Utilisation of focused antenatal care in Zambia: examining individual and community level factors using a multilevel analysis

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Abstract

Objectives: We examine the individual and community level factors associated with the utilisation of antenatal care, following the adoption of the focused antenatal care (FANC) approach in Zambia.

Methods: Using the 2007 Zambia Demographic and Health Survey, linked with administrative and health facility census data, we specify two multilevel logistic models to assess the factors associated with (1) the inadequate use of ANC (defined as three or less visits), and (2) the non-use of ANC in the first trimester of pregnancy.

Results: Although, all women in the selected sample had at least one ANC visit, 40% did not have the minimum number required (four), while more than 80% of the initial check-ups did not occur in the first trimester. At the individual level, the woman's employment status, quality of ANC received and the husband's educational attainment are negatively associated, while parity, the household childcare burden and wealth are positively associated with inadequate utilisation of ANC. Both individual and community level characteristics influence inadequate use and non-use of ANC in the first trimester; however, community level factors are relatively stronger in rural areas.

Conclusion: The results suggest that improving the content of care during ANC visits may foster adequate use of ANC and encourage early initiation of ANC visits. Furthermore, health

promotion programs need to further encourage male involvement in pregnant women's' decision to seek ANC in order to encourage adequate use of services.

Introduction

Effective utilisation of antenatal care (ANC) is associated with improved maternal and neonatal health outcomes (Darmstadt *et al.* 2005; Bullough *et al.* 2005; WHO 2005). Although a reduction in maternal mortality ultimately depends on access to adequate obstetric care, promoting the use of ANC could be instrumental in encouraging women to seek skilled assistance at birth (Abouzahr and Wardlaw 2003; Campbell and Graham 2006; Gage 2007). Skilled assistance at birth, when most maternal deaths occur, is shown to significantly reduce maternal mortality (Campbell and Graham 2006). Moreover, timely and appropriate ANC is important for the health of newborns (Halim *et al.* 2010). In terms of timing, international consensus favours initiation of care in the first trimester of pregnancy to ensure adequate antenatal follow-up, the early detection and management of complications, and the prevention of mother to child transmission of HIV in pregnancy (AbouZahr and Wardlaw 2003; Kirkham *et al.* 2005). Most developing countries have adopted ANC programmes to improve maternal and neonatal health outcomes (Abouzahr and Wardlaw 2003; Adam *et al.* 2005). Yet, within these countries, high rates of ANC coverage continue to co-exist with high maternal and neonatal mortality rates, prompting calls to improve the quality of implementation.

Due to the poor implementation of traditional ANC programmes, 'focused ANC' (FANC) has been introduced, and the World Health Organization (WHO) recommends it in developing countries (Villar *et al.* 2001; Abouzahr and Wardlaw 2003). FANC emphasises the quality of antenatal, rather than the frequency of antenatal visits. FANC is intended to reduce waiting times, increase the time spent educating women about pregnancy-related issues and promote the

use of skilled assistance at birth (WHO 2001; Babalola and Fatsui 2009; Gabrysch and Campbell 2009). FANC is expected to reduce costs for both the service provider and households in developing countries, Hall (2001), by recommending only four visits for women with uncomplicated pregnancies, with the first visit in the first trimester (ideally before 12 weeks, but no later than 16 weeks), at 24-28 weeks, 32 weeks and 36 weeks gestation (Villar *et al.* 2001; Abouzahr and Wardlaw 2003). Scheduled FANC visits should include: thorough evaluation (e.g. history taking and physical examination), intervention (e.g. prevention/prophylaxis and treatment), and promotion (e.g. health education and counselling).

According to the Central Statistical Office (2009), 94% of women completed one antenatal visit in 2007, yet the maternal mortality rate was 591 deaths per 100,000 live births. Possibly, mortality rates remain so high, due to low first trimester ANC usage or incomplete ANC follow-through; 19% of ANC visits occur in the first trimester, while 60% complete the recommended minimum four antenatal visits during pregnancy. In order to improve the effectiveness of ANC services, ANC provision in Zambia has transitioned to the new model, and key components of FANC were included in the National Health Strategic Plan (Ministry of Health Zambia (MOH) 2005).

While the factors associated with the use of ANC in sub Saharan Africa and Asia, such as maternal education, availability, cost, household income, women's employment and cultural beliefs are well documented (Magadi *et al.* 2000; Adamu and Salihu 2002; Chakraborty *et al.* 2003; Overbosch *et al.* 2004; Kabir *et al.* 2005; Simkhada *et al.* 2008), limited evidence exists on individual and community level factors associated with ANC use after the adoption of FANC. Existing studies examining FANC use small samples, which may not be nationally representative (Mathole *et al.* 2004; Chege 2005; Birungi and Onyango-Ouma 2006; Nyarko *et al.* 2006; Aniebue and Aniebue 2011), while little attention is given to community characteristics and supply-side factors that influence FANC utilization. Understanding both individual and community level factors associated with FANC use is important, since individuals reside in communities and

individual decisions can be influenced by their communities (Gage 2007). Identifying these factors can further the development of comprehensive policies to improve ANC effectiveness in Zambia.

Therefore, this study analyses individual and community level factors associated with inadequate use of ANC, despite the introduction of FANC in Zambia; ANC is considered inadequate, if a woman has three or less ANC visits or does not initiate ANC in the first trimester. Moreover, we construct a composite index based on FANC's key components, using multiple correspondence analysis (MCA) to capture the quality of ANC received, which underpins the effectiveness of FANC in improving pregnancy outcomes. Previous studies on the utilisation of ANC consider these components separately, and, therefore, may not capture the true content of the care received, because content varies across women and facilities. By linking the Zambia Demographic and Health Survey (ZDHS) with administrative and health facility census data, we are able to asses both demand-side and supply-side factors that influence the use of ANC.

Methods

Data and variables

The data for the study come from the 2007 ZDHS, a nationally representative household survey covering a wide range of topics, but focusing on women aged 15–49. Detailed information about the ZDHS is available at http://www.measuredhs.com and from the report (CSO 2009). The analysis focuses on responses from 2925 women, who had given birth during the three years preceding the survey. We focus on these three years, as they correspond to the implementation[1]

[1]Following the development of the focused antenatal care (FANC) implementation manuals by WHO in 2001 (WHO, 2001), a number of countries in sub-Saharan Africa implemented the FANC approach. Countries such as Ghana adopted the FANC approach in 2002 (Nyarko *et al*., 2006) and Kenya in 2001 (Birungi *et al*., 2006). In Zambia, the exact date of the implementation of the FANC is not available in the literature reviewed. The 2001/2 ZDHS report does not make any reference to the implementation of FANC in Zambia. The ZHDS 2007 report (CSO, 2009) acknowledges the introduction of FANC without any reference to specific dates of implementation.

of FANC in Zambia (MOH 2005). The 2007 ZDHS data was complemented with data from the Zambia Health Facility Census (HFC) 2005 and the Health Management and Information System (HMIS) database to, respectively, calculate the distance to the nearest health facility and capture community level variables. The HFC covered all public and semi-public (i.e. mission and non-governmental health facilities), as well as larger private-for-profit, health facilities (MOH 2008). The HMIS includes information on supply and use of services at all public health facilities nationwide, aggregated to the district level.

Empirical method

Two indicators of utilization are used to analyse the factors associated with ANC inadequacy: the receipt of three or less check-ups, (1, if the woman had three or less visits, and 0 otherwise); and non-use in the first trimester of pregnancy (1, if the woman's first visit does not occur during the first trimester of pregnancy, and 0 otherwise). Multilevel logistic regression is used to examine the influence of individual and community level characteristics on the utilisation of ANC. Multilevel analysis accounts for the hierarchical structure of the ZDHS data, enabling the estimation of community level effects on the outcome variables (Gage 2007). Ignoring observation clustering yields underestimated standard errors, and may result in spurious significant results (Luke 2004; Gage 2007; Rabe-Hesketh and Skrondal 2008).

The regression model consists of two sub-models, levels 1 and 2. Level 1 represents the relationships among the individual variables, while level 2 examines the influence of community factors. Both individual and household characteristics are individual level variables, because the average number of women in any household is small, and, therefore, the household cannot be

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However, key elements of the FANC were incorporated in the National Health Strategic Plan and by 2005; the coverage rate for FANC implementation in Zambia was about 70% (MOH, 2005).

analysed as its own level. To assess the influence of unobserved community characteristics on the overall variation in ANC use, we specify a null model (without covariates). Two extended model specifications, examining potential determinants of inadequate ANC use are also fit. Model 1 includes individual characteristics only, while model 2 includes both individual and community variables. Statistical analyses are performed using xtlogit in Stata 12 (StataCorp 2011).

The variables used in the study and expected signs are informed by previous literature on determinants of ANC utilization (Gage 2007; Gabrysch and Campbell 2009; Babalola and Fatusi 2009; Ndao-Brumblay *et al.* 2012). The individual variables include a categorical measure of parity: 1, 2–4 and 5 or more births. Multiparity puts women at greater risk of obstetric complications, implying greater need for ANC services (Bai *et al.* 2002). On the other hand, birthing women with higher parity may seek fewer services, due to knowledge and experience gained from past births, the lack of child support for younger children and negative comments from the birth attendants at the health facility (Gage and Calixte, 2006). The mother's age was omitted from the regression, due to high correlation (0.8) with parity (Gage 2007). The woman's and husband's education status are grouped into three categories: no education, primary education and secondary education or higher. Based on previous evidence, more education is associated with a higher propensity for maternal health services (Gage 2007; Sagna and Sunil 2012).

Previous literature has demonstrated that household wealth is strongly related to the use of maternal health services (Sagna and Sunil 2012; Gage 2007; Fan and Habibov 2009). In Zambia, antenatal care is provided for free, thus, wealthier households are expected to be better equipped to cope with any other direct and indirect costs of seeking antenatal care (De Allegri *et al.* 2011). In this research, household wealth is captured via the ZDHS wealth index, which is grouped into three categories: poor, middle and rich. More information on the construction of the household

wealth index by DHS can be found in Rutstein and Johnson (2004). The household childcare burden is measured by the number of children in the household under the age of five. Without child support, birthing women with more young children needing care may use ANC less frequently. Religion, also included, is categorised as catholic, protestant and other. Religion may influence attitudes towards modern health services, and may, therefore, affect the use of maternal health services. Previous research finds a positive correlation between antenatal health service use and Catholicism, but negative associations for women following traditional religions (Addai 2000). In Ethiopia, women who followed Orthodox, Muslim and Protestant religions were more likely to use ANC compared to those with traditional beliefs (Mekonnen and Mekonnen, 2003) and in India, Muslims were much more likely to seek routine ANC (Pallikadavath *et al.* 2004; Navaneethan and Dharmalingam 2002).

To capture the actual quality of ANC received, an FANC composite quality index is constructed. The components considered, and demarcated as true/false, include: attendance by skilled health worker, weight and height measured, blood pressure checked, urine and blood sample taken, told about complications, given or bought iron tablets, and took fansidar as prophylaxis for malaria prevention. Multiple correspondence analysis (MCA), rather than principle components analysis (PCA), is used to construct the quality index. Although PCA is widely used (Sunil *et al.* 2006; Gage 2007; Ndao-Brumblay *et al.* 2012), it was designed to deal with continuous variables (Vyas and Kumaranayake 2006). MCA is employed, instead, because it is designed for categorical variables (Blasius and Greenacre 2006). MCA was used to calculate the weights using the 'mca' command in Stata 12 (Statacorp 2011) with adjustment of the principal inertias (eigenvalues), as suggested (Greenacre 1993). The composite index score for each woman was calculated from the generated weights, and included as a predictor in the models. Table 1 lists the variables underpinning the composite index, with categories and weights for each variable. The weights are identified from the first dimension of the MCA with iterative adjustment. This dimension

explained about 64% of total inertia. The weights in Table 1 reflect higher and lower quality of care, via positive and negative values, respectively.

[TABLE 1]

Community level variables often cited in the literature (Gage 2007; Ndao-Brumblay *et al.* 2012) capture characteristics – accessibility, economic status and other health system factors – which are expected to influence behaviours. In the analysis similar measures were included, such as: community type (urban or rural), drug availability at community health facilities, community average ANC uptake, health facility density and the community's poverty status. Poverty status follows the material deprivation index (MDI), and ranges from -4.65, least deprived, to 1.66, most deprived (Kabaso and Tembo 2009). Straight-line distances from each ZDHS cluster to the nearest health facility are calculated via a Geographical Information System (GIS) platform and exported to Stata. Previous literature suggests that proximity to a health facility, quality of ANC services provided and antenatal uptake in the community are positively associated with a woman's utilisation of ANC, while poverty concentration in the community is negatively associated with ANC utilisation (Gage and Calixte 2006; Gage 2007; Sagna and Sunil 2012; Kyei *et al.* 2012a). In this study, the supply-side is proxied by the availability of drugs and the density of health facilities in the community, ANC uptake provides an indication of demand and distance to the nearest facility captures an interaction between both supply and demand.

Results

Descriptive statistics

Descriptive statistics (Table 2) are suggestive of ANC inadequacy; 40% of women complete less than four check-ups, while at least 80% initiate care after the first trimester. There is preliminary evidence that these outcomes are related to education and income, while varying by region.

[TABLE 2]

Individual and community level effects

The strength of the preceding preliminary results was further subjected to a two-stage multilevel model that included both individual and community variables. Model 2 is the general specification, incorporating both individual and community variables, while model 1 excludes the community variables. The analysis was performed on the full sample, a rural sample and an urban sample. To select the appropriate specification for each outcome, the AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion) and the value of the log likelihood function are considered. The preferred model is one with smaller AIC, BIC and absolute log likelihood. Except for not initiating ANC in the first trimester, where model 2 (including both individual and community level variables) is better, we find that the individual level model fit is better. The community context, though, has a greater role in explaining individual level variations on insufficient ANC visits in the rural areas.

To establish the extent to which differences in the communities explain individual variation in inadequate use of ANC, we further estimated a series of random intercept models. From the null model, estimates of the intra-class correlation (ICC), which measures the degree to which community context can explain total variation in ANC utilisation, are provided in Table 3. Similarly, the variance of the random intercept term, which shows the extent to which outcomes between communities differ, after controlling for the covariates, were obtained (Table 3). About 6% to 11% of the overall variation in insufficient visits and no visits in the first trimester, respectively, can be attributed to unobserved community level differences. The low ICC suggests that most of the variation in the models is explained by individual characteristics. Moreover, the inclusion of individual and community level covariates reduces the variation explained by unobserved community characteristics (ICC) for inadequate visits in rural areas. These results

reinforce the previous conclusion: the individual level models have more explanatory power, except in the case of inadequate ANC visits in rural areas[2].

[TABLE 3]

Odds ratios for the various specifications of both outcome variables are presented in Tables 4 and 5[3]. At the individual level (Table 4), employed women are less likely to have three or less ANC visits compared to the unemployed (OR=0.82, P=0.056), while the odds of having three or fewer ANC visits are higher, if the quality of ANC received is low (OR=0.96, P=0.000); the result was statistically significant in both rural and urban areas. Multipara women in urban areas, and the household childcare burden, in both rural and urban areas, are positively associated with an inadequate number of visits. Although the woman's education was not statistically associated with less than four ANC check-ups, the odds of insufficient visits for women whose husband attained a secondary education qualification are lower (OR=0.75, P=0.000), compared to women, whose husbands have received no education, at least in urban areas. The effect of wealth is insignificant in both urban and rural areas, whereas the results from the full sample show that household wealth is positively associated with insufficient visits at the individual level. However, this surprising association disappeared after adjusting for community level variables in the full sample model (Table 4). Unexpectedly, the results suggest that higher quality health care services provided in rural areas, as captured by the structural inputs of quality of health care – namely drug availability and density of health facilities – is positively associated with insufficient ANC visits.

Except for the childcare burden (OR=1.24, P=0.000), the woman's employment status (OR=0.716, P=0.058), the husband's educational attainment (OR=0.55, P=0.015) for secondary

[2] Results of the test of joint significance of community level variables for inadequate ANC visits suggests that only the community level variables in rural areas are jointly significant, the results from urban areas were insignificant.
[3]Results for the models not presented are available on request.

education or higher) and the actual quality of ANC received (OR=0.88, P=0.000), none of the other individual level variables were significant in explaining initial visits occurring after the first trimester (Table 5). The household childcare burden was statistically significant in both rural and urban areas, while the other results were valid only for urban areas.

[TABLE 4]

[TABLE 5]

Discussion

Using data from the 2007 ZDHS linked with administrative and health facility census data, this research empirically identifies the individual and community level factors associated with inadequate ANC use, following the adoption of FANC in Zambia. The findings demonstrate that a considerable proportion of parturient women in Zambia continue to receive less than the minimum number of required visits (four) and/or do not receive antenatal check-ups in the first trimester, even after the adoption of FANC. While all the women in the selected sample have at least one ANC visit, 40% have three or fewer visits and more than 80% do not have antenatal check-ups in their first trimester. These results suggest that, even though the objective of increasing ANC coverage to all women has been achieved, there are missed opportunities for early interventions – the prevention of mother to child transmission of HIV/AIDS – because too few women seek ANC in the first trimester.

As noted, community factors are found to have a stronger influence on adequate use of ANC in rural areas. The finding that the availability of better quality services is a significant predictor of inadequate use of ANC in rural areas, if unexpected, is plausible and similar to Kyei *et al.* (2012a). Although previous literature suggests that women are more likely to have adequate visits, due to the increased availability and accessibility of ANC (Gage and Calixte 2006; Gage 2007; Sagna and

Sunil 2012), seeking ANC from health facilities with better technical quality of care may be associated with out-of-pocket payments for other components of care, as well as higher travel costs. Zambia has promoted access to ANC, via free public provision; however, the health facility distribution favours urban areas (MOH 2010). More so, there are variations in drug availability among health facilities – hospitals have better supplies than health centres – which is indicative of inadequate funding for drugs and poor logistics operations (MOH, 2005). Thus, women might (indirectly) pay for better care, while simultaneously reducing the quantity of care. If true, additional questions deserve consideration. Are Zambian women fully aware of the benefits of subsequent ANC visits? Are ANC visits undertaken merely to gain access to health facility delivery services, because ANC is a prerequisite for delivery at a health facility? If the answer to either of these questions is yes, that is further evidence of missed opportunities. ANC check-ups provide a platform to inform and educate women about pregnancy and create awareness about the importance of future check-ups, the importance of skilled care at the time of delivery and other health initiatives. It is also possible that other trade-offs are at play. Health facilities that provide better quality services may provide less interpersonal quality of care, which may be more important for ANC use (Gabrysch and Campbell 2009; Kyei *et al.* 2012a). Conversely, the structural inputs used in the study may not precisely capture the quality of health services (Donabedian 1988).

At the individual level, decisions to seek ANC after the first trimester and/or have insufficient ANC visits are determined by similar factors, although there are urban-rural differences. This similarity is an indication that policies aimed at encouraging adequate visits could also address some of the obstacles to first trimester ANC use. Notably, ANC quality, proxied by the content of care received, is associated with inadequate use of ANC in both rural and urban areas, as well as with late ANC initiation in urban areas. Previous literature suggests that the quality of care shapes the women's decision to use ANC (Gabrysch and Campbell 2009). The findings from

this study suggest that the content of ANC is an important determinant of use, and that improving the content of care to ensure universal coverage can encourage the overall use of ANC, which is fits nicely with the goals of FANC.

The finding that higher parity is a barrier to adequate use of ANC is consistent with previous developing country literature (Magadi *et al.* 2000; Overbosch *et al.* 2004; Simkhada *et al.* 2008; Sagna and Sunil 2012). The perceived lower risk associated with births of higher order may explain the greater odds of inadequate visits among multiparous women. Moreover, higher parity women may not feel the need to use antenatal services, due to their accumulated pregnancy experiences and knowledge of the birthing process.

Empirically, distance has been a structural barrier deterring women from seeking ANC; however, we find that distance to the nearest health facility does not significantly influence inadequate ANC. Similar results were found in Kenya and rural Haiti (Magadi *et al.* 2000; Gage and Calixte 2006). Also, recent studies in Zambia find that distance does not play a significant role in deterring ANC use, but is important for delivery services (Gabrysch *et al.* 2011; Kyei *et al.* 2012a). A possible explanation is that delivery services are less readily available, whereas access to ANC is enhanced through outreach health services. Health workers travel from designated bases to provide antenatal services and return to their base, helping to overcome the distance barrier.

For women in both the rural and urban areas, no evidence of the influence of the woman's education and household wealth on ANC use was found, which differs from the previous literature (Addai 2000; Gage and Calixte 2006; Fan and Habibov 2009; Halim *et al.* 2011). The observed lack of association between inadequate ANC use and factors, the woman's education and household wealth, suggests that non-utilisation of ANC affects people from different socio-demographic and economic profiles equally; however, a more detailed examination of inequality is left for future research. Noteworthy is that in 2007, the use of ANC services was higher

among more educated and wealthier women (CSO, 2009). The observed positive association between adequate ANC use in urban areas and the husband's educational attainment, which is in line with findings from developing countries (Simkhada *et al.* 2008), suggests that male involvement is crucial in determining adequate use of ANC. The participation of men in reproductive health services in Zambia is still relatively low and these findings call for greater efforts in the health promotion programs to engage men. As expected and in line with findings from Ghana and Mali, the woman's employment status varied positively with adequate ANC use (Addai 2000; Simkhada *et al.* 2008; Gabrysch and Campbell 2009). Employment, which is also associated with education, helps overcome other financial barriers, increasing the woman's mobility.

Confirming findings from Zimbabwe (Mathole *et al.* 2004), ANC-seeking behaviour in the first trimester of pregnancy is not determined by geographic access, but rather by other unobserved factors, possibly, cultural perspectives around announcing pregnancy in the early stages. In Zimbabwe, women were apprehensive in seeking care during the first trimester, due to cultural beliefs and fears that women are most vulnerable to witchcraft in the early period of pregnancy (Mathole *et al.* 2004). Studies in rural Kenya and Nigeria have uncovered other important sociocultural factors influencing the attitude to ANC utilisation (van Eijk *et al.* 2006; Ndidi and Oseremen 2010; Aniebue and Aniebue 2011). Such factors include perceptions and satisfaction with FANC, as well as cultures and customs in pregnancy care. Women's perceptions were found to play a more dominant role in seeking care in the first trimester (Ndidi and Oseremen 2010). For instance, perception towards having fewer visits, such as the fear of inadequate learning during antenatal care and suspicion that four visits was inadequate for familiarisation with care providers, has been demonstrated to act as a barrier to seeking FANC (Aniebue and Aniebue 2011). In Nigeria, late initiation of ANC was strongly determined by the perception that ANC is primarily curative and not preventative. However, such variables are not captured in

DHS surveys. Further research is needed to identify other factors affecting the utilisation of ANC in the first trimester, particularly in the rural areas of Zambia, in order to improve use.

The study was based on a large representative national survey, the 2007 ZDHS, which allows for the examination of various factors related to the utilisation of antenatal care, and increases the validity of the results. The study was able to use multiple data sources that allowed linkages and analysis of additional supply-side factors that are not usually captured by one dataset. Furthermore, the potential of recall bias has been minimised by restricting the sample only to the woman's most recent delivery within the last three years. However, the interpretation of the results needs to take into account the study limitations. By 2005, the FANC coverage rate in Zambia was about 70% (MOH 2005); however, it was not possible to identify the exact districts in which FANC was introduced, due to unavailability of data. Thus, the analysis also includes some areas in which components of FANC may not, yet, have been introduced, and is likely to introduce a bias in the results. The bias generated could be problematic, if the characteristics of the women in uncovered areas are significantly different from those in covered areas. Additionally, while the 2005 Zambia HFC contains information on health facilities collected at one point in time, the availability or number of health facilities could have changed during the three-year period (2005–2007), covering ANC use in the sample. However, using health facilities data enabled us to include measures, such as distance, to assess accessibility, and these variables are not captured in the household survey. Unfortunately, the distances are measured in a straight line to the nearest health facility, and not necessarily to facilities that provide ANC. However, since most of the facilities covered in the Zambia HFC provide ANC services (93%) (Nyei *et al.* 2012), any measurement error bias generated by including all facilities is expected to be minimal. Also, a potential bias in the true distance effects is possible, due to the random noise generated by the geo-scrambling procedure used by MEASURE DHS (http://www.measuredhs.com/What-We-Do/Gis.cfm), and by the differences in actual

distances travelled to health facilities compared to the straight-line distances that are used in the analysis. Also, data from routine health information systems can be problematic. As such, efforts were made to detect outliers in the data that could have resulted from misreporting. Moreover, at the national level, about 92%[4] of HMIS reports from health facilities were complete in 2007. Another potential limitation is that data from most of the private health facilities is not incorporated into the HMIS and therefore the data might not be a reflection of all the health facilities in the country. Finally, due to data limitations, the analysis does not include women who died, due to childbirth-related complications and, thus, if inadequate ANC use is positively correlated with childbirth-related deaths, the results could overestimate the actual use of ANC. While these limitations are unlikely to impact the validity of the analyses, there is need for more studies on how FANC is implemented in the country to identify gaps that could be addressed to improve the provision of better care. Although the study accounts for some community-level variation, through structural inputs at healthcare facilities, a large proportion of the variation remains unexplained. Thus, the importance of sociocultural barriers needs to be recognised in the effective implementation and continuance of FANC, deserving more attention in future research.

Conclusion

The study provides evidence that, while both individual- and community-level factors are instrumental in determining early initiation of ANC and adequate use, after the adoption of FANC in Zambia, there are other unobserved factors that are important for explaining ANC use. This calls for further qualitative research to understand why women do not initiate ANC visits early and why women still have inadequate ANC visits. The content of ANC quality of care

[4] The proportion of complete reports is an indicator of the quality of the HMIS data and should be as close to 100%, and at least more than 90%. The indicator is defined as the number of reports received from health facilities per number of reports that should have been received during the time period.

received during ANC plays a crucial role in influencing ANC; this observation calls for greater efforts to improve the content of ANC in health facilities so as to complement existing efforts that are intended to encourage adequate use of ANC. The results also suggest that the education of the husband is strongly associated with adequate use of ANC. Thus, from a policy perspective, the awareness of FANC should go beyond the individual pregnant women to include the husbands. Current efforts in Zambia to include men in reproductive health services, such as family planning and the HIV/AIDS counselling during ANC visits are laudable, but more emphasis needs to be placed on the importance of adequate ANC visits and early initiation of visits. Although improving education is beyond the scope of health sector interventions, the knowledge of the importance of ANC services could be promoted through targeted interventions that proxy for the role of education.

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Table 1: Variables included in and weights obtained from MCA

Variable	Categories	Weights
Skilled assistance	Attended by skilled worker during visit	0.171
	Not attended by skilled worker during visit	-2.897
Weight	Weighed during pregnancy	0.346
	Not Weighed during pregnancy	-3.238
Height	Height measured during pregnancy	1.555
	Height not measured during pregnancy	-0.535
Blood pressure	Blood pressure checked during pregnancy	0.634
	Blood pressure not checked during pregnancy	-2.864
Urine sample	Urine sample taken during pregnancy	2.363
	Urine sample not taken during pregnancy	-0.601
Blood sample	Blood sample taken during pregnancy	1.218
	Blood sample not taken during pregnancy	-1.792
Complications	Told about complications during pregnancy	0.516
	Not told about complications during pregnancy	-1.514
Iron tablets	Given or bought iron tablets during pregnancy	0.079
	Not given or bought iron tablets during pregnancy	-1.105
Prophylaxis	Took fansidar as prophylaxis for malaria prevention in pregnancy	0.209
	Did not take fansidar as prophylaxis for malaria prevention in pregnancy	-1.829

Table 2: Descriptive statistics for the dependant variables, 2007 Zambia DHS (n=2,925)

	Three or less visits		No visit in first trimester	
Variables	Mean	S.D	Mean	S.D
Total	0.397	0.489	0.822	0.383
Individual-level variables				
Parity				
1	0.198	0.398	0.201	0.401
2-4	0.482	0.500	0.479	0.500
5+	0.320	0.467	0.319	0.466
Religion				
Catholic	0.187	0.390	0.177	0.382
Protestant	0.796	0.403	0.809	0.393
Other	0.017	0.130	0.014	0.118
Children in HH under five				
Household childcare burden	1.888	0.889	1.840	0.894
Woman's employment status				
Employed	0.459	0.498	0.486	0.500
Woman's education				
No education	0.126	0.332	0.124	0.329
Primary	0.610	0.488	0.610	0.488
Secondary or higher	0.264	0.441	0.266	0.442
Husband's education				
No education	0.177	0.382	0.171	0.377
Primary	0.458	0.498	0.448	0.497
Secondary or higher	0.365	0.482	0.381	0.486
Index for actual quality of ANC received	-0.467	4.598	-0.226	4.447
Household wealth index				
Poor	0.405	0.491	0.417	0.493
Middle	0.223	0.417	0.236	0.425
Rich	0.372	0.484	0.347	0.476
Community-level variables				
Urban	0.361	0.480	0.339	0.473
Proportion of drugs available	0.715	0.115	0.709	0.115
Material deprivation index	-0.408	1.889	-0.310	1.869
Distance to nearest facility	7.013	6.027	7.141	6.070
Number of health facilities per 1000	0.136	0.053	0.137	0.052
Antenatal care uptake	0.954	0.132	0.956	0.138

Table 3: Intra-class correlation and variances for random intercepts, 2007 Zambia DHS

	Three or less antenatal visits			No visit in first trimester		
	Full	Rural	Urban	Full	Rural	Urban
Intra-class correlation[+]						
Null model	0.060***	0.073***	0.030*	0.105***	0.142***	0.034
Individual level model	0.059***	0.076***	0.018	0.114***	0.150***	0.024
Individual- and community level model	0.054***	0.063***	0.016**	0.110***	0.114***	0.009
Variance of the random intercept						
Null model	0.211***	0.261***	0.101***	0.386***	0.545**	0.117**
Individual level model	0.204***	0.269***	0.062**	0.424***	0.581***	0.080
Individual- and community level model	0.188***	0.222***	0.052**	0.408***	0.544**	0.029

*** p<0.01, ** p<0.05, * p<0.1, [+]The Intra-class correlation is a ratio of the community level variance to the total variance.

Table 4: Multilevel modelling of three of less visits with individual and community level covariates

	Full (n=2,925)		Urban (n=1,000)		Rural (n=1,925)		Urban (n=1,000)	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Individual level variables								
Parity (ref=1)								
2-4	1.028	(0.816 , 1.296)	1.263	(0.871 , 1.833)	0.931	(0.688 , 1.259)	1.267	(0.873 , 1.839)
5+	1.031	(0.798 , 1.331)	1.692**	(1.084 , 2.643)	0.844	(0.612 , 1.165)	1.704**	(1.091 , 2.660)
Religion (ref=Catholic)								
Protestant	0.886	(0.719 , 1.091)	0.858	(0.619 , 1.190)	0.884	(0.674 , 1.159)	0.856	(0.617 , 1.188)
Other	1.452	(0.725 , 2.906)	0.561	(0.131 , 2.398)	1.986	(0.873 , 4.518)	0.557	(0.130 , 2.381)
Household childcare burden								
Number of children under 5 in HH	1.203***	(1.097 , 1.320)	1.159*	(0.994 , 1.352)	1.211***	(1.078 , 1.360)	1.163*	(0.997 , 1.358)
Woman's employment status (ref=unemployed)								
Employed	0.802***	(0.682 , 0.944)	0.772*	(0.591 , 1.009)	0.802**	(0.653 , 0.985)	0.782*	(0.598 , 1.024)
Woman's education (ref=no education)								
Primary	1.016	(0.792 , 1.303)	0.787	(0.420 , 1.476)	1.028	(0.780 , 1.354)	0.799	(0.426 , 1.501)
Secondary and above	0.934	(0.692 , 1.262)	0.707	(0.369 , 1.352)	1.01	(0.695 , 1.467)	0.721	(0.375 , 1.384)
Partner's education (ref=no education)								
Primary	0.941	(0.737 , 1.202)	0.761	(0.467 , 1.241)	1.031	(0.773 , 1.375)	0.76	(0.465 , 1.242)
Secondary and above	0.750**	(0.584 , 0.964)	0.545***	(0.357 , 0.833)	0.891	(0.648 , 1.226)	0.544***	(0.356 , 0.833)
Index for actual quality of ANC received	0.952***	(0.933 , 0.972)	0.964*	(0.925 , 1.005)	0.946***	(0.924 , 0.969)	0.966	(0.926 , 1.007)
Household wealth(ref=poorest)								
Middle	1.015	(0.816 , 1.262)	1.097	(0.355 , 3.396)	0.966	(0.764 , 1.222)	1.083	(0.348 , 3.366)
Rich	1.243	(0.909 , 1.701)	1.468	(0.490 , 4.397)	1.156	(0.785 , 1.702)	1.515	(0.497 , 4.615)
Community level variables								
Area type (ref=rural)								
Urban	1.389**	(1.028 , 1.878)						
Proportion of drugs available	2.669**	(1.090 , 6.539)			6.138***	(1.966 , 19.157)	0.456	(0.102 , 2.039)
Material deprivation index	0.975	(0.907 , 1.047)			0.955	(0.845 , 1.080)	0.982	(0.893 , 1.080)
Distance to nearest facility	1.001	(0.983 , 1.019)			0.999	(0.980 , 1.019)	1.006	(0.959 , 1.055)
Density of health facilities	5.098	(0.662 , 39.256)			17.300**	(1.211 , 247.145)	0.921	(0.037 , 22.773)
Prenatal care uptake	1.455	(0.700 , 3.024)			1.105	(0.407 , 3.000)	1.554	(0.528 , 4.571)
Constant	0.143***	(0.045 , 0.458)	0.898	(0.256 , 3.149)	0.088***	(0.020 , 0.382)	0.958	(0.124 , 7.405)
Log likelihood	-1931.3		-663.6		-1255.7		-662.4	
AIC	3904.7		1357.1		2551.5		1364.7	
BIC	4030.4		1430.7		2662.9		1462.9	

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Multilevel modelling of no ANC visit in the first trimester with individual covariates only, 2007 Zambia DHS

	Full (n=2,925)		Rural (n=1,925)		Urban (n=1,000)	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Individual level variables						
Parity (ref=1)						
2-4	0.895	(0.667 , 1.200)	0.812	(0.547 , 1.204)	1.059	(0.671 , 1.671)
5+	0.929	(0.671 , 1.288)	0.798	(0.527 , 1.209)	1.438	(0.807 , 2.561)
Religion (ref=Catholic)						
Protestant	0.980	(0.748 , 1.284)	0.996	(0.702 , 1.412)	0.941	(0.610 , 1.450)
Other	1.593	(0.571 , 4.441)	2.311	(0.614 , 8.700)	0.688	(0.127 , 3.725)
Household childcare burden						
Number of children under 5 in HH	1.243***	(1.099 , 1.407)	1.239***	(1.062 , 1.446)	1.226*	(0.993 , 1.514)
Woman's employment status (ref=unemployed)						
Employed	0.845	(0.685 , 1.042)	0.919	(0.703 , 1.200)	0.716*	(0.509 , 1.008)
Woman's education (ref=no education)						
Primary	1.079	(0.781 , 1.490)	1.134	(0.800 , 1.607)	0.505	(0.169 , 1.516)
Secondary and above	1.009	(0.686 , 1.485)	1.281	(0.790 , 2.079)	0.422	(0.139 , 1.279)
Partner's education (ref=no education)						
Primary	0.842	(0.606 , 1.170)	0.868	(0.592 , 1.272)	0.761	(0.385 , 1.506)
Secondary and above	0.679**	(0.488 , 0.945)	0.743	(0.489 , 1.129)	0.549**	(0.310 , 0.970)
Index for actual quality of ANC received	0.963***	(0.938 , 0.989)	0.981	(0.951 , 1.012)	0.884***	(0.833 , 0.937)
Household wealth (ref=poor)						
Middle	1.151	(0.873 , 1.517)	1.146	(0.846 , 1.551)	0.408	(0.049 , 3.371)
Rich	1.269	(0.932 , 1.728)	0.981	(0.608 , 1.583)	0.605	(0.075 , 4.849)
Constant	4.468***	(2.661 , 7.501)	4.420***	(2.349 , 8.319)	30.217***	(2.959 , 308.587)
Log likelihood	-1349.6		-885.5		-448.7	
AIC	2729.3		1801.1		927.4	
BIC	2819.1		1884.6		1001	

*** p<0.01, ** p<0.05, * p<0.1