Socioeconomic inequalities in maternal healthcare utilization in Zambia: 1997-2014

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Abstract

Background Exploring the trends and socioeconomic inequalities in the use of maternal healthcare utilisation between 1997 and 2014.

Methods Data were analyzed using descriptive and multivariate regression methods.

Results Women in the higher wealth quintiles (Q4 and Q5) generally had higher prevalence of using health facility delivery and postnatal care services compared with those in the lower wealth quintiles (Q1 and Q2), whereas the prevalence of timely and adequate ANC visit was comparatively higher among those in the lower wealth quintiles.

Conclusion Findings indicated important sociodemographic inequalities in using maternal healthcare services, addressing which may help promote the utilisation of these services.

Introduction
Zambia is a land-locked country in Southern Africa with around two-thirds of the total population living below international poverty line [1]. Despite being one of the fastest growing economies in Africa, a large proportion of the Zambian population is still facing significant challenges in meeting the basic amenities such as proper housing, access to clean water, and sanitation and health care. The demography is characterised by widespread poverty, food insecurity and malnutrition, and a fragile healthcare system which are contributing to high burden of maternal and child mortality in the country. Historically, Zambia has a high maternal mortality ratio [2, 3] which, even after an appreciable progress during last two decades [4], remains one of the highest in the world (398 in 2014 Vs 577 in 1990) [5, 6]. Zambia’s situation of poor healthcare condition is not unique in the continent as most of the African countries failed to meet the maternal and child health related Millennium Development Goals such as reducing maternal mortality ratio between 1990 and 2015 by the 75% [7, 8].

The causes of low maternal healthcare services uptake are numerous and multifaceted, and broadly classified into behavioral, cultural, economic, and sociodemographic factors at individual level and remoteness of health facility, inadequate infrastructure and skilled human resource for healthcare at community level [9, 10, 11, 12, 13]. A large number of studies has been conducted on Demographic
and Health Survey data that adopted the Andersen and Newman Behavioural Model to identify the factors associated with poor use of ANC, facility delivery and postnatal services [14, 15]. To date, there is no such study or report available for Zambia, and thus the factors behind the low utilisation of maternal healthcare services are not yet fully understood. Although the a few subnational studies have been conducted [12, 16, 17], there remains a lack of comprehensive research data showing the full spectrum of maternal healthcare services use such as timing and adequacy of antenatal care, health facility delivery and postnatal care. Therefore, the present study was conducted to explore the factors associated with these four components of maternal healthcare using nationally-representative data from Zambia Demographic and Health Surveys (DHS) conducted since 1996-1997. DHS provides information on a wide range of demographic and socioeconomic factors which were selected systematically to fit within the scope of the Andersen and Newman Behavioural Model. Findings of the present study are expected to enhance the understanding of the enabling and predisposing factors associated with the uptake of maternal healthcare services in Zambia as well as in the neighbouring countries with similar economic and sociocultural environment.

Methods

Data source

Data for this study were collected from the last four rounds of Zambia Demographic and health survey (ZDHS 1997, 2002, 2007, 2014). These surveys are conducted by Central Statistical Office (CSO) in partnership with the Ministry of Health. Financial assistance was provided by the Ministry of Health, and United States Agency for International Development (USAID) along with technical assistance by ICF international. The main purpose of these surveys is to provide quality information for monitoring and evaluation of population health programmes and assist in evidence-based health policy making. DHS surveys employ multistage cluster design for sample selection, and are conducted by face-to-face interviews on eligible men (15–59 years), women (15–49 years), couples and households [18]. Data for this study were collected from women’s questionnaire. The data are made freely accessible in the public domain to all stakeholders. Further details of the surveys are available from table 1 and previous publications*:
Patient and public involvement

We did not directly involve Zambia women in study planning.

Outcome measures

The outcome variables of interest were: 1) timing of first antenatal care, 2) frequency of antenatal care, 3) facility delivery, and 4) postnatal care for the latest childbirth occurring within the last five years from the survey. All of these items are assessed based on the self-report of the participant.

Timing of first antenatal care was classified as timely (if within the first trimester) and late (if beyond the first trimester) [19]. Frequency of antenatal care visits was defined as adequate and inadequate as per World Health Organization recommendation [20]. Facility delivery was defined as childbirths occurring at any healthcare institution, and home delivery if otherwise [21]. Use of postnatal care (Yes/No) was assessed by asking whether or not the respondent underwent any health checkup by a health professional after delivery. This study considered a postnatal check-up within 48 hours after birth as a potential maternal healthcare indicator as per the WHO.

Explanatory variables

Selection was explanatory variables was guided by Andersen’s behavioral model of health service utilisation which postulates that healthcare utilisation is a function of three major factors: 1) predisposing factors, 2) enabling factors and 3) need factors [15]. For this study, the data were secondary and hence the selection of the explanatory variables in line with the behavioral model was not possible. To this effect, the three sets of factors were met by using proxy indicators. Predisposing
factors were indicated by the sociodemographic variables including: age (15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49 years), residency (urban, rural), religion (Christian, other), ethnicity (Bemba, Tonga, Chewa, Other), parity (1-2, >2 children), and sex of household head (male, female) \[22\]. Enabling factors were indicated by women’s education (none, primary, secondary/higher), employment (none, professional e.g. sales/services, agriculture/other manual), household wealth quintile (Q1/richest, Q2/richer, Q3/middle, Q4/richer, Q5/poorest) and husband’s education (none, primary, secondary/higher) \[15\]. Need factors were proxied by encountering family planning (FP) related message in newspaper (Yes/No), radio (Yes/No), and TV(Yes/No) \[22\]. Measurement technique for wealth quintile was published elsewhere \[23\]. Making ANC visits was also regarded as a need factor for facility delivery and postnatal care \[10\].

**Data analysis**

Data were analyzed with Stata version 14. Datasets were merged and cleaned by applying the inclusion criteria: experience of at least 1 childbirth in the preceding 5 years. As the surveys used cluster sampling techniques, all analyses were adjusted for this by using the **svy** command \[24\]. This command uses the information on sampling weight, strata, and primary sampling unit provided with the datasets. Following that, the dataset was accounted for the cluster sampling design, sampling strata and weight by using complex survey mode. Sample characteristics were described as percentages. Prevalence of antenatal care, facility delivery and postnatal care was presented as bar charts. Following that, multinomial logistic regression models were used to estimate variations in the odds of receiving the maternal healthcare services. Results of four outcome variables were presented in four separate tables, each divided into three subsamples: overall, urban and rural. Model fit statistics were run after the regression analysis using the variance inflation factor (VIF) command. No multi-collinearity was detected as VIF values were below 10 for all the models. All tests were two-tailed and was considered significant at alpha value of 5%.

**Results**

In total 22,605 women were included in the study from the four surveys: DHS 1996-97 (4,615), DHS
2002 (4,491), DHS 2007 (4,148), and DHS 2013-14 (9,351). Sample characteristics were provided in the appendix (Table A). In short, majority of the women were aged between 20-24 years, rural residents, followers of Christianity, of Bemba ethnicity, had more than two children, lived in male-headed households, had primary level education, and had outdoor employment.

**Descriptive analyses**

**Figure 1: Maternal healthcare utilisation by type.**

Figure 1 shows that prevalence of women making the first ANC visit within the first trimester has increased from 11.8% in 1996-97 to 23.9% to 2013-14, whereas that of making at least four ANC visit has decreased from 72.3 to 55.3% in 2013-14. The prevalence of health facility delivery (44.2% in 1996-97 vs 73.4% in 2013-14) and postnatal care (43.8% in 2002 Vs 73% in 2013-14) has also increased substantially during the same period.

**Figure 2: Maternal healthcare utilisation by age groups**

Figure 2 shows the prevalence of maternal healthcare services across age groups. The prevalence of timely ANC visit, health facility delivery, and postnatal care were higher among those aged between 20 and 34 years than the adolescent and those aged above 34 years.

**Figure 3: Maternal healthcare utilization by educational level**

Figure 3 shows the prevalence of maternal healthcare services according to educational level. The prevalence of timely ANC visit, health facility delivery, and postnatal care were higher among those aged between 20 and 34 years than the adolescent and those aged above 34 years. Women who had no education had the lowest prevalence of making timely and adequate ANC visits, facility delivery and postnatal care, while those had primary level education had the highest prevalence of using these services.
Figure 4: Maternal healthcare utilisation by household wealth quintile

Figure 4 shows the prevalence of maternal healthcare services according to household wealth status. Women in the higher wealth quintiles (Q4 and Q5) generally had higher prevalence of using health facility delivery and postnatal care services compared with those in the lower wealth quintiles (Q1 and Q2), whereas the prevalence of timely and adequate ANC visit was comparatively higher among those in the lower wealth quintiles.

Multivariate analyses

Predictors of timely initiation, at least one and adequate use of antenatal care were shown in table 2, 3, 4 and that of health facility delivery and postnatal care were shown in table 5 and 6 respectively. The findings show that the odds of timely initiation and at least one ANC visits have increased significantly since the 1996-97 survey, however that of having adequate ANC visits have decreased since then. In general, women in the higher age group (compared with those aged 15-19 years) had higher odds of having adequate ANC visits, and the associations were significant for urban and rural areas. For women in the rural areas, the odds of timely initiation [OR=1.309, 95%CI= 1.181,1.450] of ANC visits were higher, but were lower for at least one ANC [OR=0.674, 0.506,0.899], health facility delivery [OR=0.300, 95%CI=0.274,0.329], and postnatal care [OR=0.482, 95%CI=0.435,0.533].

Compared with women who had no formal education, those who had primary and higher education generally had significantly higher odds of having adequate ANC visits, health facility delivery and postnatal care. Women from the highest wealth quintile households have higher odds of timely initiation of ANC [OR=1.178, 95%CI=1.013,1.369], adequate ANC [OR=1.424, 95%CI=1.059,1.913], health facility delivery [OR=1.640, 95%CI=1.414,1.903], and postnatal care [OR=1.228, 95%CI=1.048,1.439]. Non-Christian women in general had lower odds of using most of the maternal healthcare services. Compared with Bemba, belonging Chewa ethnicity showed a positive effect on all the outcome measures except for timely initiation of ANC visits. Having more than two children were
inversely associated with adequate ANC, health facility delivery, and postnatal care services. Regarding media use, encountering FP related message on newspaper, radio and TV showed a positive association with all types of the maternal healthcare services. Women with husband’s having secondary/higher education showed a protective effect on using ANC, health facility delivery, and postnatal care services. Women who made at least four ANC visits had significantly higher odds of using facility delivery [OR=1.722, 95%CI=1.603,1.850] and postnatal care [OR=1.378, 95%CI=1.262,1.504] as well, and this association was significant for both urban and rural areas.

Table 2: Predictors of timely initiation of first antenatal check in Zambia. (n=22,591).

ZDHS 1997-2014

Table 3: Predictors of making at least one antenatal check in Zambia. (n=22,591). ZDHS 1997-2014

Table 4: Predictors of adequate antenatal checks in Zambia (n=22,591). ZDHS 1997-2014

Table 5: Predictors of using health facility delivery services in Zambia. (n=22,591). ZDHS 1997-2014

Table 6: Predictors of taking postnatal care in Zambia. (n=16,472).

ZDHS 1997-2014

Discussion
Optimal utilisation of maternal healthcare services is essential for ensuring better pregnancy outcome and consequently the health of future generations. A healthy pregnancy determines not only the health of the newborn, but also has a major impact on adult health with broader and long-lasting implications for national human development efforts. Data-based evidence is therefore necessary to inform the ongoing programs working to meet the maternal health related targets such as
Sustainable Development Goals. The current study provides an insight on the prevalence and predictors of the three crucial components of maternal healthcare including antenatal, skilled birth attendant and postnatal care services. The findings indicate that the proportion of women making their first ANC visit within the first trimester has been increasingly albeit slowly since 1997. The prevalence of women of making at least one ANC visits has also increased during the same period, however, that of making four or more ANC visits has been decreasing since 2002. This finding is potentially alarming one and the cause behind this negative trend requires further investigation. A possible explanation might be that women who received care once didn’t seek further assistance owing to unsatisfactory service quality. Patience dissatisfaction in maternal healthcare service such as ANC is common in African settings [25, 26], and has been shown have negative effects on subsequent healthcare visits including low level of institutional delivery [27].

Despite the lower prevalence of adequate ANC visits, the average prevalence of facility delivery has been increasing since 1997. The prevalence of women delivering at health facility for the four surveys were 57.7%, and has improved from 44.16% in 1996-1997 to 73.37% in 2013-14, which is higher than the sub-Saharan African average of about 50% [28]. As expected, the prevalence of receiving PNC has also increased from over two-fifth (43.7%) in 1997 to around three-quarter (73%) in 2013-14. The positive effect of using skilled birth assistance on taking PNC was reported in Ethiopia [29] and Tanzania [30]. Also worthy of note is the age and educational difference in the uptake of all type maternal healthcare services. For instance, the prevalence of timely ANC visit, health facility delivery, and postnatal care were generally higher among women aged between 20 and 34 years and lower among the adolescent and those aged above 34 years. In a recent study on Demographic Health Survey data from seven countries (Bangladesh, Cambodia, Cameroon, Nepal, Peru, Senegal and Uganda), similar patterns of using ANC and facility delivery were reported [31]. Non- and inadequate use of healthcare among the adolescent women is common issue that needs to be addressed to promote the prevalence of maternal health service utilisation.

In addition to age, the descriptive analyses also revealed noticeable disparities in the use of the four types of services among different education subgroups. Women with no education had lower
prevalence of taking ANC, facility delivery and PNC services than those who had primary and higher education. The positive effect of education on healthcare service utilisation in general can be interpreted through its enabling mechanism. Educated individuals are more likely to be health aware i.e. concerned of their health status and need for timely medical services[^32], and have better capacity to afford the services compared with those without education [^33]. A multicountry study (DR Congo, Egypt, Ghana, Nigeria and Zimbabwe) based on Demographic and Health Surveys data reported that women's education had significantly positive effect on taking professional ANC, timing and frequency of ANC visits, facility delivery [^34]. These finding is well in line with those from the present study; women having primary and higher education had significantly higher odds of taking adequate ANC, facility delivery and PNC services. However, it is important to note that primary education showed a positive association with early ANC contact in urban sample only, but not on rural sample. In a similar context, having learnt about family planning from newspaper, TV and radio showed a positive association with the utilisation of all type of maternal healthcare services. Interestingly, husband's educational status also appeared to be an important predictor adequate ANC, facility delivery, and PNC services. These findings imply the need for continued effort to improve women's education status and health communication through mass media channels to promote the use of maternal healthcare services in the country.

Significant economic (wealth quintile), geographic (urban/rural) and cultural differences (religion/ethnicity) were also observed in the odds of utilising the maternal healthcare services. Women in the rural areas had higher odds of making early ANC contact, but lower odds of using facility delivery and PNC services. Having an employment didn't any strong impact in particular, however, higher parity showed a negative association with taking the services. Interestingly, the odds of wealth quintile were not as pronounced as educational status, despite the fact that these two indicators usually show similar effect in terms of healthcare utilisation. The present findings showed that women from higher wealth status households generally had higher odds of having used adequate ANC, facility delivery and PNC services. For PNC, the effects are particularly higher among urban women. The underlying mechanisms behind these differential effects of the different predictors are
hard to pinpoint by quantitative methods, and therefore calls for more comprehensive and qualitative studies. Nonetheless, the findings offer plenty of insight into the diverse sociodemographic factors that influence the use of maternal healthcare services in Zambia. Policy efforts to improve maternal healthcare service utilisation should therefore focus on developing innovative interventions strategies to address the sociocultural barriers to accessing care. Evidence-driven social determinants based approach by incorporating the specific needs of subpopulations may facilitate a more equitable provision of these essential and life-saving healthcare services to the vulnerable communities.

Findings of the present study fills an important gap in the literature. Main strengths were the use of nationally representative data from four rounds of survey that allows making a generalisable conclusion about the prevalence and associations. The use of Andersen and Newman Behavioural Model and methodological rigor in the analyses add further strengths to the findings. Nonetheless, this study has several limitations to report. First of all, the data were cross-sectional and hence no causality can be inferred from the associations. The data were secondary and authors have to influence over the selection and measurement of the variables. As the data were self-reported, the chances of recall and reporting bias cannot be ignored.

Conclusions
The finding of this study reveals an overall progress in usage of maternal healthcare utilisation in Zambia. The prevalence of women making the first ANC visit within the first trimester has more than doubled between 1996-97 and 2013-14, while that of having adequate ANC visits have decreased by a considerable margin. Important sociodemographic disparities were observed in the odds of using the services, among which the most notable were women’s education, ethnic background, wealth status of the household, parity, education of the husband and exposure to family planning communication through mass media. Barriers to maternal healthcare utilisation highlighted by the socioeconomic and cultural inequalities should be given special attention in designing intervention programs.

Declarations
Acknowledgments
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Authors’ contributions
ZFH, GB, ZHC and SYG conceptualized the study. ZFH, GB, SYY and TLW were responsible for data management and analysis. ZFH and GB contributed to initial drafting and interpretation of the results. GB, SYY and SYG were responsible of the linguistic. All authors read the final manuscript and gave approval for publication.

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Availability of data and materials
Datasets used during the current study are available from the last four rounds of Zambia Demographic and health survey (ZDHS 1997, 2002, 2007, 2014). These surveys are conducted by Central Statistical Office (CSO) in partnership with the Ministry of Health. All stakeholders will be accessible for the data. Owing to the confidential policy, the data are not publicly available.

Ethic approval
This study protocol was approved by the Research Ethics Committee of Southwest University of Political Science and Law (IRB no. FWA00070603).
Consent for publication

No applicable.

Competing interests

None declared.

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Tables

Table 1: Details of the Zambia Demographic and Health Surveys

| Year       | No. of clusters | Coverage          | Field work         |
|------------|-----------------|-------------------|--------------------|
| 2013-2014  | 722             | All ten* provinces| August 2013 to April 2014 |
| 2007       | 319             | All nine provinces| April 2007 to October 2007 |
| 2001-2002  | 320             | All nine provinces| November 2001 to May 2002 |
| 1996-1997  | 213             | All nine provinces| July 1996 to January 1997 |

List of provinces: Central, Copperbelt, Eastern, Lusaka, Luapula, Muchinga*, Northern, North-Western, Southern, and Western (*newest province).

Table 2: Predictors of timely initiation of first antenatal check in Zambia. (n=22,591) ZDHS 1997-2014

| Year (1996-97) | Overall | Urban | Rural |
|---------------|---------|-------|-------|
| 2002          | 1.244** | 1.689*** | 1.102 |
|                | [1.085,1.427] | [1.307,2.183] | [0.928,1.308] |
| 2007          | 1.756*** | 2.162*** | 1.570*** |
|                | [1.540,2.002] | [1.724,2.711] | [1.335,1.846] |
| 2014          | 2.433*** | 2.413*** | 2.480*** |
### Age groups (15-19)

| Age groups | 15-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 |
|------------|-------|-------|-------|-------|-------|-------|-------|
|            |       |       |       |       |       |       |       |
| 20-24      | 0.935 | 0.990 | 1.143 | 1.122 | 1.154 | 1.131 | 1.189 |
|            | [0.791,1.107] | [0.724,1.354] | [0.954,1.369] | [0.924,1.363] | [0.939,1.417] | [0.901,1.420] | [0.878,1.610] |
| 25-29      | 1.099 | 1.124 | 1.110 | 1.065 | 1.040 | 1.068 | 1.312 |
|            | [0.730,1.092] | [0.887,1.389] | [0.837,1.355] | [0.813,1.621] | [0.807,1.339] | [0.813,1.404] | [0.926,1.858] |
| 30-34      | 1.143 | 1.124 | 1.110 | 1.065 | 1.040 | 1.068 | 1.312 |
|            | [0.720,1.091] | [0.833,1.341] | [0.837,1.355] | [0.813,1.621] | [0.807,1.339] | [0.813,1.404] | [0.926,1.858] |
| 35-39      | 1.143 | 1.124 | 1.110 | 1.065 | 1.040 | 1.068 | 1.312 |
|            | [0.720,1.091] | [0.833,1.341] | [0.837,1.355] | [0.813,1.621] | [0.807,1.339] | [0.813,1.404] | [0.926,1.858] |
| 40-44      | 1.143 | 1.124 | 1.110 | 1.065 | 1.040 | 1.068 | 1.312 |
|            | [0.720,1.091] | [0.833,1.341] | [0.837,1.355] | [0.813,1.621] | [0.807,1.339] | [0.813,1.404] | [0.926,1.858] |
| 45-49      | 1.143 | 1.124 | 1.110 | 1.065 | 1.040 | 1.068 | 1.312 |
|            | [0.720,1.091] | [0.833,1.341] | [0.837,1.355] | [0.813,1.621] | [0.807,1.339] | [0.813,1.404] | [0.926,1.858] |

### Residency (Urban)

| Residency | Urban | Rural |
|-----------|-------|-------|
|           | 1.309*** | NA |
|           | [1.181,1.450] | NA |

### Religion (Christian)

| Religion | Christian | Other |
|----------|-----------|-------|
|          | 0.920     | 0.865 |
|          | [0.663,1.276] | [0.748,1.000] |
|          | 0.569*    |       |
|          | [0.359,0.901] |       |

### Ethnicity (Bemba)

| Ethnicity | Tonga | Chewa | Other |
|-----------|-------|-------|-------|
|           | 1.050 | 0.854* | 1.007 |
|           | [0.919,1.198] | [0.751,0.971] | [0.917,1.105] |
|           | 0.867* | 1.205 | 0.956 |
|           | [0.759,0.989] | [0.909,1.596] | [0.830,1.102] |
|           |       | 1.248* |       |
|           |       | [1.028,1.516] |       |
|           |       |       | [0.911,1.168] |

### Parity (1-2)

| Parity | 1-2 | >2 |
|--------|-----|----|
|        | 0.949 | 0.839** |
|        | [0.898,1.096] | [0.752,0.935] |
|        | 0.862* |       |
|        | [0.766,0.970] |       |

### Sex of household head (Male)

| Sex of household head | Male | Female |
|-----------------------|------|--------|
|                       | 1.066 | 0.992 |
|                       | [0.899,1.263] | [0.898,1.096] |
|                       |       | 0.956 |
|                       |       | [0.844,1.082] |

### Education (No Education)

| Education | Primary | </br>Secondary |
|-----------|---------|---------------|
|           | 2.259** | 1.256**       |
|           | [2.158,2.744] | [1.973,2.951] |
|           |         |       | [2.129,2.888] |
| Wealth quintile (Q1) | Q2     | Q3     | Q4     | Q5     |
|----------------------|--------|--------|--------|--------|
|                      | 0.915  | 1.025  | 1.101  | 1.178* |
|                      | [0.819,1.021] | [0.917,1.147] | [0.868,1.397] | [1.013,1.369] |
|                      | 0.838  | 1.083  | 0.882  | 1.230  |
|                      | [0.577,1.217] | [0.779,1.507] | [0.636,1.224] | [0.883,1.712] |
|                      | 0.938  | 1.045  | 0.954  | 1.092  |
|                      | [0.835,1.054] | [0.922,1.183] | [0.801,1.136] | [0.835,1.428] |

| Employment (None) | Professional/Sales | Agric/Others |
|-------------------|--------------------|--------------|
|                   | 1.024              | 0.987        |
|                   | [0.943,1.113]      | [0.879,1.108]|
|                   | 1.086              | 1.119        |
|                   | [0.948,1.244]      | [0.866,1.446]|
|                   | 1.002              | 0.951        |
|                   | [0.899,1.116]      | [0.833,1.086]|

| Husband's education (No Education) | Primary | Secondary/higher |
|------------------------------------|---------|------------------|
|                                    | 0.943   | 1.128            |
|                                    | [0.807,1.102] | [0.802,1.587]   |
|                                    | 0.992   | 1.125            |
|                                    | [0.620,1.586] | [0.710,1.783]   |
|                                    | 0.938   | 0.939            |
|                                    | [0.795,1.108] | [0.784,1.124]   |

| FP in newspaper (No) | Yes | Yes |
|----------------------|-----|-----|
|                      | 1.413*** | 1.427*** |
|                      | [1.223,1.632] | [1.194,1.707] |
|                      | 1.308*   |       |
|                      | [1.013,1.689] |       |

| FP in radio (No) | Yes | Yes |
|------------------|-----|-----|
|                  | 1.292* | 0.968 |
|                  | [1.031,1.620] | [0.832,1.126] |
|                  |       | 1.046 |
|                  |       | [0.938,1.166] |

| FP in TV (No)    | Yes | Yes |
|------------------|-----|-----|
|                  | 1.193** | 1.118 |
|                  | [1.047,1.359] | [0.946,1.322] |
|                  |       | 1.013 |
|                  |       | [0.928,1.106] |

| Pseudo $R^2$     | 0.328 | 0.345 | 0.325 |

Exponentiated coefficients; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Table 3: Predictors of making at least one antenatal check in Zambia. (n=22,591) ZDHS 1997-2014

| Year (1996-97) | Overall     | Urban       | Rural       |
|---------------|-------------|-------------|-------------|
| 2002          | 0.987       | 0.408*      | 1.086       |
|               | [0.781,1.248]| [0.188,0.885]| [0.842,1.401]|
| 2007          | 2.067***    | 0.689       | 2.452***    |
|               | [1.567,2.726]| [0.317,1.496]| [1.813,3.316]|
| 2014          | 2.912***    | 0.898       | 3.620***    |
|               | [2.203,3.849]| [0.438,1.842]| [2.638,4.969]|
| Age groups (15-19) |          |             |             |
| 20-24         | 1.281       | 0.880       | 1.387       |
|               | [0.886,1.853]| [0.313,2.473]| [0.932,2.065]|
| 25-29         | 1.455       | 2.915       | 1.337       |
|               | [0.951,2.226]| [0.844,10.06]| [0.847,2.109]|
| 30-34         | 1.188       | 1.584       | 1.152       |
|               | [0.759,1.859]| [0.452,5.548]| [0.711,1.867]|
| 35-39         | 1.277       | 1.446       | 1.259       |
|               | [0.797,2.047]| [0.388,5.389]| [0.757,2.092]|
| 40-44         | 1.233       | 1.072       | 1.270       |
|               | [0.744,2.043]| [0.276,4.169]| [0.735,2.195]|
| 45-49         | 0.734       | 0.813       | 0.721       |
|               | [0.419,1.287]| [0.178,3.720]| [0.392,1.326]|
| Residency (Urban) |          |             |             |
| Rural         | 0.674**     | NA          | NA          |
|               | [0.506,0.899]|             |             |
| Religion (Christian) |        |             |             |
| Other         | 0.372***    | 0.287*      | 0.374***    |
|               | [0.250,0.555]| [0.0835,0.987]| [0.245,0.572]|
| Ethnicity (Bemba) |          |             |             |
| Tonga         | 1.984***    | 1.162       | 2.152***    |
|               | [1.364,2.887]| [0.465,2.905]| [1.425,3.248]|
| Chewa         | 6.271***    | 6.221       | 6.406***    |
|               | [3.450,11.40]| [0.827,46.83]| [3.407,12.04]|
| Other         | 1.200       | 1.345       | 1.174       |
|               | [0.958,1.503]| [0.805,2.247]| [0.912,1.511]|
| Parity (1-2)  | >2          | 0.927       | 0.969       |
|               | [0.699,1.230]| [0.336,1.430]| [0.711,1.320]|
| Sex of household head (Male) |        |             |             |
|                | Coefficient | 95% CI Lower | 95% CI Upper |
|----------------|-------------|--------------|--------------|
| **Female**     | 0.928       | [0.737, 1.168] | [0.697, 1.143] |
| **Education (No Education)** |             |              |              |
| Primary        | 2.392***    | [1.962, 2.916] | [1.955, 2.972] |
| Secondary/higher | 4.526***   | [2.964, 6.910] | [2.503, 6.670] |
| **Wealth quintile (Q1)** |             |              |              |
| Q2             | 1.079       | [0.858, 1.356] | [0.833, 1.337] |
| Q3             | 0.996       | [0.784, 1.266] | [0.722, 1.193] |
| Q4             | 1.218       | [0.885, 1.674] | [0.876, 1.877] |
| Q5             | 1.427       | [0.929, 2.190] | [0.970, 3.221] |
| **Employment (None)** |             |              |              |
| Professional/Sales | 0.916      | [0.750, 1.120] | [0.750, 1.165] |
| Agric/Others   | 0.734*      | [0.545, 0.988] | [0.500, 0.953] |
| **Husband’s education (No Education)** |             |              |              |
| Primary        | 1.278       | [0.985, 1.658] | [0.974, 1.677] |
| Secondary/higher | 2.328***   | [1.679, 3.228] | [1.592, 3.227] |
| **FP in newspaper (No)** |             |              |              |
| Yes            | 1.784***    | [1.360, 2.340] | [0.471, 2.484] |
| **FP in radio (No)** |             |              |              |
| Yes            | 1.750***    | [1.370, 2.235] | [0.746, 3.169] |
| **FP in TV (No)** |             |              |              |
| Yes            | 1.364       | [0.779, 2.386] | [0.553, 2.948] |

Exponentiated coefficients; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
| Year (1996-97) | Overall | Urban | Rural |
|---------------|---------|-------|-------|
| 2002          | 1.024   | 1.024 | 1.115 |
|               | [0.923,1.136] | [0.813,1.291] | [0.985,1.261] |
| 2007          | 0.590*** | 0.327*** | 0.770*** |
|               | [0.534,0.652] | [0.272,0.394] | [0.683,0.868] |
| 2014          | 0.418*** | 0.234*** | 0.577*** |
|               | [0.381,0.458] | [0.198,0.276] | [0.514,0.647] |

| Age groups (15-19) | Overall | Urban | Rural |
|-------------------|---------|-------|-------|
| 20-24             | 1.055   | 1.058 | 1.081 |
|                   | [0.924,1.204] | [0.823,1.359] | [0.924,1.266] |
| 25-29             | 1.298*** | 1.235 | 1.375*** |
|                   | [1.122,1.502] | [0.947,1.611] | [1.150,1.645] |
| 30-34             | 1.432*** | 1.463** | 1.474*** |
|                   | [1.224,1.675] | [1.098,1.948] | [1.217,1.785] |
| 35-39             | 1.572*** | 1.656** | 1.603*** |
|                   | [1.331,1.856] | [1.216,2.255] | [1.312,1.959] |
| 40-44             | 1.677*** | 1.595** | 1.746*** |
|                   | [1.395,2.017] | [1.119,2.273] | [1.402,2.174] |
| 45-49             | 1.355*   | 1.285 | 1.417* |
|                   | [1.064,1.725] | [0.793,2.080] | [1.068,1.880] |

| Residency (Urban) | Overall | Urban | Rural |
|------------------|---------|-------|-------|
| Rural            | 1.013   | NA    | NA    |
|                  | [0.932,1.100] | [0.932,1.100] | [0.932,1.100] |

| Religion (Christian) | Overall | Urban | Rural |
|---------------------|---------|-------|-------|
| Other               | 0.646*** | 1.113 | 0.565*** |
|                     | [0.510,0.817] | [0.683,1.816] | [0.431,0.741] |

| Ethnicity (Bemba) | Overall | Urban | Rural |
|------------------|---------|-------|-------|
| Tonga            | 1.139*  | 1.014 | 1.041 |
|                  | [1.020,1.271] | [0.820,1.254] | [0.912,1.189] |
| Chewa            | 1.218** | 0.806 | 1.198* |
|                  | [1.067,1.389] | [0.630,1.030] | [1.019,1.407] |
| Other            | 1.028   | 0.935 | 1.097 |
|                  | [0.953,1.109] | [0.828,1.055] | [0.995,1.211] |

| Parity (1-2) | Overall | Urban | Rural |
|-------------|---------|-------|-------|
| >2          | 0.911*  | 0.948 | 0.866* |

* p<0.05; ** p<0.01; *** p<0.001
|                                | Q2       | Q3       | Q4       | Q5       |
|--------------------------------|----------|----------|----------|----------|
| **Sex of household head (Male)** |          |          |          |          |
| Female                         | 1.005    | 1.084    | 0.970    |          |
| **Education (No Education)**   |          |          |          |          |
| Primary                        | 1.210*** | 1.185    | 1.195*** |          |
| Secondary/higher              | 1.432*** | 1.424**  | 1.436*** |          |
| **Wealth quintile (Q1)**      |          |          |          |          |
| Q2                             | 0.979    | 0.864**  | 0.976    |          |
| Q3                             | 0.918    | 1.006    | 0.964    |          |
| Q4                             | 1.133    | 1.010    | 0.962    |          |
| Q5                             | 1.424*   | 1.124    | 1.045    |          |
| **Employment (None)**         |          |          |          |          |
| Professional/Sales            | 0.942    | 0.944    | 0.966    |          |
| Agric/Others                  | 1.099    | 1.224    | 1.015    |          |
| **Husband’s education (No Education)** |          |          |          |          |
| Primary                        | 1.133*   | 1.051    | 1.146*   |          |
| Secondary/higher              | 1.330*** | 1.253    | 1.308*** |          |
| **FP in newspaper (No)**      |          |          |          |          |
| Yes                            | 1.329*** | 1.400*** | 1.078    |          |
| **FP in radio (No)**          |          |          |          |          |
| Yes                            | 1.153*** | 1.125    | 1.137**  |          |
| **FP in TV (No)**             |          |          |          |          |
| Yes                            | 1.157*   | 1.112    | 1.155    |          |
| **Pseudo R^2**                 | 0.338    | 0.286    | 0.221    |          |
Exponentiated coefficients; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

| Place of Delivery | Overall | Urban | Rural |
|-------------------|---------|-------|-------|
| **Year (1996-97)** |         |       |       |
| 2002               | 1.033   | 1.160 | 1.060 |
|                    | [0.929,1.148] | [0.931,1.446] | [0.929,1.210] |
| 2007               | 1.432***| 1.428***| 1.465***|
|                    | [1.288,1.592] | [1.164,1.752] | [1.288,1.665] |
| 2014               | 3.932***| 2.645***| 4.634***|
|                    | [3.552,4.353] | [2.201,3.177] | [4.093,5.247] |
| **Age groups (15-19)** |         |       |       |
| 20-24              | 0.910   | 1.015 | 0.884 |
|                    | [0.786,1.055] | [0.750,1.372] | [0.747,1.047] |
| 25-29              | 1.096   | 1.243 | 1.059 |
|                    | [0.929,1.292] | [0.894,1.730] | [0.874,1.282] |
| 30-34              | 1.057   | 1.323 | 0.993 |
|                    | [0.886,1.260] | [0.928,1.887] | [0.809,1.218] |
| 35-39              | 1.081   | 1.231 | 1.051 |
|                    | [0.898,1.300] | [0.845,1.793] | [0.849,1.301] |
| 40-44              | 1.012   | 0.906 | 1.045 |
|                    | [0.827,1.238] | [0.601,1.367] | [0.829,1.317] |
| 45-49              | 0.847   | 0.640 | 0.942 |
|                    | [0.647,1.107] | [0.376,1.088] | [0.694,1.280] |
| **Residency (Urban)** |         |       |       |
| Rural              | 0.300***| NA    | NA    |
|                    | [0.274,0.329] |       |       |
| **Religion (Christian)** |         |       |       |
| Other              | 0.815   | 2.016 | 0.679*|
|                    | [0.620,1.073] | [0.958,4.245] | [0.492,0.935] |
| **Ethnicity (Bemba)** |         |       |       |
| Tonga              | 0.693***| 0.899 | 0.645***|
|                    | [0.614,0.782] | [0.692,1.167] | [0.560,0.743] |
| Chewa              | 1.998***| 2.105***| 1.986***|

Table 5: Predictors of using health facility delivery services in Zambia. (n=22,591) ZDHS 1997-2014
Other & 1.194*** & 1.163* & 1.200*** \\
& [1.097,1.301] & [1.000,1.351] & [1.081,1.331] \\

**Parity (1-2)**

>2 & 0.698*** & 0.767** & 0.671*** \\
& [0.629,0.774] & [0.631,0.933] & [0.593,0.758] \\

**Sex of household head (Male)**

Female & 1.013 & 0.897 & 1.071 \\
& [0.926,1.107] & [0.752,1.071] & [0.966,1.188] \\

**Education (No Education)**

Primary & 1.546*** & 1.378* & 1.570*** \\
& [1.397,1.711] & [1.075,1.167] & [1.405,1.756] \\

Secondary/higher & 2.946*** & 2.654*** & 2.998*** \\
& [2.583,3.359] & [2.008,3.507] & [2.569,3.498] \\

**Wealth quintile (Q1)**

Q2 & 1.009 & 1.112 & 1.028 \\
& [0.921,1.106] & [0.813,1.520] & [0.932,1.134] \\

Q3 & 1.048 & 1.049 & 1.145* \\
& [0.953,1.153] & [0.787,1.399] & [1.031,1.273] \\

Q4 & 1.262*** & 1.272 & 1.398*** \\
& [1.126,1.416] & [0.955,1.692] & [1.208,1.618] \\

Q5 & 1.640*** & 1.932*** & 1.293* \\
& [1.414,1.903] & [1.425,2.618] & [1.027,1.626] \\

**Employment (None)**

Professional/Sales & 0.872 & 0.819** & 0.905* \\
& [0.675,1.128] & [0.707,0.947] & [0.827,0.991] \\

Agric/Others & 1.000 & 0.863*** & 0.990 \\
& [0.900,1.109] & [0.800,0.931] & [0.881,1.111] \\

**Husband’s education (No Education)**

Primary & 1.040 & 1.661** & 0.964 \\
& [0.910,1.188] & [1.153,2.394] & [0.837,1.111] \\

Secondary/higher & 1.604*** & 2.759*** & 1.418*** \\
& [1.394,1.846] & [1.918,3.969] & [1.217,1.652] \\

**FP in newspaper (No)**

Yes & 1.376*** & 1.529** & 1.195 \\
& [1.162,1.629] & [1.184,1.975] & [0.941,1.517] \\

**FP in radio (No)**
|                                   | Overall          | Urban           | Rural           |
|-----------------------------------|------------------|-----------------|-----------------|
| **Year (1996-97)**                |                  |                 |                 |
| 2002                              |                  |                 |                 |
| 2007                              | 0.433***         | 0.0788***       | 0.681***        |
|                                   | [0.384,0.489]    | [0.0588,0.106]  | [0.593,0.783]   |
| 2014                              | 3.670***         | 2.015***        | 4.206***        |
|                                   | [3.341,4.030]    | [1.633,2.486]   | [3.742,4.726]   |
| **Age groups (15-19)**            |                  |                 |                 |
| 20-24                             | 1.085            | 1.159           | 1.068           |
|                                   | [0.915,1.288]    | [0.810,1.659]   | [0.877,1.301]   |
| 25-29                             | 1.139            | 1.131           | 1.143           |
|                                   | [0.943,1.374]    | [0.775,1.651]   | [0.916,1.425]   |
| 30-34                             | 1.187            | 1.153           | 1.192           |
|                                   | [0.970,1.453]    | [0.765,1.740]   | [0.941,1.509]   |
| 35-39                             | 1.187            | 1.333           | 1.154           |
|                                   | [0.961,1.467]    | [0.855,2.078]   | [0.903,1.475]   |
| 40-44                             | 1.164            | 1.058           | 1.193           |
|                                   | [0.926,1.464]    | [0.643,1.741]   | [0.917,1.551]   |
| 45-49                             | 0.951            | 0.651           | 1.024           |

Exponentiated coefficients; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
|                        | Q1                | Q2                | Q3                | Q4                | Q5                |
|------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| **Residency (Urban)**  |                   |                   |                   |                   |                   |
| Rural                  | 0.482***          | NA                | NA                |                   |                   |
|                        | [0.435,0.533]     |                   |                   |                   |                   |
| **Religion (Christian)**|                   |                   |                   |                   |                   |
| Other                  | 0.708*            | 1.199             | 0.625*            |                   |                   |
|                        | [0.517,0.970]     | [0.549,2.619]     | [0.436,0.897]     |                   |                   |
| **Ethnicity (Bemba)**  |                   |                   |                   |                   |                   |
| Tonga                  | 0.801**           | 0.705*            | 0.839*            |                   |                   |
|                        | [0.699,0.917]     | [0.529,0.940]     | [0.716,0.983]     |                   |                   |
| Chewa                  | 2.090***          | 1.911**           | 2.305***          |                   |                   |
|                        | [1.747,2.501]     | [1.255,2.911]     | [1.878,2.829]     |                   |                   |
| Other                  | 1.197***          | 0.965             | 1.312***          |                   |                   |
|                        | [1.087,1.317]     | [0.808,1.151]     | [1.166,1.476]     |                   |                   |
| **Parity (1-2)**       |                   |                   |                   |                   |                   |
| >2                     | 0.856**           | 1.021             | 0.804**           |                   |                   |
|                        | [0.762,0.963]     | [0.820,1.271]     | [0.698,0.927]     |                   |                   |
| **Sex of household head (Male)** |           |                   |                   |                   |                   |
| Female                 | 0.932             | 0.840             | 0.978             |                   |                   |
|                        | [0.842,1.032]     | [0.684,1.033]     | [0.868,1.101]     |                   |                   |
| **Education (No Education)** |              |                   |                   |                   |                   |
| Primary                | 1.460***          | 1.262             | 1.479***          |                   |                   |
|                        | [1.299,1.639]     | [0.919,1.732]     | [1.305,1.677]     |                   |                   |
| Secondary/higher       | 1.986***          | 1.755**           | 1.999***          |                   |                   |
|                        | [1.715,2.301]     | [1.249,2.467]     | [1.683,2.375]     |                   |                   |
| **Wealth quintile (Q1)**|                  |                   |                   |                   |                   |
| Q2                     | 1.204***          | 1.371             | 1.210***          |                   |                   |
|                        | [1.083,1.338]     | [0.986,1.907]     | [1.083,1.353]     |                   |                   |
| Q3                     | 1.154*            | 1.460*            | 1.213**           |                   |                   |
|                        | [1.033,1.289]     | [1.076,1.981]     | [1.072,1.372]     |                   |                   |
| Q4                     | 1.071             | 1.912***          | 1.152             |                   |                   |
|                        | [0.943,1.217]     | [1.402,2.607]     | [0.981,1.354]     |                   |                   |
| Q5                     | 1.228*            | 2.407***          | 1.171             |                   |                   |
|                        | [1.048,1.439]     | [1.728,3.352]     | [0.928,1.478]     |                   |                   |
| **Employment (None)**  |                   |                   |                   |                   |                   |

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* indicates significance at the 0.05 level, ** at the 0.01 level, and *** at the 0.001 level.
| Category               | Coefficient 1 | Coefficient 2 | Coefficient 3 |
|------------------------|--------------|--------------|--------------|
| Professional/Sales     | 1.031        | 1.013        | 1.052        |
|                        | [0.944,1.127] | [0.854,1.203] | [0.945,1.172] |
| Agric/Others           | 0.920        | 0.902        | 0.919        |
|                        | [0.825,1.025] | [0.692,1.175] | [0.814,1.037] |
| Husband’s education (No Education) |             |              |              |
| Primary                | 1.032        | 1.313        | 1.005        |
|                        | [0.885,1.203] | [0.835,2.065] | [0.854,1.182] |
| Secondary/higher       | 1.259**      | 1.582*       | 1.191        |
|                        | [1.071,1.481] | [1.013,2.471] | [0.999,1.420] |
| FP in newspaper (No)   |              |              |              |
| Yes                    | 1.238*       | 1.203        | 1.235        |
|                        | [1.011,1.515] | [0.903,1.603] | [0.909,1.679] |
| FP in radio (No)       |              |              |              |
| Yes                    | 1.342***     | 1.181        | 1.374***     |
|                        | [1.225,1.470] | [0.980,1.422] | [1.236,1.528] |
| FP in TV (No)          |              |              |              |
| Yes                    | 1.579***     | 1.451**      | 1.477**      |
|                        | [1.350,1.848] | [1.158,1.817] | [1.153,1.894] |
| ANC visits (<4)        |              |              |              |
| 4+                     | 1.378***     | 1.422***     | 1.337***     |
|                        | [1.262,1.504] | [1.193,1.695] | [1.206,1.482] |
| Pseudo R²              | 0.288        | 0.210        | 0.128        |

Exponentiated coefficients; 95% confidence intervals in brackets

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figures
Figure 1

Maternal healthcare utilisation by type Figure 1 shows that prevalence of women making the first ANC visit within the first trimester has increased from 11.8% in 1996-97 to 23.9% to 2013-14, whereas that of making at least four ANC visit has decreased from 72.3 to 55.3% in 2013-14. The prevalence of health facility delivery (44.2% in 1996-97 vs 73.4% in 2013-14) and postnatal care (43.8% in 2002 Vs 73% in 2013-14) has also increased substantially during the same period.
Maternal healthcare utilization by age groups Figure 2 shows the prevalence of maternal healthcare services across age groups. The prevalence of timely ANC visit, health facility delivery, and postnatal care were higher among those aged between 20 and 34 years than the adolescent and those aged above 34 years.
Maternal healthcare utilisation by educational level

Figure 3 shows the prevalence of maternal healthcare services according to educational level. The prevalence of timely ANC visit, health facility delivery, and postnatal care were higher among those aged between 20 and 34 years than the adolescent and those aged above 34 years. Women who had no education had the lowest prevalence of making timely and adequate ANC visits, facility delivery and postnatal care, while those had primary level education had the highest prevalence of using these services.
Maternal healthcare utilisation by household wealth quintile

Figure 4 shows the prevalence of maternal healthcare services according to household wealth status. Women in the higher wealth quintiles (Q4 and Q5) generally had higher prevalence of using health facility delivery and postnatal care services compared with those in the lower wealth quintiles (Q1 and Q2), whereas the prevalence of timely and adequate ANC visit was comparatively higher among those in the lower wealth quintiles.

Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.
Appendix.docx