Mixed effects analysis of factors associated with health insurance coverage among women in sub-Saharan Africa

Hubert Amu1*, Abdul-Aziz Seidu2,3*, Ebenezer Agbaglo4‡, Robert Kokou Dowou5‡, Edward Kwabena Ameyaw6‡, Bright Opoku Ahinkorah6‡, Kwaku Kissah-Korsah2‡

1 Department of Population and Behavioural Sciences, School of Public Health, University of Health and Allied Sciences, Hohoe, Ghana, 2 Department of Population and Health, University of Cape Coast, Cape Coast, Ghana, 3 College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, Queensland, Australia, 4 Department of English, University of Cape Coast, Cape Coast, Ghana, 5 Department of Epidemiology and Biostatistics, School of Public Health, University of Health and Allied Sciences, Hohoe, Ghana, 6 School of Public Health, Faculty of Health, University of Technology Sydney, Sydney, Australia

* These authors contributed equally to this work.
‡ These authors also contributed equally to this work.
* hamu@uhas.edu.gh

Abstract

Introduction

In the pursuit of achieving the Sustainable Development Goal targets of universal health coverage and reducing maternal mortality, many countries in sub-Saharan Africa have implemented health insurance policies over the last two decades. Given that there is a paucity of empirical literature at the sub-regional level, we examined the prevalence and factors associated with health insurance coverage among women in sub-Saharan Africa.

Materials and methods

We analysed cross-sectional data of 307,611 reproductive-aged women from the most recent demographic and health surveys of 24 sub-Saharan African countries. Bivariable and multivariable analyses were performed using chi-square test of independence and multilevel logistic regression respectively. Results are presented as adjusted Odds Ratios (aOR) for the multilevel logistic regression analysis. Statistical significance was set at p<0.05.

Results

The overall coverage of health insurance was 8.5%, with cross-country variations. The lowest coverage was recorded in Chad (0.9%) and the highest in Ghana (62.4%). Individual-level factors significantly associated with health insurance coverage included age, place of residence, level of formal education, frequency of reading newspaper/magazine and watching television. Wealth status and place of residence were the contextual factors significantly associated with health insurance coverage. Women with no formal education were 78% less likely to be covered by health insurance (aOR = 0.22, 95% CI = 0.21–0.24), compared...
with those who had higher education. Urban women, however, had higher odds of being covered by health insurance, compared with those in the rural areas [aOR = 1.20, 95%CI = 1.15–1.25].

**Conclusion**

We found an overall relatively low prevalence of health insurance coverage among women of reproductive age in sub-Saharan Africa. As sub-Saharan African countries work toward achieving the Sustainable Development Goal targets of universal health coverage and lowering maternal mortality to less than 70 deaths per 100,000 live births, it is important that countries with low coverage of health insurance among women of reproductive age integrate measures such as free maternal healthcare into their respective development plans. Interventions aimed at expanding health insurance coverage should be directed at younger women of reproductive age, rural women, and women who do not read newspapers/magazines or watch television.

**Introduction**

Achievement of universal health coverage (UHC) and reduction of maternal mortality are major targets of the Sustainable Development Goal (SDG) Three, which seeks to promote health for all at all ages by the year 2030 [1]. Reduction of maternal mortality is also a proxy for assessing improvement in maternal health in the scope of the SDGs. Health insurance is a key driver of UHC, as it serves as a financial risk protection mechanism which provides affordable health coverage for the indigenes in low- and middle-income countries (LMICs) [2, 3]. Protecting women from the financial predicament of out-of-pocket payments for healthcare through health insurance coverage ensures that they have access to the appropriate orthodox healthcare especially during pregnancy and childbirth which are responsible for a significant proportion of the mortality occurring among them in LMICs [4].

In the pursuit of achieving the SDG target of UHC, many countries in sub-Saharan Africa (SSA) have implemented health insurance policies over the last two decades [4]. Many of the schemes currently cover public servants at both central and local government levels together with their family members while others cover the entire population [5–14]. The health insurance schemes in SSA have been introduced to largely replace the existing health financing systems which are dominated by out-of-pocket payments. Health insurance has, thus improved access to quality healthcare services and provided financial risk protection for the populace with special focus on the vulnerable including women of reproductive age [15–18].

While there is a paucity of the empirical literature on the factors influencing health insurance coverage at the sub-regional level, studies conducted at individual country levels and among up to five sub-Saharan African countries (Ghana, Kenya, Nigeria, Tanzania, & Uganda) have shown that socio-demographic factors such as occupation, wealth status, residence, level of education, and age significantly influence coverage of health insurance [19–24]. To provide empirical literature and bridge the existing knowledge gap for the generality of SSA, we analysed the prevalence and predictors of health insurance coverage from 24 in sub-Saharan African countries, using nationality representative demographic and health survey (DHS) data. We adopted multilevel logistic regression to achieve a robust mixed effects analysis of the individual and contextual factors influencing the coverage of health insurance in SSA. Our
findings could inform policymakers of the factors to consider when planning and implementing health insurance-related interventions geared towards achieving UHC and reducing maternal mortality.

**Materials and methods**

**Data source**

Data for this study were obtained from Demographic and Health Surveys (DHS) conducted between January 1, 2010, and December 31, 2019, in 24 sub-Saharan African countries (see Table 1). Specifically, the women’s files of the DHS were used. The choice of the 24 countries was influenced by the availability of the variables of interest in their datasets. DHS is a nationwide survey undertaken across LMICs every five years [25]. The survey is representative of each of these countries and targets core maternal and child health indicators such as health insurance coverage. In selecting the sample for each survey in the various countries, a multi-stage sampling approach was employed. The first step of this sampling approach involved the selection of clusters (i.e., enumeration areas [EAs]), followed by systematic household sampling within the selected EAs. In this study, the sample size consisted of women aged 15–49 who had complete cases on all the variables of interest (N = 307,611). We followed the ‘Strengthening the Reporting of Observational Studies in Epidemiology’ (STROBE) statement.

Table 1. Description of the sample size.

| Country       | Year               | Weighted Sample | Weighted Percentage |
|---------------|--------------------|-----------------|---------------------|
| 1. Benin      | 2017–2018          | 15,410          | 5.0                 |
| 2. Burundi    | 2016–2017          | 16,783          | 5.5                 |
| 3. Congo DR   | 2013–2014          | 18,667          | 6.1                 |
| 4. Ethiopia   | 2016               | 15,299          | 5.0                 |
| 5. Gabon      | 2012               | 8,213           | 2.7                 |
| 6. Ghana      | 2014               | 9,365           | 3.0                 |
| 7. Gambia     | 2013               | 10,051          | 3.3                 |
| 8. Guinea     | 2018               | 10,553          | 3.4                 |
| 9. Kenya      | 2014               | 14,501          | 4.7                 |
| 10. Liberia   | 2013               | 9,013           | 2.9                 |
| 11. Lesotho   | 2014               | 2,849           | 0.9                 |
| 12. Mali      | 2018               | 10,410          | 3.4                 |
| 13. Malawi    | 2015–2016          | 24,540          | 8.0                 |
| 14. Nigeria   | 2018               | 28,582          | 9.3                 |
| 15. Niger     | 2012               | 11,023          | 3.6                 |
| 16. Namibia   | 2013               | 9,100           | 3.0                 |
| 17. Sierra Leone | 2013        | 16,350          | 5.3                 |
| 18. Chad      | 2014–2015          | 5,940           | 1.9                 |
| 19. Togo      | 2013–2014          | 9,381           | 3.1                 |
| 20. Tanzania  | 2015–2016          | 13,253          | 4.3                 |
| 21. Uganda    | 2016               | 18,458          | 6.0                 |
| 22. South Africa | 2016        | 4,049           | 1.3                 |
| 23. Zambia    | 2018               | 16,014          | 5.2                 |
| 24. Zimbabwe  | 2015               | 9,809           | 3.2                 |
| All Countries |                    | 307,611         | 100                 |

*DR = Democratic Republic

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in conducting this study and writing the manuscript (see S1) [26]. The data underlying the results presented in the study are available from https://dhsprogram.com/data/available-datasets.cfm.

**Study variables**

The outcome variable in this study was health insurance coverage. This was derived from the question ‘Are you covered by any health insurance?’ It was coded 1 = “Yes” and 0 = “No” [19, 27]. Both individual and contextual (household and community level factors) level factors were considered as explanatory variables in this study. The individual-level factors were age, marital status, educational level, employment, parity, and exposure to the mass media (radio, newspaper and television). The contextual variables were sex of household head, household wealth quintile, place of residence and sub-region (see Table 2). In the DHS, wealth was computed using data on household ownership of selected assets such as bicycle, materials used for house construction, television, type of water access and sanitation facilities were used. Wealth quintile was then created from these assets through Principal Component Analysis (PCA) by placing households on a continuous measure of relative wealth after which households were grouped into five wealth quintiles namely poorest, poorer, middle, richer and richest [25]. The sub-region variable was derived by aggregating countries based on their geographical location on the African continent (thus Western, Southern, Eastern, and Central). Our choice of the explanatory variables were influenced by their inclusion in the DHS datasets and previous literature which found these variables to be associated with health insurance coverage [5, 19–24, 27].

**Statistical analyses**

The data were analysed with Stata version 14.2 for macOS (Stata Corporation, College Station, TX, USA). Three steps were followed to analyse the data. The first step was the use of descriptive statistics to describe the sample and cross-tabulation of all the explanatory variables against health insurance coverage. The second step was a bivariable analysis to select potential variables for the regression analysis. Variables that were statistically significant at the bivariable analysis stage at \( p < 0.05 \) were moved to the final step, where two levels of multilevel logistic regression models were built to assess the individual and contextual factors associated with health insurance coverage.

Clusters were considered as random effects to account for the unexplained variability at the contextual level [28]. We fitted four models (see Table 3). The first model was the empty model (Model I), which showed the variation in health insurance coverage attributed to the distribution of the primary sampling units (PSUs) in the absence of the explanatory variables. Model II had only the individual level factors and health insurance coverage. The purpose of Model II was to look at how the individual level factors are associated with health insurance coverage in the absence of the contextual factors. Model III was developed to look at the association between the contextual level factors and health insurance coverage, in the absence of the individual level factors. The final model (Model IV) was the complete model that had the individual and contextual level factors and health insurance. The purpose was to look at the association between both the individual and contextual level factors and health insurance coverage. For all the models, adjusted Odds Ratios (aOR) and their associated 95% confidence intervals were presented. These models were fitted by the Stata MLwinN software version 3.05 [29].

Using the variance inflation factor (VIF), the multicollinearity test showed that there was no evidence of collinearity among the explanatory variables (Mean VIF = 1.54, Maximum VIF = 2.09 and Minimum VIF = 1.09). The choice of reference categories were informed by...
Table 2. Socio-demographic characteristics and health insurance coverage among women in sub-Saharan Africa.

| Variables                | Weighted (N = 307,611) | Health insurance coverage | P-values |
|--------------------------|-------------------------|---------------------------|----------|
|                          | n                       | %                         | No (%)   | Yes (%) | p            |
| **Individual-level factors** |                         |                           |          |         | p < 0.001    |
| Age                      |                         |                           |          |         | p < 0.001    |
| 15–19                    | 61,599                  | 20.0                      | 93.3     | 6.9     |              |
| 20–24                    | 55,777                  | 18.1                      | 93.3     | 6.7     |              |
| 25–29                    | 54,677                  | 17.8                      | 91.7     | 8.3     |              |
| 30–34                    | 45,511                  | 14.8                      | 90.2     | 9.8     |              |
| 35–39                    | 38,719                  | 12.6                      | 89.6     | 10.4    |              |
| 40–44                    | 28,223                  | 9.2                       | 88.8     | 11.3    |              |
| 45–49                    | 23,106                  | 7.5                       | 89.1     | 10.9    |              |
| Marital status           |                         |                           |          |         | p < 0.001    |
| Never married            | 80,822                  | 26.3                      | 90.8     | 9.2     |              |
| Married                  | 168,425                 | 54.8                      | 92.1     | 7.9     |              |
| Cohabiting               | 30,783                  | 10.0                      | 87.8     | 12.2    |              |
| Widowed                  | 8,444                   | 2.8                       | 91.9     | 8.1     |              |
| Divorced                 | 19,136                  | 6.2                       | 92.5     | 7.6     |              |
| Educational level        |                         |                           |          |         | p < 0.001    |
| No education             | 92,888                  | 30.2                      | 96.1     | 3.9     |              |
| Primary                  | 99,495                  | 32.3                      | 93.6     | 6.4     |              |
| Secondary                | 98,832                  | 32.1                      | 87.3     | 12.7    |              |
| Higher                   | 16,396                  | 5.3                       | 71.9     | 28.1    |              |
| Employment               |                         |                           |          |         | p < 0.001    |
| Not working              | 100,209                 | 32.6                      | 92.5     | 7.5     |              |
| Managerial               | 14,048                  | 4.6                       | 70.6     | 29.4    |              |
| Sales                    | 56,511                  | 18.4                      | 92.0     | 8.0     |              |
| House/domestic           | 6,601                   | 2.2                       | 89.9     | 10.1    |              |
| Agricultural             | 78,344                  | 25.5                      | 92.7     | 7.3     |              |
| Services                 | 22,872                  | 7.4                       | 92.7     | 7.3     |              |
| Manual                   | 26,036                  | 8.5                       | 93.6     | 6.5     |              |
| Clerical                 | 2,989                   | 1.0                       | 72.4     | 27.6    |              |
| Parity                   |                         |                           |          |         | p < 0.001    |
| 1–3 children             | 120,208                 | 39.1                      | 90.3     | 9.7     |              |
| 4+                       | 108,687                 | 35.3                      | 92.5     | 7.5     |              |
| None                     | 78,716                  | 25.6                      | 91.5     | 8.7     |              |
| Frequency of listening to radio |             |                           |          |         | p < 0.001    |
| Not at all               | 119,195                 | 38.8                      | 94.2     | 5.8     |              |
| Less than once a week    | 65,306                  | 21.2                      | 90.9     | 9.1     |              |
| At least once a week     | 113,563                 | 36.9                      | 88.9     | 11.2    |              |
| Almost every day         | 9,548                   | 3.1                       | 87.0     | 12.9    |              |
| Frequency of reading newspaper or magazine | |                           |          |         | p < 0.001    |
| Not at all               | 238,357                 | 77.5                      | 93.3     | 6.7     |              |
| Less than once a week    | 37,626                  | 12.2                      | 87.1     | 12.9    |              |
| At least once a week     | 29,126                  | 9.5                       | 80.6     | 19.4    |              |
| Almost every day         | 2,503                   | 0.8                       | 74.9     | 25.1    |              |
| Frequency of watching television | |                           |          |         | p < 0.001    |
| Not at all               | 180,039                 | 58.5                      | 95.3     | 4.7     |              |
| Less than once a week    | 41,284                  | 13.4                      | 90.6     | 9.4     |              |

(Continued)
the categories with lower likelihood of using NHIS. For example, in the case of age, those aged 15–19 were chosen as reference category. Where this could not be determined per literature, the category with the greatest number of observations was taken as a reference category. According to Hatt and Waters [30], pooling data can reveal broader results that are "often obscured by the noise of individual data sets." To calculate the pooled values an additional adjustment is needed to account for the variability in the number of individuals sampled in each country. This is accomplished using the weighting factor $1/(A \cdot n_c/n_t)$, where $A$ is the number of countries asked a particular question, $n_c$ is the number of respondents for the country $c$, and $n_t$ is the total number of respondents over all countries asked the question [31].

### Ethical clearance

The DHS receive ethical clearance from the Ethics Review Committee of ORC Macro Inc. and the Ethics Review Committees of partner organizations in the various countries where the surveys are conducted.

### Results

**Prevalence of health insurance coverage**

The prevalence of health insurance coverage among women in SSA is presented in Fig 1. The study showed that 8.5% of women in SSA are covered by health insurance, ranging from 0.9% in Chad to 62.4% in Ghana.

Table 2 presents the results on the socio-demographic characteristics and health insurance coverage among women in SSA. Twenty per cent of the women were aged 15–19, 54.8% were married, 32.3% had primary level of formal education, 32.6% were not working and 39.1% had parity 1–3. With mass media exposure, it was found that 38.8%, 77.5% and 58.5% had not listened to radio, not read a newspaper or magazine and did not watch television at all respectively. The study further revealed that 91.9% were in male-headed households. About 6 out of every 10 women lived in rural areas. About 24% of the women were in the richest wealth

| Variables                      | Weighted (N = 307,611) | Health insurance coverage | P-values |
|--------------------------------|------------------------|----------------------------|----------|
|                                | n  | %  | No (%) | Yes (%) |                      |
| At least once a week            | 72,048 | 23.4 | 84.6 | 15.4 |                      |
| Almost every day                | 14,240 | 4.6  | 72.8 | 27.2 |                      |
| **Contextual factors**          |          |      |        |        |                      |
| Sex of household head          |          |      |        |        |                      |
| Male                           | 221,333 | 72.0 | 91.9 | 8.1  |                      |
| Female                         | 86,278  | 28.1 | 90.1 | 9.9  |                      |
| Wealth quintile                |          |      |        |        |                      |
| Richest                        | 74,021  | 24.1 | 85.1 | 15.0 |                      |
| Richer                         | 64,330  | 20.9 | 91.9 | 8.1  |                      |
| Middle                         | 59,132  | 19.2 | 93.7 | 6.3  |                      |
| Poorer                         | 56,717  | 18.4 | 94.4 | 5.6  |                      |
| Poorest                        | 53,412  | 17.4 | 92.9 | 7.1  |                      |
| Place of residence             |          |      |        |        |                      |
| Urban                          | 116,585 | 37.9 | 86.9 | 13.1 |                      |
| Rural                          | 191,026 | 62.1 | 94.0 | 6.0  |                      |

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| Variables                           | Model I                      | Model II AOR [95%CI] | Model III AOR [95%CI] | Model IV AOR [95%CI] |
|------------------------------------|------------------------------|----------------------|-----------------------|----------------------|
| **Fixed effects**                  |                              |                      |                       |                      |
| **Individual-level factors**       |                              |                      |                       |                      |
| **Age**                            |                              |                      |                       |                      |
| 15–19                              | 0.37*** [0.34, 0.40]         |                      | 0.36*** [0.33, 0.38]  |                      |
| 20–24                              | 0.34*** [0.32, 0.36]         |                      | 0.33*** [0.31, 0.35]  |                      |
| 25–29                              | 0.48*** [0.45, 0.51]         |                      | 0.47*** [0.44, 0.50]  |                      |
| 30–34                              | 0.66*** [0.62, 0.70]         |                      | 0.66*** [0.62, 0.70]  |                      |
| 35–39                              | 0.80*** [0.75, 0.85]         |                      | 0.79*** [0.75, 0.84]  |                      |
| 40–44                              | 0.94 [0.88, 0.99]            |                      | 0.94 [0.88, 0.99]     |                      |
| 45–49                              | Ref                          |                      | Ref                   |                      |
| **Marital status**                 |                              |                      |                       |                      |
| Never married                      | Ref                          |                      | Ref                   |                      |
| Married                            | 0.94*** [0.89, 0.98]         |                      | 0.94*** [0.89, 0.98]  |                      |
| Cohabiting                         | 1.37*** [1.30, 1.45]         |                      | 1.22*** [1.15, 1.30]  |                      |
| Divorced                           | 0.73*** [0.67, 0.81]         |                      | 0.69*** [0.63, 0.76]  |                      |
| Widowed                            | 0.70*** [0.65, 0.75]         |                      | 0.65*** [0.60, 0.69]  |                      |
| **Educational level**              |                              |                      |                       |                      |
| No education                       | 0.24*** [0.22, 0.26]         |                      | 0.22*** [0.21, 0.24]  |                      |
| Primary                            | 0.40*** [0.37, 0.43]         |                      | 0.39*** [0.36, 0.41]  |                      |
| Secondary                          | 0.69*** [0.65, 0.73]         |                      | 0.68*** [0.65, 0.72]  |                      |
| Higher                             | Ref                          |                      | Ref                   |                      |
| **Employment**                     |                              |                      |                       |                      |
| Not working                        | Ref                          |                      | Ref                   |                      |
| Managerial                         | 2.22*** [2.10, 2.34]         |                      | 2.12*** [2.00, 2.24]  |                      |
| Sales                              | 2.03*** [1.84, 2.23]         |                      | 2.07*** [1.87, 2.28]  |                      |
| House/domestic                     | 0.95*** [0.91, 0.99]         |                      | 0.91*** [0.87, 0.96]  |                      |
| Agricultural                       | 1.14*** [1.04, 1.25]         |                      | 1.06 [0.96, 1.17]     |                      |
| Services                           | 1.67*** [1.61, 1.74]         |                      | 1.67*** [1.60, 1.75]  |                      |
| Manual                             | 0.82*** [0.77, 0.87]         |                      | 0.77*** [0.72, 0.81]  |                      |
| Clerical                           | 0.88*** [0.83, 0.94]         |                      | 0.85*** [0.82, 0.98]  |                      |
| **Parity**                         |                              |                      |                       |                      |
| 1–3                                | 1.01 [0.96, 1.05]            |                      | 1.04 [0.98, 1.09]     |                      |
| 4 and above                        | 0.84*** [0.80, 0.88]         |                      | 0.82*** [0.78, 0.87]  |                      |
| None                               | Ref                          |                      | Ref                   |                      |
| **Frequency of listening to radio**|                              |                      |                       |                      |
| Not at all                         | 0.84*** [0.81, 0.87]         |                      | 0.81*** [0.77, 0.84]  |                      |
| Less than once a week              | 1.01 [0.97, 1.05]            |                      | 0.99 [0.95, 1.03]     |                      |
| At least once a week               | Ref                          |                      | Ref                   |                      |
| Almost every day                   | 0.52*** [0.48, 0.57]         |                      | 0.73*** [0.66, 0.80]  |                      |
| **Frequency of reading newspaper or magazine**|                              |                      |                       |                      |
| Not at all                         | 0.83*** [0.80, 0.87]         |                      | 0.80*** [0.76, 0.84]  |                      |
| Less than once a week              | 0.82*** [0.78, 0.86]         |                      | 0.84*** [0.81, 0.86]  |                      |
| At least once a week               | Ref                          |                      | Ref                   |                      |
| Almost every day                   | 0.98 [0.86, 1.10]            |                      | 1.12 [0.99, 1.28]     |                      |
| **Frequency of watching television**|                              |                      |                       |                      |
| Not at all                         | 0.42*** [0.40, 0.43]         |                      | 0.41*** [0.40, 0.43]  |                      |
| Less than once a week              | 0.71*** [0.68, 0.73]         |                      | 0.71*** [0.62, 0.80]  |                      |

(Continued)
The chi-square analysis showed that all the explanatory variables demonstrated statistically significant associations with health insurance coverage among women in SSA. Multilevel logistic regression of the factors associated with health insurance coverage among women in sub-Saharan Africa

Table 3 shows the multilevel logistic regression results of individual and contextual factors associated with health insurance coverage among women in SSA. Compared to those aged 45–49, women in the various age groups had lower odds of being covered by health insurance. The study showed that cohabiting women [aOR = 1.22, 95% CI = 1.15–1.30] were more likely to be covered by health insurance compared with women who had never married. Compared with

| Variables                  | Model I          | Model II AOR [95%CI]      | Model III AOR [95%CI]   | Model IV AOR [95%CI]   |
|----------------------------|------------------|---------------------------|-------------------------|-------------------------|
| At least once a week       | Ref              |                           |                         |                         |
| Almost every day           | 2.56***[2.41, 2.72] |                           |                         | 3.00***[2.81,3.21]      |
| **Sex of household head** |                  |                           |                         |                         |
| Male                       | 0.84***[0.81,0.86] | 0.92***[0.88,0.98]        |                         |                         |
| Female                     | Ref              | Ref                       |                         |                         |
| **Wealth status**          |                  |                           |                         |                         |
| Richest                    | 0.64***[0.61,0.68] | 1.61***[1.51,1.71]        |                         |                         |
| Richer                     | 0.50***[0.47,0.52] | 0.99 [0.94,1.06]          |                         |                         |
| Middle                     | 0.54***[0.52,0.57] | 1.00 [0.95,1.06]          |                         |                         |
| Poorer                     | 0.60***[0.57,0.62] | 0.92***[0.88,0.96]        |                         |                         |
| Poorest                    | Ref              | Ref                       |                         |                         |
| **Place of residence**     |                  |                           |                         |                         |
| Rural                      | Ref              | Ref                       |                         |                         |
| Urban                      | 1.73***[1.67,1.80] | 1.20***[1.15,1.25]        |                         |                         |
| **Sub-region**             |                  |                           |                         |                         |
| Southern                   | 0.66***[0.61,0.72] | 0.25***[0.23,0.27]        |                         |                         |
| Central                    | Ref              | Ref                       |                         |                         |
| Eastern                    | 1.74***[1.67,1.82] | 1.09***[1.04,1.14]        |                         |                         |
| Western                    | 1.27***[1.22,1.32] | 1.07***[1.03,1.12]        |                         |                         |
| **Random effects**         |                  |                           |                         |                         |
| **Contextual level**       |                  |                           |                         |                         |
| Variance (SE)              | 0.315[0.282–0.349] | 0.364[0.326–0.402]        | 0.317[0.283–0.350]      | 0.336[0.301–0.372]      |
| ICC (%)                    | 16.0[13.9–18.7]   | 19.2[17.0–25.8]           | 16.4[13.7–26.2]         | 16.0[13.4–17.4]         |
| MOR                        | 1.71[1.66–1.76]   | 1.78[1.72–1.83]           | 1.71[1.66–1.76]         | 1.74[1.69–1.79]         |
| N                          | 307,611           | 307,611                   | 307,611                 | 307,611                 |

Exponentiated coefficients; 95% confidence intervals in brackets
* p < 0.05
** p < 0.01
*** p < 0.001
SE = Standard Error; ICC = Intra-Class Correlation; LR Test = Likelihood ratio Test; MOR: Median Odds Ratio
Model I is the null model, a baseline model without any determinant variable
Model II = individual-level variables
Model III = contextual variables
Model IV is the final model adjusted for individual and contextual variables

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women who had higher education, those with no education \([aOR = 0.22, 95\% CI = 0.21–0.24]\) had the lowest odds of health insurance coverage.

With employment, compared with those who do not work, those in managerial roles \([aOR = 2.12, 95\% CI = 2.00–2.24]\) and those into sales \([aOR = 2.07, 95\% CI = 0.45–0.54]\) were more likely to be covered by health insurance. On the contrary, clerics \([aOR = 0.88, 95\% CI = 0.83–0.94]\) and women into manual occupation were less likely to be covered by health insurance. Women with parity 4 and above \([aOR = 0.82, 95\% CI = 0.78–0.87]\) were less likely to be covered by health insurance than women at parity zero. Women who did not listen to radio at all \([aOR = 0.81, 95\% CI = 0.77–0.84]\) and those who listened to radio almost everyday \([aOR = 0.73, 95\% CI = 0.66–0.80]\) had lower odds of health insurance coverage compared with those who listened to radio at least once a week. Regarding the frequency of reading newspaper or magazine, those who did not read newspaper or magazine at all \([aOR = 0.80, 95\% CI = 0.76–0.84]\) and those who read less than once a week \([aOR = 0.84, 95\% CI = 0.81–0.86]\) had lower odds of health insurance coverage compared with those who read at least once a week.
Those who did not watch television at all [aOR = 0.41, 95% CI = 0.40–0.43] had the lowest odds of health insurance coverage compared with those who watched at least once a week. Women in male-headed households [aOR = 0.92, 95% CI = 0.88–0.98] were less likely to be covered by NHIS compared with those in female-headed households. We also found that compared with those in the poorest wealth quintile, women in richest wealth quintile had higher odds of being covered by health insurance [aOR = 1.61, 95% CI = 1.51–1.71]. Those in the urban areas had higher odds of being covered by health insurance, compared with those in the rural areas [aOR = 1.20, 95% CI = 1.15–1.25]. Compared with Central Africa, women from Eastern [aOR = 1.09, 95% CI = 1.04–1.14] and Western [aOR = 1.07, 95% CI = 1.03–1.12] Africa were more likely to be covered by health insurance.

**Discussion**

We examined the prevalence and determinants of health insurance coverage among women in 24 sub-Saharan African countries. Our results showed an overall low coverage of health insurance (8.5%) among women in SSA, with cross-country variations where the lowest prevalence was recorded in Chad (0.9%) and the highest in Ghana (62.4%). In many of the countries where health insurance coverage is quite high, women have been prioritised under the health insurance policies of such countries. These include free maternal health policies embedded into the health insurance schemes and exemptions from the payment of annual premiums during pregnancy and childbirth. These interventions make antenatal and skilled delivery services free for women [32–34].

Our findings where women in other age brackets recorded lower odds of health insurance coverage confirm the observations of Ibok [35] in Nigeria, Mhere [36] in Zimbabwe, Kimani [37] in Kenya, Mulenga et al. [38] in Zambia, and Duku [39] in Ghana. Several explanations have been given for this association. Mhere [36] posited that as people grow older, they develop a greater sense of purpose for life. This comes with a sense of responsibility, including the need to take better care of one’s health. Kimani et al. [37] also explained this association within the context of the direct link between increases in age and increase in financial security. Thus, as people grow and become financially stable, they are able to cater for the costs involved in enrolling on health insurance schemes.

Married and cohabiting women having higher of health insurance coverage in our study confirms similar findings that have been made in in Nigeria [35], Zambia [38], Kenya [37], Ghana [39], Russia [40], USA [41], and Jamaica [42]. In many of the sub-Saharan African countries where parental health insurance coverage automatically covers children, the higher probability of married/cohabiting women to subscribe to health insurance may be due to their decision to use health insurance to mitigate personal and child healthcare financial burden [39]. It is also possible that married and cohabiting women would get some support and encouragement from their partners to help them subscribe to health insurance [38]. Married/cohabiting women are also likely to benefit from the financial advantages of living in dual-income households, including better opportunities to healethcare access [37].

In our study, non-educated women were less likely to be covered by health insurance compared with educated ones. This finding is congruent to the findings of some previous studies [35, 37–44]. Our finding could be due to the fact that compared with educated women, non-educated women may be more likely to subscribe to health insurance as a way of avoiding expenditure that may come with some eventual unforeseen health issues [38]. Additionally, higher educational attainment is likely to predispose the individual to various kinds of information, including the need to take good care of one’s health. Uneducated women, on the other
hand, may be less likely to have access to such information. This could explain the lower likelihood of health insurance subscription among women without formal education.

We found that reproductive age women in urban areas had higher odds of being covered by health insurance. This finding reflects the persistent challenges of social inequalities in health across SSA [45–49]. While health facilities are for instance, mostly cited in urban areas, health professionals also refuse posting to rural areas. Access to healthcare is thus, usually a challenge for reproductive age women especially in maternal (pregnancy and childbirth) situations. As health insurance schemes constitute a part of the healthcare system which are mostly focused on urban areas, it is, therefore, not surprising that the probability of coverage was lower in rural areas.

Our findings where women in managerial work recorded higher likelihoods of health insurance coverage could mean that formal employment, such as managerial work, gives individuals financial autonomy that can help them take care of the bills that come with health insurance, and thus result in a higher likelihood of health insurance. This finding is also consistent with the findings of some previous studies [35, 37, 40]. Our study recorded lower odds of health insurance coverage of wealthier women, compared with those from the poorest wealth quintile. Wealthier women are likelier to use private health facilities, due to the quality of healthcare provided [40] while in most sub-Saharan African countries, social health insurance is usually applicable to public health facilities [44]. Other studies, however, recorded higher odds of health insurance subscription among women from wealthier households [37, 38, 50]. This may explain why we found that women in the richest households to be covered by health insurance compared to poorest women in our multi-level regression Model III which was a bivariable analysis.

Our results revealed a significant association between mass media exposure and health insurance coverage. We found lower likelihoods of health insurance coverage among mothers who were not exposed to mass media (radio, TV, and newspapers), compared with those who use mass media frequently. This finding is consistent with findings of previous studies that reported a significant association between mass media exposure and health insurance coverage [35, 37, 38]. Users of mass media are privy to information on a wide variety of issues, including information on health-related issues, such as health insurance. Thus, women who do not use mass media may miss some relevant information that could have encouraged them to use health insurance, and this could be a reason for the lower likelihood of health insurance usage among women who were not exposed to mass media. Research has also revealed the effectiveness of using mass media for health promotion programs intended to increase public awareness on health issues such as health insurance [51].

**Strengths and limitations**

A key strength of our study is that we used nationally representative data of the various countries for the analysis. This, coupled with the multi-country nature of the study, address the issue of generalisability of our findings. We also used the current versions of the DHS data of the respective countries. This ensures that our findings reflect the current realities of the health insurance situation. Additionally, the data collection of the surveys used for the studies featured high standard methodological procedures, as well as highly experienced field assistants and these guarantee high quality of the data used. Moreover, we used higher-order statistics, such as multi-level binary logistic regression, for our analysis. This ensured a robust analysis of the data and catered for issues of validity.

Despite the strengths of this study, the findings need to be interpreted with caution, given that it is characterised by certain limitations. It is important to note, for instance, that the
cross-sectional design adopted in collecting the DHS data limits our ability to make any causal inferences among the variables studied. Besides, the study possibly suffers from recall bias that often characterises the DHS, given the retrospective nature of reporting health insurance coverage among the study participants in the respective countries.

Conclusion

Generally, we found a relatively low prevalence of health insurance coverage among reproductive age women in SSA. As SSA countries move towards achieving the SDG targets of achieving universal health coverage and reducing maternal mortality to less than 70 deaths per 100,000 live births, it is imperative for sub-Saharan African countries with a low prevalence of health insurance coverage among women in reproductive age to integrate interventions like free maternal healthcare into their respective health insurance packages. Younger reproductive age younger women, those in rural areas, divorced, the uneducated, those who do not read newspapers/magazines or watch television, and the rich. The mass media, in particular, can be used for health insurance promotion programs among women in reproductive age, given its effectiveness in increasing people's awareness of health issues.

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Author Contributions

Conceptualization: Hubert Amu, Abdul-Aziz Seidu.

Data curation: Hubert Amu, Abdul-Aziz Seidu.

Formal analysis: Hubert Amu, Abdul-Aziz Seidu.

Investigation: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah.

Methodology: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Project administration: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Resources: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Software: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Supervision: Hubert Amu, Abdul-Aziz Seidu, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Validation: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Visualization: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

Writing – original draft: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo.
Writing – review & editing: Hubert Amu, Abdul-Aziz Seidu, Ebenezer Agbaglo, Robert Kokou Dowou, Edward Kwabena Ameyaw, Bright Opoku Ahinkorah, Kwaku Kissah-Korsah.

References

1. Nations United. Transforming our world: The 2030 agenda for sustainable development. New York: United Nations, 2015

2. Otieno PO, Asiki G. Making Universal Health Coverage Effective in Low-and Middle-Income Countries: A Blueprint for Health Sector Reforms. InHealthcare Access-Regional Overviews 2020 Apr 5. IntechOpen.

3. Scheil-Adlung X, Asfaw A, Booyse F, Lamiraud K, Reynaud E, Juettling J, et al. What is the impact of social health protection on access to health care, health expenditure and impoverishment? A comparative analysis of three African countries. World Health Organization; 2006. pp 1–26

4. World health organization (WHO). Universal health coverage (UHC), 2019. Assessed July 7, 2020. https://www.who.int/news-room/fact-sheets/det ail/universal-health-coverage-(uhc)

5. Amu H, Dickson KS. Health insurance subscription among women in reproductive age in Ghana: do socio-demographics matter? Health Economics Review. 2016 Dec; 6(1):1–8. https://doi.org/10.1186/s13561-016-0080-z PMID: 26743635

6. Blanchet NJ, Fink G, Osei-Akoto I. The effect of Ghana’s National Health Insurance Scheme on health care utilisation. Ghana medical journal. 2012; 46(2):76–84. PMID: 22942455

7. Agyepong IA, Adjei S. Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. Health policy and planning. 2008 Mar 1; 23(2):150–60. https://doi.org/10.1093/heapol/czn002 PMID: 18245803

8. Kumi-Kyereme A, Amu H, Darthe EK. Barriers and motivations for health insurance subscription in Cape Coast, Ghana: a qualitative study. Archives of Public Health. 2017 Dec 1; 75(1):24. https://doi.org/10.1186/s13690-017-0192-x PMID: 28560036

9. Agbanyo R. Ghana’s national health insurance, free maternal healthcare and facility-based delivery services. African Development Review. 2020 Mar; 32(1):27–41.

10. Kwarteng A, Akazili J, Welaga P, Dalinjong PA, Asante KP, Sarpong D, et al. The state of enrollment on the National Health Insurance Scheme in rural Ghana after eight years of implementation. International Journal for Equity in Health. 2020 Dec; 19(1):1–4.

11. Mills A, Ataguba JE, Akazili J, Borghi J, Garshong B, Makawia S, et al. Equity in financing and use of health care in Ghana, South Africa, and Tanzania: implications for paths to universal coverage. The Lancet. 2012 Jul 14; 380(9837):126–33.

12. Kuwawenaruwa A, Borghi J. Health insurance cover is increasing among the Tanzanian population but wealthier groups are more likely to benefit. Mikocheni: Ifakara Health Institute; 2012.

13. Mtei GJ, Mulligan JA, Palmer N, Kamuzora P, Ally M, Mills A. An Assessment of the Health Financing System in Tanzania: Implications for Equity and Social Health Insurance: Report on Shield Work Package 1. InHEA 2007 6th World Congress: Explorations in Health Economics Paper 2007 May.

14. Sibomana S, Reveillon M. Burundi: Performance based financing of priority health services. Improving Health System Efficiency series, Geneva, World Health Organization. 2015; 27:58.

15. Goudge J, Alaba OA, Govender V, Harris B, Nxumalo N, Chersich MF. Social health insurance contributes to universal coverage in South Africa, but generates inequities: survey among members of a government employee insurance scheme. International journal for equity in health. 2018 Dec 1; 17(1):1. https://doi.org/10.1186/s12939-017-0710-z PMID: 29301537

16. McIntyre D, Goudge J, Harris B, Nxumalo N, Nikosi M. Prerequisites for national health insurance in South Africa: results of a national household survey. South African Medical Journal. 2009;99(10). PMID: 20128271

17. Naidoo S. The South African national health insurance: A revolution in health-care delivery!. Journal of Public Health. 2012 Mar 1; 34(1):149–50. https://doi.org/10.1093/pmid/fsd008 PMID: 22362968

18. Government of South Africa. National Health Act, 2003: National Health Insurance Policy, Towards Universal Health Coverage. Cape Town: Government of South Africa; 2017.

19. Amu H, Dickson KS, Kumi-Kyereme A, Darthe EK. Understanding variations in health insurance coverage in Ghana, Kenya, Nigeria, and Tanzania: evidence from demographic and health surveys. PloS one. 2018 Aug 6; 13(8):e0201833. https://doi.org/10.1371/journal.pone.0201833 PMID: 30080875

20. Fenny AP, Yates R, Thompson R. Social health insurance schemes in Africa leave out the poor. Int Health 2018; 10: 1–3 https://doi.org/10.1093/inthealth/ihx046 PMID: 29325056
21. Alhassan RK, Nketiah-Amponsah E, Arhinful DK. A review of the National Health Insurance Scheme in Ghana: what are the sustainability threats and prospects? PloS one. 2016 Nov 10; 11(11):e0165151. https://doi.org/10.1371/journal.pone.0165151 PMID: 27832082

22. Kiplagat I, Murithi M, Kioko U. Determinants of health insurance choice in Kenya. European Scientific Journal. 2013; 9(13):452–468.

23. Macha J, Harris B, Garshong B, Ataguba JE, Akazili J, Kuwawenaruwa A, et al. Factors influencing the burden of health care financing and the distribution of health care benefits in Ghana, Tanzania and South Africa. Health policy and planning. 2012 Mar 1; 27(suppl_1):i46–54. https://doi.org/10.1093/heapoli/czs024 PMID: 22388500

24. Carapinha JL, Ross-Degnan D, Desta AT, Wagner AK. Health insurance systems in five Sub-Saharan African countries: medicine benefits and data for decision making. Health policy. 2011 Mar 1; 99(3):193–202. https://doi.org/10.1016/j.healthpol.2010.11.009 PMID: 21167619

25. Corsi DJ, Neuman M, Finlay JE, Subramanian SV. Demographic and health surveys: a profile. International journal of epidemiology. 2012 Dec 1; 41(6):1602–13. https://doi.org/10.1093/ije/dys184 PMID: 23148108

26. Vandenbroucke JP, Von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. STROBE Initiative. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. International journal of surgery. 2014 Dec 1; 12(12):1500–24. https://doi.org/10.1016/j.ijsu.2014.07.014 PMID: 25046751

27. Ahinkorah BO. Ecological zone and health insurance coverage among adolescent girls in Ghana: analysis of the 2017 maternal health survey. Journal of Public Health. 2020 Jan 2:1–8.

28. Solanke BL, Oyonlola FF, Oyeleye OJ, Ilesanmi BB. Maternal and community factors associated with unmet contraceptive need among childbearing women in Northern Nigeria. Contraception and reproductive medicine. 2019 Dec 1; 4(1):11. https://doi.org/10.1186/s40834-019-0093-1 PMID: 31497311

29. Amu H, Kumi-Kyereme A, Darteh EK. Trends in health insurance subscription at Cape Coast, Ghana: a retrospective study from 2005–2014. Ghana Journal of Geography. 2017; 9(3):97–111.

30. Kumi-Kyereme A, Amu H, Darteh EK. Barriers and motivations for health insurance subscription in Cape Coast, Ghana: a qualitative study. Archives of Public Health. 2017 Dec 1; 75(1):24. https://doi.org/10.1186/s13690-017-0192-x PMID: 28560036

31. Obounou BW. Gabon health care system: a 20 year analysis. International Journal of Community Medicine and Public Health. 2017; 4(7):2208–11.

32. Ibok NI. Socio-economic and demographic determinants of health insurance consumption. Canadian Social Science. 2012 Oct 31; 8(5):58–64.

33. Mhere F. Health insurance determinants in Zimbabwe: case of Gweru urban. Journal of Applied Business and Economics. 2013 Mar 1; 14(2):62–79.

34. Kimani JK, Etutar R, Warren C, Bellows B. Determinants of health insurance ownership among women in Kenya: evidence from the 2008–09 Kenya demographic and health survey. International journal for equity in health. 2014 Dec 1; 13(1):27. https://doi.org/10.1186/1475-9276-13-27 PMID: 24678655

35. Mulenga JN, Bwalya BB, Gebremeskel Y. Demographic and Socio-economic determinants of maternal health insurance coverage in Zambia. Epidemiology, Biostatistics and Public Health. 2017 Mar 17; 14(1).

36. Duku SK. Differences in the determinants of health insurance enrolment among working-age adults in two regions in Ghana. BMC health services research. 2018 Dec; 18(1):384. https://doi.org/10.1186/s12913-018-3192-9 PMID: 29843699

37. Perlman F, Balabanova D, McKee M. An analysis of trends and determinants of health insurance and healthcare utilisation in the Russian population between 2000 and 2004: the ‘inverse care law’in action. BMC Health Services Research. 2009 Dec 1; 9(1):68. https://doi.org/10.1186/1472-6963-9-68 PMID: 19397799

38. Gutierrez CM. The institutional determinants of health insurance: Moving away from labor market, marriage, and family attachments under the ACA. American Sociological Review. 2018 Dec; 83(6):1144–70.

39. Bourne PA, Kerr-Campbell MD. Determinants of self-rated private health insurance coverage in Jamaica. Health. 2010 Jun 28; 2(06):541.

40. Baloul I, Dahlui M. Determinants of health insurance enrolment in Sudan: evidence from Health Utilisation and Expenditure Household Survey 2009. BMC Health Services Research. 2014 Jul 1; 14(S2):O17.

41. Yeliah J, Ramakrishna G. Socio economic determinants of health insurance in India: the case of Hyderabad city. International Journal of Development and Sustainability. 2012; 1(2):111–9.
42. Dickson KS, Adde KS, Amu H. What influences where they give birth? Determinants of place of delivery among women in rural Ghana. International journal of reproductive medicine. 2016 Dec 22;2016. https://doi.org/10.1155/2016/7203980 PMID: 28101522

43. Alam N, Hajizadeh M, Dumont A, Fournier P. Inequalities in maternal health care utilization in sub-Saharan African countries: a multiyear and multi-country analysis. PloS one. 2015 Apr 8; 10(4):e0120922. https://doi.org/10.1371/journal.pone.0120922 PMID: 25853423

44. Abiwu HAK. Factors Influencing Acceptance of Rural Posting by Health Workers to Krachi West District, Volta Region, Ghana (Doctoral dissertation). Accra: University of Ghana; 2019.

45. Yaya S, Bishwajit G, Shah V. Wealth, education and urban–rural inequality and maternal healthcare service usage in Malawi. BMJ global health. 2016 Aug 1; 1(2). https://doi.org/10.1136/bmjgh-2016-000085 PMID: 28588940

46. Yaya S, Uthman OA, Amouzou A, Ekholuenetale M, Bishwajit G. Inequalities in maternal health care utilization in Benin: a population based cross-sectional study. BMC Pregnancy and Childbirth. 2018 Dec 1; 18(1):194. https://doi.org/10.1186/s12884-018-1846-6 PMID: 29855277

47. Sarpong N, Loag W, Fobil J, Meyer CG, Adu-Sarkodie Y, May J, et al. National health insurance coverage and socio-economic status in a rural district of Ghana. Tropical medicine & international health. 2010 Feb; 15(2):191–7.

48. Ofori-Birikorang A. Promoting a new health policy in the Ghanaian media: Newspaper framing of the national health insurance scheme from 2005–2007 (Doctoral dissertation), Ohio University, USA; 2009.

49. Rasbash J, Charlton C, Browne W, Healy M, Cameron B. MLwiN version 2.31. Bristol: University of Bristol, Centre for Multilevel Modelling. 2014.

50. Hatt LE. & Waters HR. Determinants of child morbidity in Latin America: a pooled analysis of interactions between parental education and economic status. Social Science & Medicine:2006: 62(2):375–86. https://doi.org/10.1016/j.soscimed.2005.06.007 PMID: 16040175

51. Peng YK, Hight-Laukaran V, Peterson AE, & Perez-Escamilla R. Maternal nutritional status is inversely associated with lactational amenorrhea in Sub-Saharan Africa: results from demographic and health surveys II and III. The Journal of Nutrition:1998; 128(10):1672–80. https://doi.org/10.1093/jn/128.10.1672 PMID: 9772135