The Effects of Antenatal Depression and Women's Perception of Having Poor Health on Maternal Health Service Utilization in Northern Ghana

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Abstract

Objectives To examine the effects of antenatal depression and women's perceived health during the antenatal period on maternal health service utilization in rural northern Ghana; including how the effect of antenatal depression on service use might be modified by women's perceived health.

Methods Probable antenatal depression was assessed using the Patient Health Questionnaire (PHQ-9). Linear regression was used for the outcome of number of antenatal care (ANC) visits, and logistic regression was used for the outcomes of facility delivery, postnatal care (PNC) within 7 days and completion of continuum of care. Continuum of care was defined as having had four or more ANC visits, delivered at a health facility and had PNC visit within 7 days.

Results Antenatal depression had very small or no association with maternal health service utilization. Women with self-perceived fair or poor health were significantly less likely to use PNC within 7 days and less likely to complete the continuum of care. As for effect modification, we found that for women with probable moderate or severe antenatal depression (a score of 10 or greater), those with perceived fair or poor health used fewer ANC visits and were less likely to use PNC within 7 days than those with perceived excellent, very good or good health.

Conclusions Women experiencing moderate or severe antenatal depression and/or who self-perceive as having poor health should be identified and targeted for additional support to access and utilize maternal health services.

Keywords Antenatal depression · Maternal health services · Antenatal care · Facility delivery · Postnatal care · Continuum of care

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Significance Statement

What is already known on this subject: Socio-demographic and community level predictors have been identified but less is known about personal level factors such as mental health and perceived health status, particularly for rural populations in Sub-Saharan Africa.

What this study adds: This study examined the effects of antenatal depression and women's self-perceived poor health on maternal health service utilization, which had rarely been done in previous studies. We found evidence that self-perceived poor health, especially among women with moderate or severe antenatal depression, was associated with lower likelihood of maternal health service use in Ghana. We discussed several programmatic strategies.

Introduction

Reductions in maternal and newborn mortality remain critical development priorities within the United Nation's Sustainable Development Goal (SDG) 3 (United Nations, 2015). SDG Targets 3.1 and 3.2 aim to "reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030" and "reduce neonatal mortality to at least as low as 12 per 1,000 live births by 2030," respectively (United Nations, 2015). Increasing the coverage rates of antenatal care (ANC) attendance, skilled attendance at delivery and postnatal care (PNC) attendance are important strategies for reducing preventable maternal and newborn deaths (The Partnership for Maternal, Newborn and Child Health, 2006). These health services are significantly associated with reductions in neonatal and perinatal mortality (Kikuchi et al., 2016). Hence, ensuring that women can access and utilize all of these services in a continuum of care is critically important (Kikuchi et al., 2016; The Partnership for Maternal, Newborn and Child Health, 2006).

In Ghana, there has been a steady decreasing trend of both maternal and neonatal mortality in the past few decades (Ghana Statistical Service et al., 2018; UNFPA et al., 2019; UNICEF et al., 2019). Yet, the maternal mortality ratio was 308 deaths per 100,000 live births in 2017 (UNFPA et al., 2019) and the neonatal mortality was 24 deaths per 1,000 live births in 2018 (UNICEF et al., 2019). While the neonatal mortality in 2018 is close to the target set by SDG 3, maternal mortality seems to have a long path towards achieving the SDG 3 target.

Many prior studies have examined key determinants of ANC (Dickson et al., 2018; Okedo-Alex et al., 2019; Sakeah et al., 2017), facility delivery (Dankwah et al., 2019; Dickson & Amu, 2017; Enuameh et al., 2016;

Nketiah-Amponsah & Arthur, 2013; Sumankuuro et al., 2019), PNC (Sakeah et al., 2018) and completing all three health services on the continuum of care (Shibanuma et al., 2018; Singh et al., 2016; Yeji et al., 2015) for Ghana and similar contexts.

Despite the large number of studies examining a host of individual-level factors on maternal health service utilization, very few studies have examined the potential effect that women's mental health status during the antenatal period may have on maternal health service utilization (Bitew et al., 2017; Weobong et al., 2014). These studies showed mixed results on the effect of antenatal depression on maternal health service utilization (Bitew et al., 2017; Weobong et al., 2014). In Ethiopia, Bitew et al. (2017) found that antenatal depression was significantly associated with facility delivery (albeit unplanned facility delivery) but not with PNC use. While in Ghana, Weobong et al. (2014) found that antenatal depression was not significantly associated with either ANC attendance or facility delivery. This study of rural women reported that about 10% of their sample had antenatal depression (Weobong et al., 2014). Because a considerable number of women can become vulnerable to depressive symptoms during pregnancy and depression is associated with a myriad of maternal and neonatal morbidities (Weobong et al., 2014), generating more evidence on this topic is of paramount importance. In conjunction with antenatal depression, we also hypothesized that mothers' own perceptions of their health could be pertinent in determining health service utilization. To our knowledge, this factor has not been considered in previous analyses.

The purpose of this study is (1) to examine the effects of probable antenatal depression and mothers' perception of their health on utilization of ANC, facility delivery, PNC and completing the continuum of care; and (2) to examine how mothers' perceived health modifies the effect of antenatal depression on maternal health services use in northern Ghana.

Methods

Data were obtained from a parent cluster-randomized study evaluating the impact of the Integrated Mothers and Babies Course/Early Childhood Development (iMBC/ECD) intervention delivered by Catholic Relief Services in collaboration with the Ghana Health Service on maternal mental health and child development in two districts in Ghana (ClinicalTrials.gov # NCT03665246) (Baumgartner et al., 2021; Lillie et al., 2020). The study was conducted in 32 communities (clusters) in two districts in Northern Ghana: West Mamprusi District in the North East Region and Nabdam District in the Upper East Region. From the study areas, women who met the following eligibility criteria were

recruited: (1) pregnant, (2) 16 years or older; (3) planning to live in their communities for at least the next six months. A total of 374 eligible women completed pre-intervention baseline interviews from August to September 2018. For this study, Community Pregnancy Surveillance and Targeted Education Sessions (C-PrES) were also being offered by Catholic Relief Services. C-PrES groups were designed to promote the adoption of key maternal, newborn and child health behaviors among pregnant women and mothers of children under two and were open to all pregnant women in their communities. The 7-month long iMBC/ECD intervention used these C-PrES groups to deliver additional messaging on early child development and coping strategies for daily stressors and stressors surrounding pregnancy, delivery and childrearing using cognitive behavioral therapy and attachment theory. The team expected the intervention to begin in October 2018 but due to a delay it began in December 2018, thus the immediate post-intervention interview period was July 2019 and 313 women were interviewed. Between baseline and the immediate post-intervention period, there were 16 miscarriages or still births, 7 children born alive but since died, 1 woman who was pregnant, 12 women who traveled outside of the community at the time of the survey and 25 women who were either not able to be traced or were simply absent. All participants provided written informed consent, or, if they were illiterate, were read the consent form and provided their fingerprint with a witness signature. This study received ethical approval by Duke University Campus Institutional Review Board (#2019-0020) and Navrongo Health Research Centre Institutional Review Board in Ghana.

Probable antenatal depression was measured at baseline using the Patient Health Questionnaire-9 (PHQ-9) which has been validated for use in low- and middle-income contexts (Ali et al., 2016). For our study, the PHQ-9 was forward and back-translated prior to finalization for the two relevant local languages, Mampruli and Nabt. The Cronbach's alpha was 0.88. For primary analyses, we used the PHQ-9 as a continuous score but for meaningful interpretation of results, we also considered symptom severity, using scores of 10 or greater for those with probable moderate or severe depression (Kroenke et al., 2001).

Women were asked: "In general, would you say your health is…" and the response options were poor, fair, good, very good and excellent. Women's self-reported perceived health status was thus coded as a binary variable "poor/fair" or "good/very good/excellent". Women's age in years was coded as a continuous variable and education was coded as "none", "primary or post-primary education" or "secondary, college or university education". Parity was coded as "1", "2", "3" or "4 or more". Work in the past week was coded as a binary variable, the Household Hunger Scale was recoded as either "none or

little hunger" or "moderate or severe hunger" in the past month (See Online Appendix A) (Ballard et al., 2011). Marital control and intimate partner violence during the past 12 months were assessed using standard items from the 2008 Ghana Demographic and Health Survey (DHS) (Ghana Statistical Service et al., 2009). Controlling behaviors by husbands/partners and experience of physical or sexual violence by husbands/partners were both coded as binary variables (See Online Appendix B). Emotional violence was highly correlated with physical or sexual violence and was therefore omitted. Even when emotional violence was included in the models for sensitivity analysis, the results were very similar to what is presented in the paper (data not shown). Perceived support from female friends and relatives and perceived support from husbands/partners were each coded as either "sufficient" or "insufficient". Distance to the health facility in kilometers was measured as a continuous variable. Geographic district was coded as "West Mamprusi District" or "Nabdam District".

The above variables were measured at baseline while participants were pregnant; however, number of months pregnant at time of first ANC visit, number of ANC visits, place of delivery and use of PNC were collected at the immediate post-intervention period which was almost 10 months later. Even though these variables were collected at the immediate post-intervention period, most women had either delivered around the start of the intervention or early in the intervention period which was from December 2018 to June 2019. Over 90% of the children were 4 months or older at immediate post-intervention. The mean age of child was 7 months (range: 0–15 months) at immediate post-intervention. The number of months pregnant at first ANC visit was coded as a continuous variable. Number of ANC visits was also coded as a continuous variable. Place of delivery was coded as "facility delivery" or "home delivery". Two women who delivered on the way to the hospital were excluded from the analyses. PNC was defined as attendance within the first 7 days of delivery rather than just the first 48 hours because the first week of delivery is still a critical time period for the survival of both the mothers and their newborns (The Partnership for Maternal, Newborn and Child Health, 2006). Complete 'continuum of care' service use was defined as having had four or more ANC visits, having delivered at a health facility and having had PNC within the first 7 days of delivery. If women did not use these services, they were coded as not having completed the continuum of care (i.e. not using any of the three services, using any one of the three services or using any two of the three services). Nearly 40% of women reported completing the continuum of care in our sample (see Results). Continuum of care was similarly defined and examined in another study in Ghana (Shibanuma et al., 2018).

All analyses were conducted in Stata SE version 16.1. Number of ANC visits, facility delivery, PNC within 7 days and continuum of care were predicted in separate regression models. Linear regression was used for number of ANC visits because it is a continuous outcome. For facility delivery, PNC within 7 days and completion of the continuum of care which are all dichotomous outcomes, logistic regression was used. For all the regression models, standard errors were adjusted for clustering of the data using cluster-robust standard errors. In addition, variables previously described in *measures* except women's age and number of months pregnant at first ANC visit were included in every regression model. Women's age was excluded due to its very high collinearity with parity. Number of months pregnant at first ANC visit was only included in the model for predicting number of ANC visits. This is because when baseline data were collected, many of the women had already utilized ANC visits. The average number of ANC visits at baseline was 3.6 visits.

Antenatal depression and women's self-reported perceived health were interacted in all the models to examine how the effect of antenatal depression might be modified by women's perceived health. Effect modification was graphically presented by showing adjusted predicted probabilities at different levels of the continuous PHQ-9 score by women's perceived health using Stata's marginsplot feature. In addition, average marginal effects (for continuous predictors) or discrete probability differences (i.e. risk differences; for categorical predictors) were estimated using Stata's margins command. As a result, raw regression coefficients, including those of the interacted terms, are not presented in the tables.

Results

The mean age of study participants at baseline was 26.8 years old (standard deviation [SD] = 6.6) and very few women had secondary, college or university education (7.7%). More than three-quarters had two or more children (78.3%). Nearly half had worked in the past week (48.4%) and moderate or severe household hunger was reported by about a quarter of the women (26.5%). About 14.4% of women perceived themselves to have fair or poor health.

A little more than three-quarters of women (76.4%) reported that their husbands/partners were controlling their behavior and 37.4% reported that they experienced physical or sexual intimate partner violence in the past year. As for social support, only 37.1% reported that they had sufficient support from their female friends and relatives and 46.3% reported that they had sufficient support from their husbands/partners. About 67.7% of the sample were in the West Mamprusi district and 32.3% were in the Nabdam district (Table 1).

Table 1 Descriptive analysis of the study variables

	Mean (SD)/N (%)
Outcomes	
Number of ANC visits	5.6 (2.1)
Number of women with at least one ANC visit	312 (99.7%)
First ANC visit around the first trimester (3-4 months)	275 (88.1%)
Facility delivery	196 (63.0%)
PNC within 7 days	183 (58.5%)
Continuum of care	124 (39.7%)
Baseline variables	
Antenatal depression (continuous PHQ-9)	6.2 (4.2)
Probable moderate or severe antenatal depression	59 (18.8%)
Distance to a health facility (in kilometers)	7.6 (4.6)
Women's education	
None	144 (46.0%)
Primary/Post-primary	145 (46.3%)
Secondary/College	24 (7.7%)
Women's age	26.8 (6.6)
Parity	
1	68 (21.7%)
2–3	105 (33.6%)
4 or more	140 (44.7%)
Work in the last 7 days	151 (48.4%)
Moderate/Severe household hunger	83 (26.5%)
Women's self-reported health being fair/poor	45 (14.4%)
Controlling behaviors by husbands/partners	239 (76.4%)
Physical or sexual intimate partner violence	117 (37.4%)
Sufficient support from female friends and relatives	116 (37.1%)
Sufficient support from husbands/partners	144 (46.3%)
Geographic District	
West Mamprusi District	212 (67.7%)
Nabdam District	101 (32.3%)

N = 313

PHQ-9 scores 10 or greater can be categorized as probable "moderate or severe" depression.

All service utilization questions were based on women's recall.

The average score on the PHQ-9 indicating antenatal depression was 6.2 (SD = 4.2). Using the cutoff of 10 or greater, about 18.8% of the sample had probable moderate or severe antenatal depression. On average, there was a health facility 7.6 kilometers away from the clusters where women lived (SD = 4.6). As for maternal health service utilization, the average number of ANC visits was about 5.6 visits (SD = 2.1). Almost all women in the sample had at least one ANC visit (99.7%) and about 88.1% of women who had at least one ANC visit had their first visit around the first trimester (3 to 4 months). Only 63.0% delivered in health facilities and 58.5% had PNC within the first 7

days of delivery. Only 39.7% of women completed the continuum of care (four or more ANC visits, delivered at a health facility and had PNC within the first 7 days of delivery) (Table 1).

On average, a unit increase in the PHQ-9 score (higher scores indicate worse depression severity) was significantly associated with greater number of ANC visits but the effect size was very small (risk difference [RD] = 0.045 greater

Table 2 Multivariable results for number of ANC visits, facility delivery, PNC within 7 days and continuum of care

	Linear regression		Logistic regression					
	Number of ANC visits		Facility Delivery		PNC within 7 days		Continuum of care	
	Effects	95% CI	Effects	95% CI	Effects	95% CI	Effects	95% CI
Number of months pregnant at first ANC visit	− 0.850 ***	(− 0.976, − 0.723)						
Antenatal Depression (PHQ-9)	0.045 *	(0.011, 0.079)	0.005	(− 0.007, 0.016)	0.004	(− 0.009, 0.016)	0.004	(− 0.005, 0.014)
Mother's perception of her health being fair or poor	− 0.530	(− 1.100, 0.040)	− 0.048	(− 0.206, 0.111)	− 0.185 **	(− 0.320, − 0.051)	− 0.286 ***	(− 0.441, − 0.131)
Women's education								
None	–	–	–	–	–	–	–	–
Primary/Post-primary	0.304	(− 0.221, 0.830)	0.056	(− 0.065, 0.178)	0.057	(− 0.049, 0.164)	0.123 *	(0.002, 0.243)
Secondary/College	0.234	(− 0.431, 0.898)	0.175	(− 0.015, 0.364)	0.081	(− 0.142, 0.304)	0.262 *	(0.045, 0.478)
Parity (# of pregnancies)								
1	–	–	–	–	–	–	–	–
2–3	0.436	(− 0.023, 0.895)	− 0.127	(− 0.260, 0.007)	− 0.049	(− 0.231, 0.133)	− 0.028	(− 0.197, 0.141)
4 or more	0.016	(− 0.375, 0.407)	− 0.186 **	(− 0.312, − 0.060)	− 0.039	(− 0.201, 0.122)	− 0.026	(− 0.207, 0.156)
Work in the last 7 days	0.100	(− 0.191, 0.390)	− 0.047	(− 0.158, 0.065)	0.059	(− 0.060, 0.178)	0.041	(− 0.049, 0.131)
Moderate/Severe household hunger	− 0.022	(− 0.418, 0.373)	0.022	(− 0.094, 0.138)	− 0.054	(− 0.201, 0.093)	− 0.058	(− 0.152, 0.036)
Controlling behaviors by husbands/partners	− 0.251	(− 0.764, 0.262)	− 0.084	(− 0.192, 0.024)	0.057	(− 0.065, 0.180)	0.028	(− 0.092, 0.147)
Physical or sexual intimate partner violence	− 0.156	(− 0.429, 0.118)	0.0004	(− 0.108, 0.109)	− 0.013	(− 0.145, 0.118)	− 0.017	(− 0.148, 0.113)
Female support	− 0.078	(− 0.649, 0.494)	− 0.034	(− 0.155, 0.087)	0.065	(− 0.072, 0.202)	− 0.012	(− 0.134, 0.110)
Husband/Partner support	− 0.206	(− 0.631, 0.219)	− 0.046	(− 0.170, 0.079)	− 0.018	(− 0.175, 0.140)	− 0.010	(− 0.123, 0.104)
Geographic District								
Nabdam	–	–	–	–	–	–	–	–
West Mamprusi	− 1.434 ***	(− 2.036, − 0.832)	− 0.369 ***	(− 0.480, − 0.258)	− 0.130	(− 0.319, 0.060)	− 0.240 **	(− 0.411, − 0.068)
Distance to health facility (in kilometers)	0.017	(− 0.017, 0.051)	− 0.008	(− 0.022, 0.006)	− 0.003	(− 0.016, 0.011)	− 0.002	(− 0.015, 0.012)

N = 309 (for ANC visits); N = 308 (for facility delivery); N = 310 (for PNC within 7 days); N = 309 (for continuum of care).

Each column represents separate regression models. Standard errors were adjusted for clustering of the data using cluster-robust standard errors.

The effects presented in this table are either average marginal effects (for continuous variables) or discrete probability differences (i.e. risk differences; for categorical variables) where the average predicted probability of the referent category and the average predicted probability of the comparison category are differenced

*p < 0.05 **p < 0.01 ***p < 0.001

ANC visits; 95% CI: 0.011, 0.079). A unit increase in the PHQ-9 score was not associated with using any other maternal health services (Table 2). Women with perceived fair or poor health were significantly less likely to use PNC within 7 days (RD = − 0.185; 95% CI − 0.320, − 0.051) and complete the continuum of care (RD = − 0.286; 95% CI − 0.441, − 0.131) compared to women with perceived excellent, very good or good health (Table 2).

In terms of effect modification, we found that for women with probable moderate or severe antenatal depression (a score of 10 or greater), those with self-perceived fair or poor health used fewer ANC visits and were less likely to use PNC within 7 days than those with perceived excellent, very good or good health (Fig. 1). The predicted probability of delivering at a health facility was not significantly different by any indication of antenatal depression or perceived health status however (Fig. 1). For completing the continuum of care, women with perceived fair or poor health were significantly less likely to complete the continuum of care compared to women with perceived excellent, very good or good health, irrespective of their indication of antenatal depression (Fig. 1).

On average, a month delay of first ANC visit during pregnancy was significantly associated with fewer ANC visits overall (RD = − 0.850; 95% CI: − 0.976, − 0.723). In other words, delayed first ANC visit meant fewer total ANC visits. Compared to women with no formal education, those who had education were significantly more likely to complete the continuum of care (Table 2). Women with four or more children were significantly less likely to deliver at a health facility compared to women with only one child (RD = − 0.186; 95% CI − 0.312, − 0.060). Women in West Mamprusi district had fewer ANC visits and were less likely to deliver in a facility and complete the continuum of care compared to women in Nabdam district (Table 2).
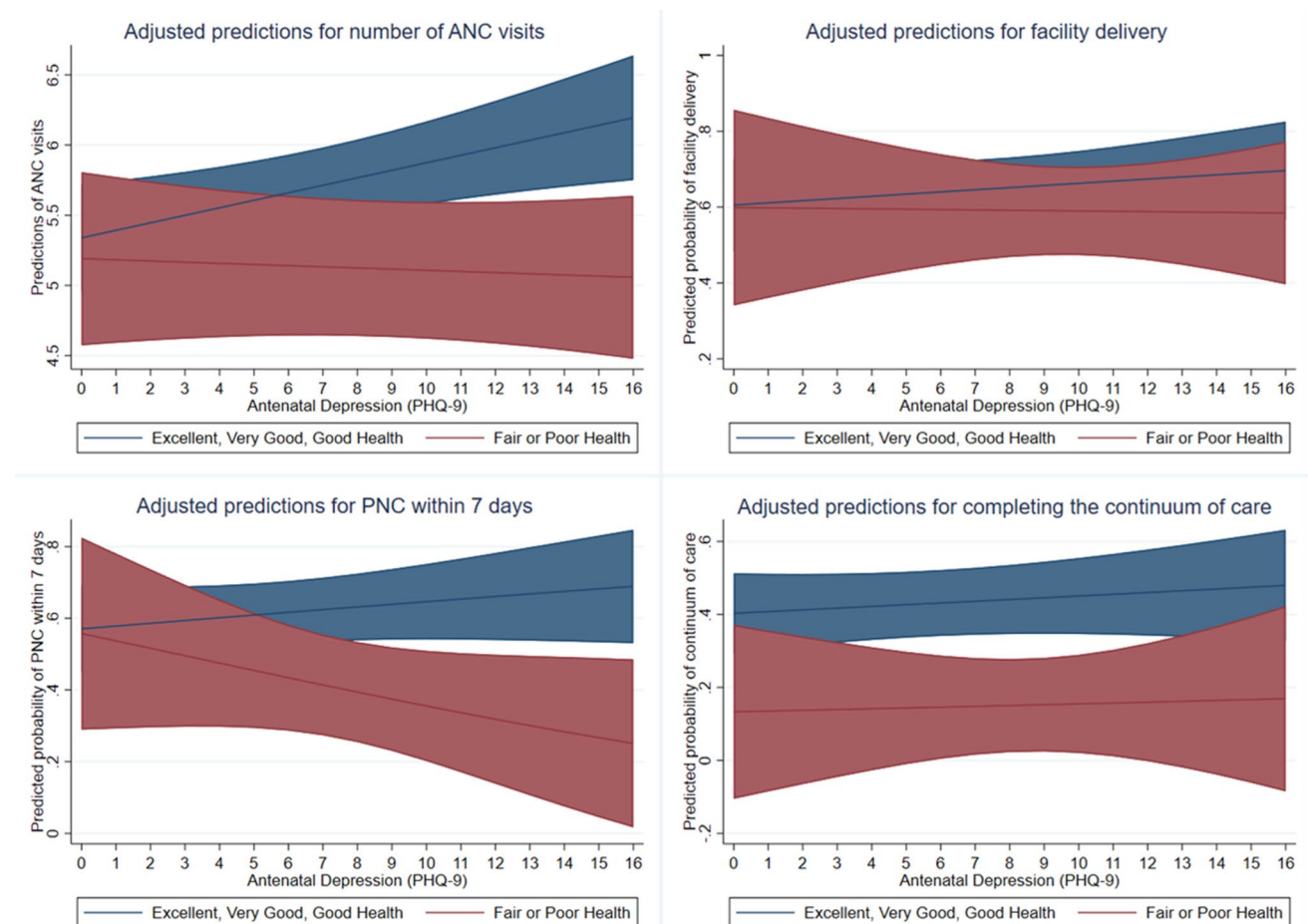
Fig. 1 Adjusted predictions of ANC visits, facility delivery, PNC within 7 days and continuum of care by antenatal depression and women's perceived health (graphical representation of effect modification)

Discussion

The main findings of this study bring new understanding about how probable antenatal depression and mother's perceived health are associated with maternal health service utilization. On average, higher PHQ-9 scores, indicating worse depression severity, were associated with a very small increase in the number of ANC visits (RD = 0.045 greater ANC visits; 95% CI: 0.011, 0.079) but not associated with facility delivery, PNC within 7 days or completing the continuum of care. This contrasts findings of some prior studies examining the effect of antenatal depression on key maternal and newborn outcomes (Bitew et al., 2017; Weobong et al., 2014). A study in Ghana found that antenatal depression (based on the PHQ-9) was not associated with either four or more ANC visits or facility delivery (Weobong et al., 2014). Yet, another study in Ethiopia found that antenatal depression (based on the PHQ-9) was associated with increased odds of facility delivery but not associated with PNC use (Bitew et al., 2017). Currently, there seems to be mixed evidence on the effect of antenatal depression on maternal health service utilization. Interestingly, further examination of effect modification in our study revealed that for women with probable moderate or severe antenatal depression, their perceived fair or poor health was significantly associated with fewer ANC visits compared to women with perceived excellent, very good or good health. Similarly, for women with probable moderate or severe antenatal depression, their perceived fair or poor health was significantly associated with lower probability of PNC within 7 days as well as lower probability of using all recommended services in the continuum of care, compared to women with perceived excellent, very good, or good health. These findings, contrary to the expectation that women in poor health may be accessing more health services, imply that those who may be in greater need of timely and adequate health services during pregnancy, delivery and in the immediate postnatal period are not able to optimally utilize relevant health services.

Nearly all women in the sample had at least one ANC visit and among those who had at least one ANC visit, close to 90% had their first visit in the first 3 to 4 months. This is higher than the national estimate of about 64% reported in the 2017 Ghana Maternal Health Survey (Ghana Statistical Service et al., 2018). We speculate that the high frequency of early ANC visits may potentially be explained by women's exposure to various maternal and child health programming in this area. Because a large number of pregnant women are already entering into the healthcare system around the first trimester, the first ANC visit should be used as an opportunity to screen for and identify women with probable moderate to severe antenatal depression and women who perceive themselves to have fair or poor health. This more holistic assessment for the pregnant woman aligns with WHO's new ANC guidance for a positive pregnancy experiences (World Health Organization, 2016). However, a major challenge with this facility-based approach is that the current healthcare system is severely overburdened and understaffed (Bradley et al., 2015). Any effort to impose additional screening procedures for at-risk women will therefore have to be brief, concise, and locally validated. There are a number of existing and newly developed screening tools that could be appropriate for low-resource contexts such as northern Ghana (Chorwe-Sungani & Chipps, 2017; Natamba et al., 2014; Rochat et al., 2013; Spies et al., 2009; Stewart et al., 2013; van Heyningen et al., 2019).

Another approach that is more community-based is to partner with existing community health workers. There have been many attempts in low- and middle-income countries to train community health workers (CHWs) for integration into maternal and newborn services (Olaniran et al., 2019). One such example in Ghana was the USAID-funded "Encouraging Positive Practices for Improving Child Survival (EPPICS) Project, which was implemented by the Ghana Health Service and the Catholic Relief Services between 2011 and 2015 (Tuli & Wilcox, 2015). In addition, Ghana's National CHW program was initiated in 2014 under the Ghana Health Service and their cadre is growing. Using CHWs to detect early danger signs and illnesses have shown to be effective (Tripathi et al., 2016). It also shifts the burden away from facility-based healthcare workers although there had been reports of CHWs being asked to do more than what they were properly trained to do (Baatiema et al., 2016; Okyere et al., 2017; Olaniran et al., 2019). With existing trust and rapport, CHWs could facilitate access to services via a better understanding of the underlying reasons why women in their communities are experiencing barriers to care.

At the household level, male involvement has been highlighted as a key strategy to increase women's utilization of maternal health services (Bougangue & Ling, 2017; Craymah et al., 2017; Saah et al., 2019). A number of prior studies have also found that partner's higher education level were significantly associated with greater use of maternal health services (Dickson & Amu, 2017; Okedo-Alex et al., 2019; Sakeah et al., 2017, 2018; Yeji et al., 2015). In our study, controlling behaviors by husbands/partners and whether or not husbands/partners provided sufficient support in the past month were not associated with using any of the maternal health services. This could imply that the kind of support women are perceiving to receive from their husbands/partners may not really be translating to support required specifically for seeking care at the health facilities. Continued

programmatic and policy attention is warranted on raising supportive male involvement for increasing women's health service utilization. For example, programs can focus on helping males understand the full benefits of women and their children utilizing health care services and how they can play an instrumental role in providing tangible support for women to seek care. Depending on the context, programs could also help participants plan ahead for anticipated healthcare costs and transport arrangements.

Notably, women in West Mamprusi district were significantly less likely to use maternal health services compared to women in Nabdam district. Recent demographic and health survey reports in Ghana also seem to corroborate these health disparities across various regions, especially in the northern part of the country (Ghana Statistical Service et al., 2018). Lastly, prior studies have found that cost of care (Okedo-Alex et al., 2019), distance to the facility (Dickson & Amu, 2017) or transport to the facility (Yeji et al., 2015) continue to be determinants of service utilization, which is consistent with the proposed barriers to seeking obstetric care in the *Three Phases of Delay Model* (Gabrysch & Campbell, 2009; Thaddeus & Maine, 1994). In our specific study context, however, distance to the facility and measure of household poverty were not associated with health service utilization controlling for other individual-, household- and community-level factors.

Many of the factors examined in our analysis model pertain to the first phase of delay which includes individual, spousal and family barriers as well as women's status or treatment in the household, their health and previous healthcare experience among others (Thaddeus & Maine, 1994). The second and third phases of delay pertain to barriers in reaching a health facility and receiving adequate care once at the health facility (Thaddeus & Maine, 1994). In order to meet the increasing demand for health services with provision of quality of care, continued attention must be given to facilitators and barriers relevant to all three phases of delay.

There are limitations to the study. First, our study was only conducted in northern Ghana and therefore it warrants caution when trying to generalize our findings to a broader setting or population. Second, close to 16% of women were lost to follow up from baseline and a comparison between those who were followed up and those who were not showed a few noticeable standardized mean differences for some of the study's covariates, namely education level and distance to health facility (See Online Appendix C). Second, service-level determinants such as availability of health facilities, quality of care and cost of care (i.e. second and third phases of delay) were not included in the models due to data not being available. Other studies have examined these effects on maternal and newborn service utilization (Calhoun et al., 2018; Dalinjong et al., 2018; Escamilla et al., 2018; Gitobu et al., 2018; Kim et al., 2019, 2020; Singh et al., 2018).

Despite the limitations, we believe our findings offer valuable insight with regards to the effects of probable antenatal depression and women's self-perceived health on using maternal health services, which have not been explored extensively in the literature.

For women with probable moderate or severe antenatal depression, their self-perceived health being fair or poor was significantly associated with lower likelihood of seeking maternal health services. This is concerning as they are likely in greater need of such services compared to those who do not perceive themselves to have fair or poor health during pregnancy. This is especially true in geographic areas where maternal and newborn mortality and morbidity are already quite high.

Declarations

Conflict of interest Kim, Gallis, Lillie and Baumgartner report grants from Catholic Relief Services during the conduct of the study; and five of the authors of this publication (Ali, Adam, Abubakr-Bibilazu, Hembling, McEwan) were paid employees of Catholic Relief Services, the funder, at the time this study was carried out and assisted with study design, data collection and manuscript preparation. However, no Catholic Relief Services author had access to aggregate study data during data collection, nor was any Catholic Relief Services employee involved with data analysis or data interpretation of study results.

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