - Amhara 1249 | 97.5 |
| | - Others 32 | 2.5 |
| Wealth quintile | - poorest 60 | 4.7 |
| | - poor 571 | 44.6 |
| | - Middle 58 | 4.5 |
| | - Rich 336 | 26.2 |
| | - richest 256 | 20.0 |
| Birth order | - 1 288 | 22.5 |
| | - 2-4 661 | 51.6 |
| | - 5+ 332 | 25.9 |
| Interval between successive births(n=993) | - < 24 months 46 | 3.6 |
| | - 24-33 months 245 | 24.7 |
| | - 34-59 months 630 | 63.4 |
| | - >=60 months 72 | 7.3 |
Intendedness of the pregnancy
- Intended 1062 82.9
- Mistimed 175 13.7
- unwanted 44 3.4

Previous use of family planning
- Yes 942 73.5
- No 339 23.5

History of adverse pregnancy outcomes
- Yes 117 9.1
- No 1164 90.9

History of Pregnancy related complications
- Yes 135 10.5
- No 1146 89.5

Knowledge of at least 2 danger signs
- Yes 388 30.3
- No 893 69.5

Descriptive presentation of key elements of the continuum of maternal care

Antenatal Care (ANC) follow up

While 898 (70.1%) (95% CI: 67.5%–72.6%) of the women received antenatal services from skilled health professionals (doctor, health officer, nurse, or midwife in Ethiopian context) at least once, 511 (39.9%) (95% CI: 37.2%–42.6%) of the women continued for the WHO recommended four or more ANC visits during their most recent pregnancies. Of the mothers who had at least one ANC visit, only 134 (14.9%) of them had their first ANC visit during their first trimester, while 615 (68.5%) of them during the second trimester, and the rest 149 (16.6%) started during the third trimester.

Furthermore, the findings showed that most of the women who made at least one antenatal care did not receive the key ANC service components recommended by the WHO; and only 418 (46.5%) of them received all the items of the antenatal care contents. For instance, of the nine key ANC components considered in this study, a smaller percentage of women had urine 519 (57.8%) and blood samples taken for 556 (61.9%). On the other hand, the coverage of the blood pressure measurement at least once was much better than other antenatal service, 857 (95.4%).

Skilled Birth attendant (SBA) use

Overall, less than half, 609 (47.5%) of the most recent births were assisted by skilled birth attendants either at hospitals or health centers. For those mothers who gave birth outside the health institutions sudden onset of labor 395 (58.8%) and lack of transportation for getting to health facilities 323 (48.1%) were the main barriers mentioned for not seeking care. This is further confirmed by the fact that only 175 (28.5%) of the women who delivered in healthcare facilities got an ambulance service to travel to the health facilities when labor started.

The finding further revealed that 178 (13.9%) of the women were encountering at least one complication during or immediately after delivery; severe vaginal bleeding 30 (16.9%) and prolonged labor 109 (61.2%) were the most frequently mentioned problems, among others.

Postnatal care use

For the postnatal care, despite 562 (43.0%) of the respondents received at least one PNC within 6 weeks after-delivery, only a third, 192 (14.9%) of the mothers reported a health check within the first 48 to 72 hours of birth. Women who reported post-partum care were asked about the content of care they received; and the most frequently received service was counseling on breastfeeding, reported by 467 (83.1%). On the contrary, counseling about
follow ups 154 (27.4%) and postpartum family planning 221(39.3%) were among the least frequently received services.

**Pre-pregnancy and Postpartum family planning use**

Contraceptive uses, both pre-pregnancy and postpartum, were more commonly reported than any other components of the continuum of care. Of the respondents, 942(73.5%) reported that they were using modern contraceptive before the index pregnancy. The proportion of women who received modern contraceptive after delivery was 762(59.5%). The contraceptive method mix among postpartum women is dominated by injectable 545 (71.5%) followed by implants, 164(21.5%).

For women who failed to use any modern contraceptive after delivery issues related to postpartum amenorrhea 137(26.4%), fear of side effects of hormonal contraceptives 97(18.7%), and infrequent sexual intercourse 119(22.9%) were the top most reasons cited for non-use of modern contraception.

**Retention on the continuum of the maternal care pathway**

*Figure 1* illustrates the flow of services within the continuum of care to indicate the proportions of women who transit from one maternal service to the next, and the points along the continuum where women drop off from the journey.

As could be seen in the figure 1, 70.1%(67.5%-72.6%) of the women received ANC services at least once in their pregnancy but a substantial of them( 30.2%) did not continue on the pathway to receive 4 or more ANC visits, which was the highest drop-off in the continuum. As a result, only 39.9% (37.2-42.6%) made four or more visits. Across the continuum, the smallest relative drop-off (8.8%) was observed between ANC 4+ and facility delivery; 31.1% (28.5%-33.7%) of women who received at least four ANC continued giving birth in health care facilities. Furthermore, after facility delivery about one for every five (19.0%) women did not go on to receive a PNC health check within 48 hours of birth (*Figure 1*).

The percentages of women who received the various possible combinations of maternal health services within the continuum of care is shown table 2; and this combination helps to point out the closely aligned elements of the continuum of care.

The finding indicated that 321 (25.1%) of women interviewed reported not having any contact at any points of the continuum during their pregnancy, and only 155 (12.1%) accomplished all the stages of the continuum of care (4+ ANC visits, SBA, and PNC visit within 48 hours). The result also highlighted that only a few (or none at all) women attended facility delivery or postnatal care within 48 hours or both without first having received focused antenatal care, showing positive linkages among different maternal services. Accordingly, facility delivery without having received four or more antenatal care was uncommon at less than one percent. Furthermore, postnatal care was uncommon unless it was combined delivery with an SBA and at least four ANC visits (*Table 2*)

**Table 2: Percent distribution of reproductive aged women by different types of maternal health services received for the most recent birth, West Gojjam, Northwest Ethiopia, 2018(n=1281)**
| S.N | ANC1 | ANC 4+ | SBA | PNC within 48 hrs. | Number (%) |
|-----|------|--------|-----|-------------------|-------------|
| 1   | No   | No     | No  | No                | 321 (25.1)  |
| 2   | Yes  | No     | No  | No                | 238 (18.6)  |
| 3   | No   | No     | Yes | No                | 53 (4.1)    |
| 4   | No   | No     | No  | Yes               | ----        |
| 5   | Yes  | Yes    | No  | No                | 113 (8.8)   |
| 6   | No   | No     | Yes | Yes               | 9 (0.7)     |
| 7   | Yes  | No     | Yes | No                | 121 (9.4)   |
| 8   | Yes  | No     | No  | Yes               | ----        |
| 9   | Yes  | Yes    | Yes | No                | 243 (19.0)  |
| 10  | Yes  | No     | Yes | Yes               | 28 (2.2)    |
| 11  | Yes  | Yes    | No  | Yes               | ----        |
| 12  | Yes  | Yes    | Yes | Yes               | 155 (12.1)  |
|     | Total|        |     |                   | 1281 (100%) |

Note: Yes= received the service, No= did not receive the service, ANC1= At least one ANC visit, ANC4= Four or more ANC visit, SBA=Skilled birth attendant at delivery (or delivery at health centers and hospitals), PNC=Postnatal check-up for the mother within 48 hours after birth.

Multilevel analysis

As stated in the methods section, three multilevel logit regression models were fitted to identify factors influencing utilization of maternal health services along the continuum of care.

The first step in the multilevel model analysis was to consider if our data justified the decision to assess random effects at kebele (cluster) level. In this regard, the result of the empty model revealed that there was a considerable amount of variation for each indicator of maternal health service utilization across the clusters ($P < 0.05$), which justifies developing a multilevel model.

As shown by the intra-community correlation coefficient (ICC) values, 24.9%, 20.1%, and 21.2% of the total variances in the use of at least four antenatal cares (ANC4+), facility delivery, and postnatal care within 48 hours were attributable to unobserved differences across clusters, respectively (Table 3). When adjusted for all the study covariates, the kebele(Cluster) level variances in the use of ANC 4+, skilled attendance at delivery, and retention in PNC reduced to 22.4%, 10.1% and 11.8%, respectively ($p>0.05$).

As shown in table 4, the full model showed that there are some variations in the predictors of the specific indicators of maternal service use; hence, we present the findings separately for each maternal indicators (Table 4).

Table 3: Parameter coefficients for the multilevel model for retention in the three indicators of maternal healthcare services (ANC, SBA, PNC): empty model, without covariates in West Gojjam, 2018
Predictors of ANC 4+ visits

Model I analyzed the predictors of four or more antenatal care visits by women who took at least one antenatal care service. Results of the fully adjusted model showed that women's age at the last birth, their education, and their knowledge on pregnancy-related complications were relatively the strongest level one predictors. The odds of retention in the antenatal care were higher among mothers aged between 18-24 years (AOR = 6.15, 95% CI = 2.41–16.48); women attended at least secondary education (AOR = 3.02, 95% CI = 1.16–7.83); and those who knew at least two pregnancy danger signs of pregnancy (AOR=3.31; 95%CI; 2.02, 5.41). Moreover, mothers who belonged to the richest wealth tertile (AOR = 2.21, 95% CI = 1.12–4.34) and those who had intended pregnancy (AOR = 2.24, 95% CI = 1.13–4.43) were other level one predictors of this model.

Of level two covariates considered in this study, the highest readiness score of the nearby health care facility (in providing antenatal care) had a positive association with the use of four or more antenatal follow-up (AOR=2.21, 95%CI; 1.12, 4.34) than women residing near to facilities of low readiness score.

The ICC (rho) in the use of at least four antenatal care show a marginal reduction from 24.9% (p< 0.05) in the empty model to 22.4% (still appreciably large) in the full model. In other words, the proportion of reduction in variance at the kebele level due to the covariates is only 12.8% ((1.092 - 0.952)/1.092), indicating continued clustering of antenatal care utilization even after controlling for both level 1 and level 2 covariates(Table 4).

Retention in skilled birth attendance (ANC4 &SBA)

Model II analyzed the factors associated with the continuation of care from pregnancy to having skilled birth attendance among women who received at least four ANC visits.

In the fully adjusted model, the odds of retention in SBA were higher among ANC clients whose pregnancy was intended (AOR= 6.28, 95% CI 1.56, 25.31); who experienced any kind of pregnancy-related complications (AOR= 2.73, 95% CI; 1.44, 5.19); and those who had better knowledge of danger signs (AOR = 9.71, 95% CI; 4.56, 20.68) than their counterparts. In addition, women who had attended secondary and above education (AOR = 5.93, 95% CI = 1.92–18.34) and partnered with at least primary education (AOR = 1.63, 95% CI = 1.01–2.64) had a positive association with retention in skilled birth attendance. On the other hand, the age of the women showed an inverse
relation with safe delivery; the odds of retention in SBA were higher among ANC clients aged between 15–24 years (AOR = 6.96, 95% CI; 3.33, 14.54) than 35 years and above.

As a level 2 predictor, mothers who lived in urban areas (AOR = 4.08, 95% CI = 2.63–6.31) were found to be positively associated with receiving skilled attendance at birth. Similarly, women's odds of giving birth to health facilities was 3.07 (AOR= 3.07, 95% CI; 1.27, 7.41) times higher for women resided near to health facilities that were more ready to deliver antenatal interventions than the women around less ready facilities to antenatal service (Table 4).

**Retention in PNC within 48 hours after birth**

Model III estimates the effects of predictors on the continuation of care from delivery to early post-delivery period among women who received both at least four antenatal care and skilled birth attendance (i.e. completion of the continuum of care).

Retention in the entire continuum was higher among mothers who initiated ANC within the first 16 weeks (AOR = 7.53, 95% CI; 2.94, 19.29) than those booked lately. In addition, women who received the recommended contents during ANC consultation, which are indications of ANC quality, were virtually three folds [AOR= 3.31, 95% CI; 1.08,10.16] more likely to complete the continuum of maternal care as compared to women received poor quality of antenatal care.

The birth history of mothers (such as abortion, stillbirth, LBW) and mode of delivery were also important predictors in influencing the utilization of maternal health services. Women who had a history of poor fetal outcome before the last birth were 70 percent (AOR= 0.30, 95%CI; 0.12, 0.79) less likely to use maternal services compared to their counterparts who had normal pregnancy outcomes. Similarly, the odds of retention in early PNC attendance decreases by 64% for women who delivered spontaneously than assisted deliveries, (AOR=0.36, 95%CI; 0.20, 0.68).

Women married to better-educated husbands were more likely to use facility-based delivery; the odds of reporting in the use of postnatal care among women whose husbands were attending secondary or higher education were about three (AOR=2.48, 95%CI;1.07,5.73) times higher than those married to non-educated husbands. Likewise, housewives were 3.07 times (AOR=3.07, 95%CI; 0.38, 24.55) more likely to use maternal services compared to professionally employed women.

Women who mentioned at least two pregnancy danger signs were 2.64 (AOR=2.64; 95%CI; 1.27, 5.49) times more likely to complete the continuum than their counterparts (Table 4).

**Table 4: Result of multilevel logistic regression for maternal health care service use by women aged 15–49 who had their most recent birth between 12—18 months preceding the survey, West Gojjam Zone, Ethiopia, 2018**
## Predictor variables

|                  | Adjusted odds ratio (95% CI) |
|------------------|------------------------------|
|                  | ANC 4+                       | ANC&SBA                     | ANC,SBA&PNC                  |
| **Fixed Effects**|                              |                             |                             |
| **Individual level factors** |                              |                             |                             |
| **Women's education** |                              |                             |                             |
| Below primary education* | 1.00                         | 1.00                        | 1.00                         |
| Primary education  | 1.51(1.04,2.22)              | 0.033* (1.33,3.49)          | 2.16(1.92,18.34)             |
| Secondary and above | 3.02(1.16,7.83)              | 0.024* (5.93)               | 0.002* (1.94,33,11.54)       |
| **Husbands education** |                              |                             |                             |
| Below primary education | 1.00                         | 1.00                        | 1.00                         |
| Primary education  | 1.97(1.34,2.90)              | 0.001* (1.63,101,2.64)      | 0.04* (1.01,42,2.44)         |
| Secondary and above | 1.13(0.46,2.74)              | 0.79                        | 1.58(0.57,4.41)              |
| **Women's Occupation** |                              |                             |                             |
| Employed          | 1.00                         | 1.00                        | 1.00                         |
| Farmer            | 7.35E5(9.49E6,0.001)         | 0.00 (1.03,14,02)           | 0.99 (0.27,0.10,0.78)        |
| Merchant           | 8.02E5(7.62E-)               | 0.00 (2.73,42,33)           | 0.47 (3.07,0.38,24,55)       |
| House wife        | 6.0001                       | 0.00 (2.97,21,74)           | 0.28 (3.61,108,12,07)        |
| Others            | 6.30E5(7.57E-)               | 0.00 (8.23,99,89)           | 0.10 (1.19,21,69)            |
| **Husband's Occupation** |                              |                             |                             |
| Employed          | 1.00                         | 1.00                        | 1.00                         |
| Farmer            | 0.19(0.01,2.49)              | 0.20* (0.68,21,21)          | 0.53 (5.32,0.95,29,74)       |
| Merchant           | 0.21(0.02,2.72)              | 0.19 (0.60,14,25)           | 0.49 (0.92,0.13,6,49)        |
| Others            | 0.27(0.03,2.70)              | 0.27 (0.26,0,8,0,89)       | 0.03* (3.78,0.66,21,62)      |
| **Religion**      |                              |                             |                             |
| Orthodox Christian| 1.00                         | 1.00                        | 1.00                         |
| Others            | 0.74(0.33,1.65)              | 0.48 (0.58,27,127)          | 0.17 (0.42,0.14,130)         |
| **Age of the mother** |                              |                             |                             |
| 35+ years         | 1.00                         | 1.00                        | 1.00                         |
| 25-34 years       | 1.52(0.99,2.33)              | 0.052 (2.25,44,3,53)        | 0.001* (0.44,18,106)         |
| 15-24 years       | 6.15 (2.41,16,48)            | 0.0001* (6.96,33,14,54)     | 0.001* (2.33,59,9,06)        |
| **Birth interval** |                              |                             |                             |
| < 24 months       | 1.00                         | 1.00                        | 1.00                         |
| 24-33 months      | 1.25(0.44,3,53)              | 0.68 (0.44,18,108)          | 0.07 (0.36,0.07,1,91)        |
| 34-59 months      | 2.48(0.77,8,04)              | 0.13 (1.22,45,3,28)         | 0.69 (0.36,0.06,2,35)        |
| >= 60 months      |                              |                             |                             |
| **Intendedness of the pregnancy** |                              |                             |                             |
| Intended          | 2.24(1.13,4.43)              | 0.02* (6.28,156,25,31)      | 0.01* (2.09,0.66,6,69)       |
| Not Intended      | 1.00                         | 1.00                        | 1.00                         |
| History of poor fetal outcome before the last pregnancy |                              |                             |                             |
| Yes               | 0.99(0.48,2.06)              | 0.98 (0.87,48,15)           | 0.64 (0.30,01,12,0,79)       |
| No                | 1.00                         | 1.00                        | 1.00                         |
Complications encountered during the last pregnancy

|                          | No                               | Yes       | No       |
|--------------------------|----------------------------------|-----------|----------|
|                          | 1.23 (0.56, 2.70)                | 0.61      | 2.73 (1.44, 5.19) | 0.002*  | 1.07 (0.60, 1.89) | 0.82 |

Knowledge on danger signs related to maternal & RH issues

|                          | Knowledgeable | Not knowledgeable |
|--------------------------|---------------|-------------------|
|                          | 3.31 (2.02, 5.41) | 0.001*  | 9.71 (4.56, 20.68) | 0.001*  | 2.64 (1.27, 5.49) | 0.01 |

Household wealth index

|                          | Higher         | Middle         | Lower       |
|--------------------------|----------------|----------------|-------------|
|                          | 2.21 (1.12, 4.34) | 0.02*      | 0.98 (0.60, 1.59) | 0.91  | 0.59 (0.29, 1.16) | 0.13 |
|                          | 2.15 (1.50, 3.09) | 0.001      | 1.27 (0.85, 1.90) | 0.24  | 0.89 (0.52, 1.56) | 0.70 |
|                          | 1.00           | 11.00        | 1.00        |

Timing of first ANC

|                          | within 16 weeks | After 16 weeks |
|--------------------------|-----------------|---------------|
|                          | 7.53 (2.94, 19.29) | 0.001*       |

Content of ANC

|                          | Appropriate | Inappropriate |
|--------------------------|-------------|---------------|
|                          | 3.31 (1.08, 10.16) | 0.04*        |

Mode of delivery

|                          | SVD          | Assisted/surgery |
|--------------------------|--------------|-----------------|
|                          | 0.36 (0.20, 0.68) | 0.001 |

Community level factors

Type of residence

|                          | Urban         | Rural           |
|--------------------------|---------------|-----------------|
|                          | 1.51 (0.83, 2.76) | 1.00          |

Health facility readiness level

|                          | High Readiness | Medium readiness | Low readiness |
|--------------------------|----------------|------------------|---------------|
|                          | 3.53 (1.27, 9.82) | 0.02*      | 3.07 (1.27, 7.41) | 0.021* | 1.18 (0.44, 3.16) | 0.57 |
|                          | 2.25 (0.68, 7.43) | 0.18        | 1.41 (0.65, 3.06) | 0.38  | 1.49 (0.79, 2.80) | 0.21 |
|                          | 1.00           | 1.00           | 1.00           |

Random Effects

|                          | Variance ($\tau^2_0$) | ICC          | -2LL()        |
|--------------------------|-----------------------|--------------|---------------|
|                          | 0.952 (0.56)          | 0.224        | 3259.902      |
|                          | 0.371 (0.26)          | 0.101        | 5072.391      |
|                          | 0.440 (0.39)          | 0.118        | 1765.477      |

Discussion

The utilization of the three aspects of maternal health care—antenatal, delivery, and postnatal service within 48 hours and the association between individual, household, the community including facility-level factors were
examined in this study.

The study found that after receiving antenatal care many women dropped out from the pathway of the continuum and did not have four or more antenatal care, a skilled birth attendant or postnatal care within 48 hours after birth. Consequently, only 12.1% of the women completed all the three key elements of the continuum of care. This finding was in line with the findings of similar studies undertaken in some other SSA countries[25, 26]. However, the coverage of CoC was extensively lower than the coverage reported in South Asia [25] and Cambodia[27]. The significantly lower rate of completion in the current study compared with other studies might be attributed to the inclusion of only women who received four or more ANC care and PNC within 48 hours, whilst others included those who received at least one ANC and PNC within 6 weeks. The relatively low completion rate and large dropout suggest that most pregnant women and newborns who lived in our study area might be at risk of maternal and neonatal complications, as they could miss proven interventions at various points of contact in the continuum.

As observed in previous studies [28, 29], our finding also re-affirms the noteworthy effect of four or more prenatal care for subsequent maternity and reproductive health services as only a few women who did not receive ANC went on to have a facility delivery or PNC check within 48 hours. For instance, delivery with an SBA without having received four or more antenatal care was uncommon at less than one percent. It could be possible to imply that frequent contact in the health system provides a woman the opportunity of getting focused health messages such as birth preparedness and the need to deliver in a health facility. Moreover, based on the effects of using ANC on the subsequent maternal services observed in this study area and elsewhere, it seems right to consider ANC visit as a router that connects the other indicators of maternal health services together.

The analytical part of this study identified several factors (operating at various levels.) that have significant effects on the utilization of maternal health care services. The findings have further highlighted that there are commonalities and differences in the factors associated with the use of the three maternal services. Of a set of factors considered in this study, women's knowledge on danger signs of pregnancy remains significant across all the three indicators of maternal health services. Women who had better awareness and understanding of the benefits of maternal health services and danger signs of pregnancy or childbirth were more likely to receive the three maternal services than their counterparts; a finding that reinforces the hypothesis that increased perception of risk encourages the use of care from other studies [30-32]. Health knowledge enables women to be aware of their rights and health status in order to seek appropriate health services[33].

Mothers’ adherence to the entire continuum of care was higher among those women who initiated ANC follow up during the first four months of gestation than those booked late. Previous studies from Ethiopia and other SSA countries have also reported the relation between the timing of ANC and subsequent maternity services[9, 10]. Many women, especially in Africa and Asia, hide their pregnancy at early stage until they had missed several periods before confirming a pregnancy [34], or chose to keep their pregnancy secret until noticed by family members[35]. Further, even if women realized that they are pregnant, the motivation to visit maternity clinics is often superseded by cultural and superstitious beliefs about pregnancy disclosure[36, 37], especially when women thought that pregnancy has been risk-free. Nonetheless, a pregnant woman who did not access antenatal care timely misses opportunities for early detection and prompt treatment of complications, if happen [38, 39].

The health issues of women cannot be addressed without giving due attention to quality of care for the simple reason that ignoring quality issue affects women's decisions regarding the time of initiation and continuity of care [40]. Consistent with previous studies[8, 26], our data showed that women who received the key components during
ANC consultation, which are indicators for ANC quality, were virtually three times more likely to complete the continuum of care as compared to women received poor quality of antenatal care.

This study has found that education of woman and her husband had a significant effect on the utilization of maternal services. These observations are in consonance with previous results from Ethiopia [9, 16, 17, 31] and elsewhere [25, 27]. The positive relationship between education and maternal service utilization might be explained as follows. As the level of education increases the social distance between pregnant women and service providers becomes reduced; women become more aware of health-protective information[32], these, in turn, improve women's ability in accessing the health care services without waiting on the decision made by husbands or other health decisive[41].

The reviewed literature showed inconsistent results on the correlation between age and maternal service utilization; some show no effect[42], or older age at motherhood is associated with increased odds of maternity service use[43]. Our finding revealed that younger age at motherhood (between 15-24 years) was associated with increased odds of utilizing four or more ANC visits and facility-based delivery than older age women. Our finding is supported by Moyer and colleagues finding that shows an inverse relationship between age and maternity service utilization unless the woman was younger than 18 years [10]. The same study justified that younger mothers may desire to follow modern trends, and be so more likely to use maternal services than older mothers who desire more traditional practices. However, as aged women are more likely to be of high parity and the risk of maternal and fetal complications increase among old and grand multiparous mothers[44], lower levels of retention of these group of women in SBA is particularly problematic.

In this study, unintended pregnancy at the time of conception was associated with less frequent antenatal visits or home deliveries compared to wanted pregnancies. Intentness of pregnancy was also indicated as a factor influencing maternal service utilization in other studies [7, 45, 46]. In this aspect, Yohannes and colleagues from Ethiopian argued that as many women with unintended pregnancy are too young or too old, they may have negative attitude towards their pregnancies and may go through a period of denial, and hence tend to hide the pregnancy due to fear of stigma [46].

The study also noted that household wealth status was positively and significantly associated with utilization of four or more ANC visits. In fact, the degree of inequalities due to household wealth detected in this study was less than the one detected in earlier studies in Ethiopia and other developing countries[15, 16, 25]. Unlike other studies, where the effect of household wealth status spans across all maternal service utilization, the effect of household wealth status in this study was limited only for antenatal care use. The lack of variation in delivery and postnatal care services by wealth status in our study might be attributed to the introduction of healthcare financing reforms by the government of Ethiopia, which includes social and community based health insurance schemes, and charge free maternity services in public health facilities, among others[47]. Further, for most women labor begins suddenly at night[48], and inaccessibility of transport during this time, accompanied by poor road condition in remote areas, could have a detrimental effect on SBA than do for antenatal care.

At the community level, urban residence and high level of facilities readiness to antenatal care were found to be associated with higher odds of using facility delivery and antenatal care services, respectively. Consistent with studies in Ethiopia [16, 17, 42] and other countries [18, 25] women who live in urban areas were more likely to attend an assisted delivery than women resided in the rural areas. Lack of infrastructure (e.g. road condition, transport) in rural areas may explain this disparity; in Ethiopia, health facilities are disproportionately distributed in
favor of urban residents [49]. In this aspect, Berhan et al from Ethiopia claimed that several women with obstetric problems paid more than 4000 Ethiopian Birr for less than 100 km travel, which was extremely high by any standard in the country[50]. The urban-rural service gap might also be associated with a low propensity of rural dwellers to seek maternal care during pregnancy; a large proportion of them believe that pregnancy is a natural process requiring no medical intervention [51].

In this study, facility readiness for ANC service was positively associated with the use of frequent ANC visit and facility delivery services. This finding is in agreement with other studies [31, 52]. As mentioned by Barker and his colleagues inadequate staffing, lack of drugs, equipment, diagnostics or incompetence of health providers could be barriers to accessing maternal services[53].

The findings of this study need to be viewed in light of the following limitations. As with other cross sectional studies, the nature of the data does not allow drawing causal inferences. The data were collected retrospectively and therefore are prone to recall bias. However, in order to mitigate the effect of recall bias, we focused on the most recent births within the last 12-18 months prior to the survey. Despite the limitations, however, this analysis offers insights into the relationship between services along the continuum of care.

**Conclusions**

This study demonstrated that the completion rate of the entire continuum of maternal care was extremely low, indicating that women were not getting the maximum possible health benefit from existing health services. Factors influencing each of the three indicators of maternal care service revealed to operate at various levels - individual, household, community, and health facility, which highlights a need to contextualize efforts. The findings suggest that efforts to promote use of maternal health services should pay special attention to the needs of old age, uneducated women, rural dwellers, women of unintended pregnancy, and the poor. Further, the positive link between early initiation of first antenatal care with proper content and subsequent maternal care services underscores the need for improving the quality of antenatal care.

**List Of Abbreviations**

ANC: Antenatal Care; ANC4+: Antenatal Care Visits (four or more); AOR: Adjusted Odds Ratio; CI: confidence Interval; CoC: Continuum of Care; EDHS: Ethiopian Demographic and Health Surveys; HIV: Human Immunodeficiency Virus; PNC: Postnatal Care; SBA: Skilled Birth Attendant; SDG: Sustainable Development Goals; SPSS: Statistical Package for Social Science; SSA: Sub-Saharan Africa; VIF: Variance Inflation Factor; WHO: World Health Organization

**Declarations**

**Ethics approval and consent to participate**

Ethical clearance for the study was obtained from the Ethical Committee of College of Medicine and health Sciences, Bahir Dar University. Letter of permission was obtained from regional health bureau and line offices. All participants gave informed consent. Personal identifiers were excluded from the data collection form to maintain privacy and confidentiality.

**Consent for publication**
Not Applicable

Availability of data and materials

All the data related to this research are available in text, figures or tables.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

AA: conceived the study, wrote the proposal, participated in data collection, analyzed the data and drafted the paper. GD: contributed to survey design, data collection, analysis and manuscript writing. GT: participated in proposal development, data collection, data analysis, and manuscript writing. All authors read and approved the final manuscript.

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References

1. Alkema L, Chou D, Hogan D, Zhang S, Moller A-B, Gemmill A, Fat DM, Boerma T, Temmerman M, Mathers C: Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. The Lancet 2016, 387(10017):462-474.

2. World Health Organization: Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division Annex 2015, 7:51.

3. Central Statistical Agency (CSA) [Ethiopia] and ICF. Ethiopia Demographic and Health Survey 2016: Key Indicators Report. Addis Ababa E, and Rockville, Maryland, USA. CSA and ICF, 2016
4. 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. The Lancet 2007, 370(9595):1358-1369.

5. Kikuchi K, Ansah EK, Okawa S, Enuameh Y, Yasuoka J, Nanishi K, Shibanuma A, Gyapong M, Owusu-Agyei S, Oduro AR: Effective linkages of continuum of care for improving neonatal, perinatal, and maternal mortality: a systematic review and meta-analysis. PloS one 2015, 10(9):e0139288.

6. Heredia-Pi I, Servan-Mori E, Darney BG, Reyes-Morales H, Lozano R: Measuring the adequacy of antenatal health care: a national cross-sectional study in Mexico. Bull World Health Organ 2016, 94(6):452-461.

7. Sinyange N, Sitali L, Jacobs C, Musonda P, Michelo C: Factors associated with late antenatal care booking: population based observations from the 2007 Zambia demographic and health survey. The Pan African medical journal 2016, 25.

8. Marchant T, Tilley-Gyado RD, Tessema T, Singh K, Gautham M, Umar N, Berhanu D, Cousens S, Schellenberg JRA: Adding content to contacts: measurement of high quality contacts for maternal and newborn health in Ethiopia, north east Nigeria, and Uttar Pradesh, India. PloS one 2015, 10(5):e0126840.

9. Fekadu GA, Ambaw F, Kidanie SA: Facility delivery and postnatal care services use among mothers who attended four or more antenatal care visits in Ethiopia: further analysis of the 2016 Demographic and Health Survey. BMC Pregnancy and Childbirth 2019, 19(1):64.

10. Moyer CA, Mustafa A: Drivers and deterrents of facility delivery in sub-Saharan Africa: a systematic review. Reproductive health 2013, 10(1):40.

11. Pearson L, Gandhi M, Admasu K, Keyes EB: User fees and maternity services in Ethiopia. International journal of gynecology & obstetrics 2011, 115(3):310-315.

12. UNFPA. Trends in Maternal Health in Ethiopia. Challenges in Achieving the MDG for Maternal Mortality; In-depth analysis of the EDHS 2000-2011, 2012.

13. FMOH: Health Sector Transformation Plan: 2015/16 - 2019/20 (2008-2012 EFY). Addis Ababa, Ethiopia In.; October 2015.

14. Federal Ministry of Health. National Strategy for Newborn and Child Survival in Ethiopia, 2015/16 – 2029/20. June 2015, Addis Ababa, Ethiopia.

15. Tesfaye G, Loxton D, Chojenta C, Semahneg A, Smith R: Delayed initiation of antenatal care and associated factors in a systematic review and meta-analysis. Reproductive health 2017, 14(1):150.

16. Alemi Kebede KH, Teklehaymanot AN: Factors associated with institutional delivery service utilization in Ethiopia. International journal of women's health 2016, 8:463.

17. Chaka EE, Abdurahman AA, Nedjat S, Majdzadeh R: Utilization and Determinants of Postnatal Care Services in Ethiopia: A Systematic Review and Meta-Analysis. Ethiopian journal of health sciences 2019, 29(1):935.

18. Mohan D, LeFevre AE, George A, Mpembeni R, Bazant E, Rusibamayila N, Killewo J, Winch PJ, Baqui AH: Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health policy and planning 2017, 32(6):791-799.

19. Bryce J, Arnold F, Blanc A, Hancioglu A, Newby H, Requejo J, Wardlaw T, Measurement CWGoIC: Measuring coverage in MNCH: new findings, new strategies, and recommendations for action. PLoS medicine 2013, 10(5):e1001423.

20. ANRS Health Burea: The 2016/17 Fiscal Year Annual performance report of Amhara regional state health bureau. Bahir Dar In.; July,2017.
21. Do M, Micah A, Brondi L, Campbell H, Marchant T, Eisele T, Munos M: Linking household and facility data for better coverage measures in reproductive, maternal, newborn, and child health care: systematic review. *Journal of global health* 2016, 6(2).

22. World Health Organization: Service availability and readiness assessment (SARA): an annual monitoring system for service delivery: reference manual. In.: World Health Organization; 2013.

23. Tom A, Bosker TASRJ, Bosker RJ: Multilevel analysis: an introduction to basic and advanced multilevel modeling; Sage; 1999.

24. Koo TK, Li MY: A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of chiropractic medicine* 2016, 15(2):155-163.

25. Singh K, Story WT, Moran AC: Assessing the continuum of care pathway for maternal health in South Asia and sub-Saharan Africa. *Maternal and child health journal* 2016, 20(2):281-289.

26. Shibanuma A, Yeji F, Okawa S, Mahama E, Kikuchi K, Narh C, Enuameh Y, Nanishi K, Oduro A, Owusu-Agyel S: 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.

27. 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 and childbirth* 2015, 15(1):62.

28. Gottfredsdottir H, Steingrímsdóttir P, Böjömsdóttir A, Guðmundsdóttir EÝ, Kristjánsdóttir H: Content of antenatal care: Does it prepare women for birth? *Midwifery* 2016, 39:71-77.

29. Jacobs C, Moshabela M, Maswenyeho S, Lambo N, Michelo C: Predictors of antenatal care, skilled birth attendance, and postnatal care utilization among the remote and poorest rural communities of Zambia: a multilevel analysis. *Frontiers in Public Health* 2017, 5:11.

30. Belayneh T, Adefris M, Andargie G: Previous early antenatal service utilization improves timely booking: cross-sectional study at university of Gondar hospital, northwest Ethiopia. *Journal of pregnancy* 2014, 2014.

31. Worku AG, Yalew AW, Aferwork MF: Factors affecting utilization of skilled maternal care in Northwest Ethiopia: a multilevel analysis. *BMC international health and human rights* 2013, 13(1):20.

32. Kea AZ, Tulloch O, Datiko DG, Theobald S, Kok MC: Exploring barriers to the use of formal maternal health services and priority areas for action in Sidama zone, southern Ethiopia. *BMC pregnancy and childbirth* 2018, 18(1):96.

33. Åkerman E, Essén B, Westerling R, Larsson E: Healthcare-seeking behaviour in relation to sexual and reproductive health among Thai-born women in Sweden: A qualitative study. *Culture, health & sexuality* 2017, 19(2):194-207.

34. Finlayson K, Downe S: Why do women not use antenatal services in low-and middle-income countries? A meta-synthesis of qualitative studies. *PLoS medicine* 2013, 10(1):e1001373.

35. Shrestha SK, Travaglia J, Joshi C: A Narrative Synthesis of the Published Literature on Antenatal Care in Low and Middle Income Countries. *Health Prospect* 2014, 13(1):12-23.

36. Van Lerberghe W, Matthews Z, Achadi E, Ancona C, Campbell J, Channon A, De Bemis L, De Brouwere V, Fauveau V, Fogstad H: Country experience with strengthening of health systems and deployment of midwives in countries with high maternal mortality. *The Lancet* 2014, 384(9949):1215-1225.

37. Aragaw A, Yigzaw T, Tetemke D, G/Amlak W: Cultural Competence among Maternal Healthcare Providers in Bahir Dar City Administration, Northwest Ethiopia: Cross sectional Study. *BMC Pregnancy and Childbirth* 2015, 15(1):227.
38. Horn F, Sabova L, Pinterova E, Homova J, Tmka J: Prevention of neural tube defects by folic acid-awareness among women of childbearing age in Slovakia. *Bratislavské lekarské listy* 2014, 115(2):91-97.
39. WHO: Guideline: Daily iron and folic acid supplementation in pregnant women. 2012. *World Health Organization: Geneva, Switzerland* 2014.
40. Nair M, Yoshida S, Lambrechts T, Boschi-Pinto C, Bose K, Mason EM, Mathai M: Facilitators and barriers to quality of care in maternal, newborn and child health: a global situational analysis through metareview. *BMJ open* 2014, 4(5):e004749.
41. Kobani D, Nkpolu O: The impact of girl-child education on community development: A study of Ika Local Government Area of Akwaibom State. *Res on Human and Soc Sci* 2014, 4(12):122-128.
42. Berhan Y, Berhan A: A meta-analysis of socio-demographic factors predicting birth in health facility. *Ethiopian journal of health sciences* 2014, 24:81-92.
43. Benova L, Macleod D, Radovich E, Lynch CA, Campbell OM: Should I stay or should I go?: consistency and switching of delivery locations among new mothers in 39 Sub-Saharan African and South/Southeast Asian countries. *Health policy and planning* 2017, 32(9):1294-1308.
44. Shan D, Qiu P-Y, Wu Y-X, Chen Q, Li A-L, Ramadoss S, Wang R-R, Hu Y-Y: Pregnancy Outcomes in Women of Advanced Maternal Age: a Retrospective Cohort Study from China. *Scientific reports* 2018, 8(1):12239.
45. Gebremeskel F, Dibaba Y, Admassu B: Timing of first antenatal care attendance and associated factors among pregnant women in Arba Minch town and Arba Minch district, Gamo Gofa zone, South Ethiopia. *Journal of environmental and public health* 2015.
46. Wado YD, Afework MF, Hindin MJ: Unintended pregnancies and the use of maternal health services in southwestern Ethiopia. *BMC international health and human rights* 2013, 13(1):36.
47. Zelelew H: Health care financing reform in Ethiopia: improving quality and equity. *Bethesda (MD): Health Systems* 2018, 20:20.
48. Sharkey JT, Puttaramu R, Word RA, Olcese J: Melatonin synergizes with oxytocin to enhance contractility of human myometrial smooth muscle cells. *The Journal of Clinical Endocrinology & Metabolism* 2009, 94(2):421-427.
49. Bobo FT, Yesuf EA, Woldie M: Inequities in utilization of reproductive and maternal health services in Ethiopia. *International journal for equity in health* 2017, 16(1):105.
50. Berhan Y, Berhan A: Commentary: reasons for persistently high maternal and perinatal mortalities in ethiopia: part iii—perspective of the “three delays” model. *Ethiopian journal of health sciences* 2014, 24:137-148.
51. Ye Y, Yoshida Y, Md H-O-R, Sakamoto Junichi J: Factors affecting the utilization of antenatal care services among women in Kham district, Xiengkhouang province, Lao PDR. 2010.
52. Karkee R, Lee AH, Pokharel PK: Women's perception of quality of maternity services: a longitudinal survey in Nepal. *BMC pregnancy and childbirth* 2014, 14(1):45.
53. Baker U, Peterson S, Marchant T, Mbaruku G, Temu S, Manzi F, Hanson C: Identifying implementation bottlenecks for maternal and newborn health interventions in rural districts of the United Republic of Tanzania. *Bulletin of the World Health Organization* 2015, 93:380-389.

**Figures**
Figure 1

Maternal service utilization along the continuum of maternal care (ANC, SBA, and PNC within 48 hours after birth), West Gojjam, Northwest Ethiopia, 2018