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**A call for action: Poor and uneducated to be insured.
Evidence from a nationally representative sample of women
of reproductive ages in the Democratic Republic of the
Congo**

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Title:

A call for action: Poor and uneducated to be insured. Evidence from a nationally representative sample of women of reproductive ages in the Democratic Republic of the Congo

Zacharie Tsala Dimbuene, PhD^{1,2}

Raphaël Muanza Nzuzi, M.Sc.¹

Paul-Denis Nzita Kikhela, PhD¹

¹ Department of Population and Development Sciences, Faculty of Economics and Management, University of Kinshasa, Democratic Republic of the Congo

² Corresponding author:

Name: Zacharie Tsala Dimbuene

Affiliation: Department of Population and Development Sciences, University of Kinshasa, Democratic Republic of the Congo

Email: zacharie.tsala.dimbuene@gmail.com

Abstract

Objective To investigate inequalities of health insurance coverage (outcome) at provincial level, and the effects of education and poverty on the outcome.

Design Secondary analysis of Demographic and Health Surveys (DHS). The outcome variable was health insurance ownership.

Settings The Democratic Republic of the Congo.

Subjects Women aged 15–49 years (n = 18,827).

Results Findings indicated significant spatial variations of the health insurance ownership which ranged from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the Capital City.

Furthermore, findings showed that an additional year of women education increased by 10% the chance of health insurance ownership (AOR: 1.098; 95%CI: 1.065—1.132). finally, living in better-off households increased by 150% the chance of owing a health insurance (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households.

Conclusions Our analysis shows that like other sub-Saharan African countries, the Democratic Republic of the Congo will not reach the Sustainable Development Goal (SDG)—3, aimed at improving maternal and child health unless serious political shift is done in the countries to tackle inequalities among poor and uneducated women via universal health coverage (UHC).

Strengths and limitations

- This paper used nationally representative data to disentangle inequalities of access to health insurance at sub-national level. However, the cross-sectional nature of the data in the DHS limits the over-generalization of the findings, and it is impossible to make any causal inferences.
- Findings showed that health insurance are unequally distributed across provinces, with a concentration of the outcome in Kinshasa the Capital City. This also means that an over-sampling of women of reproductive ages in other provinces should have been necessary to better capture the outcome in the country. However, this was not possible given that DHSs do not aim at collecting data on health insurance coverage.
- Finally, data collected in the DHSs may suffer from recall bias given the retrospective nature of reporting health insurance coverage among women of reproductive ages in the country.

Introduction

Most sub-Saharan Africa (SSA) countries did not achieve Millennium Development Goals (MDG).^{1,2} It is very likely that most SSA countries will not achieve Sustainable Development Goals (SDG).³ In the 2015 final declaration, the United Nations (UN) sought to promote “Health for all at all ages” by 2030, as reflected in the SDG Three. To achieve this goal, universal health coverage (UHC) and reduction of maternal mortality are of paramount importance.^{4,5} UHC has been criticized in the literature due the lack of consistent framework to guide policy makers in improving equity in access and use of services to better achieve equitable health outcomes.⁶ Nonetheless, scholars and policy makers all agree that UHC is about ensuring that people in communities and countries have access to the health care they need without suffering financial hardship.⁷ This is where health insurance enters into play. Indeed, health insurance serves as a protective mechanism in pooling financial resources of participants. As such, health insurance is a key driver of UHC.^{4,6} Ironically, while Japan is celebrating its 50th anniversary of UHC^{8,9} and countries like Thailand and South Korea celebrate 30 years of UHC^{10,11}, alarmingly only 8.5% of women of reproductive ages in SSA have access to health insurance.⁴ This is a serious threat to achieve the SDG Three. Importantly, Amu et al.⁴ found significant variations across countries. Health insurance coverage ranged from less than 1% in Chad to 62.4% in Ghana. This definitely calls for context- or country-specific analyses to better understand individual-level and community-level characteristics associated with health insurance coverage.

Recent experiences in SSA countries showed promising results to expand health insurance to community members.^{12–17} Overall, evidence suggests that political involvement, and specifically strong and dynamic leadership, is crucial to ensure the expansion of health in SSA countries, and especially in the Democratic Republic of the Congo (DRC) where the health insurance coverage is

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3 extremely low at 5% among women of reproductive ages in the country had health insurance,
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5 according to the 2013—2014 Demographic and Health Survey.^{4,18} More importantly, there is no
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7 publicly owned insurer¹⁸, making access to health insurance even more difficult given the high
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9 unemployment rates in the country.
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11 12 13 14 **Social determinants of Health (SDoH) as a conceptual framework to analyze** 15 16 17 **optimal health insurance coverage**

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19 The first generation of studies on the health of populations emphasized medical conditions to
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21 understand how the health of populations are shaped over time.¹⁹ These studies rapidly showed
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23 significant drawbacks because they have neglected social forces driving health of populations.
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25 Therefore, the second generation included, in their inquiries to better understand the evolution of
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27 health over time, social forces that interplay in shaping health.^{19–21} This is referred to as the “social
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29 determinants of health (SDoH)”.²² The SDoH are a set of conditions in which people are born,
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31 grow up, work, live, and age, and the wider set of forces and systems shaping the conditions of
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33 their daily life.²³ Studies by Braveman and colleagues^{19,20} provide sound discussions about the
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35 influences of social factors on health. In its initial format, the SDoH encompasses factors of
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37 multiple layers, including individual, community, national and global level factors. Indeed, besides
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39 structural determinants (e.g., social system, socioeconomic position, etc.), previous studies showed
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41 that material circumstances, behaviours, biological and psychological factors derived from the
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43 structural factors also affect the health of populations.^{19,20} At global level, there is increasing
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45 debate on the effects of climate changes on health hazards.²⁴
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53 In this paper, a special attention is devoted to education and socioeconomic status proxied by
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55 household wealth index (HWI) and their relationships with health insurance that is considered
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3 one's behaviours. It is hypothesized that holding a health insurance is contingent upon education
4 and HWI. Amid scarcity of resources and rampant poverty, people might not consider health
5 insurance as a priority. Yet, out-of-pocket expenses are among the barriers that limit access to
6 affordable health care, and therefore exposing people to illnesses and deaths.
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14 ***Education and health insurance.*** There are consistent findings across studies that education is
15 positively and significantly associated with good health.^{25,26} According to this study, this well-
16 established link can be understood via (i) work and economic conditions; (ii) social-psychological
17 resources; and (iii) health lifestyle. Regarding health insurance, it is posited that the effects of
18 education are mediated through work and economic conditions. Indeed, more educated people are
19 more likely to be working and therefore benefit from employer's funded health insurance scheme.
20 Empirically, studies conducted in SSA countries confirmed this assumption. For instance, a study
21 in Burkina Faso showed that education was positively education level of head of household was
22 positively and significantly associated with knowledge and enrolment in health insurance
23 scheme.²⁷ In contrast, a study in Ghana showed that education was not significantly associated
24 with ownership of health insurance among women of reproductive ages even though the
25 association went in the expected direction.²⁸ In a multi-country study including Kenya, Tanzania,
26 Ghana and Nigeria, Amu et al.²⁹ found that education had a significant and positive association
27 with ownership of health insurance for both females and males in these countries, even though the
28 associations were stronger in Kenya compared with other countries. For instances, females and
29 males with higher education were almost 15 times and 17 times more likely to own health
30 insurance compared with their counterparts with no education, respectively. Similar findings were
31 reported in Kenya with comparable datasets.³⁰
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3 ***Socioeconomic status and health insurance.*** There is abundant literature on the linkages between
4 socioeconomic status or position (hereafter, SES) and health. Previous research has established
5 that SES is a fundamental cause of inequalities.³¹⁻³³ On a theoretical point of view, and to be a
6 “fundamental cause of inequalities”, four criteria should be met. First, the cause influences multiple
7 health problems. It is important to stress here that the cause is not limited to one disease or health
8 problem. Second, the cause affects the disease through multiple risk factors. Third, the cause
9 determines access to other resources to avoid risks or mitigate the consequences of the disease
10 might it appears. Fourth, the effect of the cause on the disease should be reproduced over time via
11 the replacement of intervening mechanisms.³² This theory emphasized the role of SES on health.
12 When comes health insurance, it is posited that SES effects ownership of health insurance through
13 lifestyles and behaviours. Not only people with higher SES are more likely to be employed and
14 therefore they have more chances to own health insurance. Furthermore, people from higher SES
15 are more likely to be educated and better understand the importance of health insurance. Indeed,
16 resources of knowledge, power, money, prestige, and beneficial social connections are among
17 others, factors that explain why people from a specific social class might benefit from good health.
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32,34 In fact, previous research stressed out the role of health behaviours to better understand the effect of education on health.²⁵

Empirically, findings showed that poverty is a leading cause of economic loss and it increases the vulnerability of the poor in Burkina Faso, Niger and Togo.³⁵ Likewise, Barasa et al.¹⁸ showed that SES was critical to further our understanding of inequalities of health insurance coverage in SSA. Overall, this study showed that health insurance coverage is inequitable in SSA, and it needs to be adequately addressed if SSA countries want to reach SDG Three by 2030. A study conducted in Five Francophone Africa countries (Benin, Madagascar, Mali, Niger, and Togo) have analyzed

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3 Demographic and Health Surveys (DHSs) and found that health insurance coverage was very low,
4 ranging from 1.1% in Benin to 3.3% in Togo.³⁶ Not only the study found significant variations
5 between urban and rural areas, it also reported that ownership of health insurance was positively
6 and significantly associated with household wealth index. Overall, the likelihood of ownership of
7 health insurance was higher among women living in better-off households compared with their
8 counterparts in poor households.
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11 Although findings suggested a positive and significant relationship between SES and ownership of
12 health insurance, one might be careful to an over-generalization of this association. A systematic
13 review aimed at identifying barriers and facilitators to implementation, uptake, and sustainability
14 of community-based health insurance (CBHI) schemes in low- and middle-income countries
15 (LMICs) reported mixed effects of socioeconomic status on CBHI schemes.³⁷ A caveat for this
16 conclusion relies on variable measurement in the studies included in the systematic review.^{38–40}
17 These studies used different settings and various approaches to conceptualize and operationalize
18 SES which might explain the mixed results observed in the papers; therefore, the conclusion of
19 this systematic review is certainly debatable.
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42 **Methods**

43 **Data**

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45 The data utilized in this study come from the 2013—2014 Demographic and Health Survey
46 conducted in the Democratic Republic of the Congo (DRC-DHS 2013–14). This is a nationally
47 representative survey, using a two-stage sampling design, which collected information on
48 households, women and men of reproductive ages, anthropometric measures, contraception and
49 family planning, among others.⁴¹ The first stage involved the selection of sample points or clusters
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3 from an updated master sampling frame constructed in accordance with DRC's administrative
4 division in 26 provinces or domains. These domains were further stratified into urban and rural
5 areas. Urban areas neighbourhoods were sampled from cities and towns whereas for rural areas
6 villages and chiefdoms were sampled. The clusters were selected using systematic sampling with
7 probability proportional to size (PPS). Household listing was then conducted in all the selected
8 clusters to provide a sampling frame for the second stage selection of households. The second
9 stage of selection involved the systematic sampling of the households listed in each cluster, and
10 households to be included in the survey were randomly selected from the list. The rationale for the
11 second stage selection was to ensure adequate numbers of completed individual interviews to
12 provide reliable estimates for key outcomes. This paper reports on findings from women
13 individual record file to construct the outcome and independent variables.
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30 **Variable measurement and operationalization**

31 *Dependent variable*

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33 The outcome variable of this study was **ownership of health insurance**. Women of reproductive
34 ages were asked a single question: "*Are you covered by any health insurance*"? The dependent
35 variable is coded 1 if the woman owned health insurance, 0 otherwise. It should have been
36 interesting to investigate public vs. private insurance. However, the low percentage of women
37 owing a health insurance did not allow such an in-depth investigation.
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49 *Independent variables*

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51 The selection of independent variables included in these analyses was guided by the existing body
52 of literature on health insurance and universal health coverage.^{37,42,43} For this study, these variables
53 were grouped into two broad categories: individual- and household/community-level variables.
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Individual-level variables included current women's age (in years), education (in years completed), marital status, religion, working status, index of media exposure, parity, antenatal care attendance, and husband/partner's education. The index of media exposure is a sum of three questions pertaining to medias: watching television; listening radio; and reading newspapers. Respondents were asked how often they watch TV, listen to radio, or read newspapers. Responses were 0 "Not at all"; 1 "Less than once a week"; 2 "At least once a week". The responses to these three questions were summed up to get the index of media exposure. The higher the index of media exposure, the more the woman was exposed to media influences. At household/community level, the following variables were included: sex of the head of household; household wealth index (HWI); community literacy level; community socioeconomic status; place of residence; and province of residence. HWI was built using Principal Component Analysis (PCA); details have been described elsewhere⁴¹. In this paper, a new grouping was done to include poor households (40%), middle households (20%), and better-off households (40%). Community literacy measures the ability of women in the clusters to read effectively through the literacy variable v155. Women in the cluster who can read were coded 1, and 0 otherwise. Thereafter, the average was computed, and three terciles were defined as "Low", "Medium" and "Higher". Community socioeconomic status (CSES) was defined using HWI. All better-off households in the cluster were coded 1, and a mean was computed. Two quantiles were defined to get two categories of CSES: "Low" and "High".

Analytical strategy

Descriptive statistics

The paper begins with bivariate analyses between the dependent variable and the set of putative covariates using the Chi-square statistic to test significance associations. Given the nature of the

dependent variable (ownership of health insurance: 1 = Yes; 0 = No), only categorical variables were included. There is also a debate in the statistical literature on which variables to include in the multivariable modeling based on the significance tests in bivariate analyses. In this paper, all independent variables reaching statistical significance and there was no need to discuss this issue.

Modeling strategy

For multivariate analyses, this paper utilizes multilevel modeling to investigate the effects of context and to quantify the influences of women's education and poverty on the ownership of health insurance, controlling for variables at individual and household/community levels. This choice is guided by the hierarchical nature of the data. Consequently, women from the same group are assumably alike at least in part because they share a common set of characteristics, thus violating the standard assumption of independence of observations, yielding to biased variance estimates if one could not account for the clustering of observations. Additionally, multilevel modeling allows to disentangle contextual from compositional effects by simultaneously modeling the effects of community- and individual-level predictors, with women as units of analysis.^{4,44} Two-level logistic regression models were performed as follows, in which i and j refer to individual- and community-level variables, respectively:

$$\text{logit}\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_0 + \sum_{k=1}^p \beta_k x_{ij}^k + \sum_{l=1}^q \delta_l z_j^l \quad (1.a)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (1.b)$$

The quantity π_{ij} is the probability that a sampled woman referenced (i, j) owns a health insurance; $x_{ij}^{(k)}$ and $z_j^{(l)}$ are the k^{th} individual-level covariate and l^{th} community-level covariate respectively; β_{0j} represents the intercept modelled to randomly vary across clusters; the estimates β_k and δ_l represent

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3 the regression coefficients of individual- and community-level covariates respectively; and u_{0j} is
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5 the random cluster residuals distributed as $N(0, \sigma_u^2)$.⁴⁵ Analyses were performed using STATA SE
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7 version 15 for macOS, accounting for the complex survey design of DHS data to ensure that
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9 findings are generalized to the entire population of women of reproductive ages in the country.
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11 Besides the null model allowing for a theoretical justification of multilevel modeling, three models
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13 were estimated. The first model included individual-level covariates. The second model included
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15 only household/community-level covariates. Finally, a full model included covariates at
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17 individual- and household/community-level covariates was performed.
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23 **Model selection**

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25 Model selection is largely discussed in the statistical literature.^{46–49} First, statistical literature
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27 suggests that p-values and tests based upon them can be less efficient, especially with large
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29 samples.⁴⁸ Second, the goodness-of-fit used to assess the performance of model to fit the data can
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31 be of limited utility when one has to choose among several candidate models.⁵⁰ In this paper,
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33 Aikake Information Criterion (*AIC*) and Bayesian Information Criterion (*BIC*) are used to evaluate
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35 and choose the best models.⁴⁷
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42 **Patient and public involvement**

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44 Patients/public were not involved in the design or implementation of this study.
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50 **Results**

51 **Descriptive results**

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Overall, 5% of women of reproductive ages in the DRC owns a health insurance (Table 1). Among those owing a health insurance, it is offered by the employer (76%), or women subscribed in a mutual/community health insurance scheme (20%). It is worthy to mention that there are significant geographical variations in terms of health insurance (Figure 1). While 15.5% of women of reproductive ages own a health insurance, a marginal percentage of 1.2% of women are insured in Bandundu, Kasai Occidental and Maniema. Put differently, health insurance coverage is a “new reality” in these provinces; this really calls for immediate action if the DRC wants to reach SDG Three. From Table 1, findings indicated that women owing a health insurance lived in better-off households (10.4%), advantaged neighbourhoods (10.1%) and communities with high literacy level (10.6%); are urban residents (10.4%); and they are married to high-educated men (18.4%).

Table 1:
Sociodemographics and health insurance among women of reproductive ages in the Democratic Republic of the Congo

Variables	N (Weighted)	Dependent variable: Owns a health insurance				p-value
		%	No 95% CI	%	Yes 95% CI	
Individual-level characteristics						
Marital status						
Single	4,545	91.5	[89.5,93.1]	8.5	[6.9,10.5]	<0.001
Married or cohabiting	12,448	95.9	[94.9,96.7]	4.1	[3.3,5.1]	
Formerly married or cohabiting	1,834	97.8	[96.7,98.5]	2.2	[1.5,3.3]	
Religion						
Catholic	5,434	94.9	[93.1,96.2]	5.1	[3.8,6.9]	p = NS
Protestant	5,243	96	[94.5,97.1]	4.0	[2.9,5.5]	
Other Christians	7,377	94.2	[93.0,95.2]	5.8	[4.8,7.0]	
Other religions	773	96.2	[91.7,98.3]	3.8	[1.7,8.3]	
Working status						
No	6,979	93.5	[91.8,94.9]	6.5	[5.1,8.2]	p < 0.001
Yes	11,848	95.9	[95.0,96.6]	4.1	[3.4,5.0]	
Antenatal care attendance						
None	1,512	98.4	[97.2,99.1]	1.6	[0.9,2.8]	p < 0.001
1-3 ANC visits	12,230	94.6	[93.6,95.5]	5.4	[4.5,6.4]	
4+ ANC visits	5,085	95.0	[93.3,96.2]	5.0	[3.8,6.7]	
Husband/Partner's education						
No education	6,030	93.0	[91.3,94.4]	7.0	[5.6,8.7]	p < 0.001
Primary	3,375	99.1	[98.5,99.5]	0.9	[0.5,1.5]	
Secondary	8,294	97.1	[96.1,97.9]	2.9	[2.1,3.9]	
University or higher	1,128	81.6	[78.1,84.6]	18.4	[15.4,21.9]	

Household- and Community-level characteristics

Sex of household head

Male	14,391	94.7	[93.5,95.6]	5.3	[4.4,6.5]	$p < 0.05$
Female	4,436	95.9	[94.6,96.9]	4.1	[3.1,5.4]	

Household Wealth Index

Poor (40%)	8,106	99.3	[98.9,99.6]	0.7	[0.4,1.1]	$p < 0.001$
Middle (20%)	3,655	98.6	[97.7,99.1]	1.4	[0.9,2.3]	
Rich (40%)	7,066	89.6	[87.9,91.2]	10.4	[8.8,12.1]	

Community Literacy Level

Low (33%)	6,342	98.7	[97.9,99.2]	1.3	[0.8,2.1]	$p < 0.001$
Medium (33%)	6,214	98.5	[97.3,99.2]	1.5	[0.8,2.7]	
High (34%)	6,271	89.4	[87.4,91.2]	10.6	[8.8,12.6]	

Community Socioeconomic Status

Low (50%)	11,868	98.7	[97.5,99.4]	1.3	[0.6,2.5]	$p < 0.001$
High (50%)	6,959	89.9	[87.9,91.6]	10.1	[8.4,12.1]	

Place of residence

Rural	12,157	98.2	[97.0,98.9]	1.8	[1.1,3.0]	$p < 0.001$
Urban	6,670	89.6	[87.7,91.3]	10.4	[8.7,12.3]	

Province of residence

Kinshasa	1,804	84.5	[81.2,87.3]	15.5	[12.7,18.8]	$p < 0.001$
Bandundu	2,473	98.8	[98.1,99.3]	1.2	[0.7,1.9]	
Kongo Central	945	96.9	[94.6,98.3]	3.1	[1.7,5.4]	
Equateur	2,696	97.8	[95.5,98.9]	2.2	[1.1,4.5]	
Kasai Occidental	1,461	97.3	[90.9,99.2]	2.7	[0.8,9.1]	
Kasai Oriental	2,073	98.8	[96.4,99.6]	1.2	[0.4,3.6]	
Katanga	2,196	91.4	[87.8,94.0]	8.6	[6.0,12.2]	
Maniema	855	98.7	[96.3,99.5]	1.3	[0.5,3.7]	
Nord Kivu	1,154	93.5	[84.9,97.3]	6.5	[2.7,15.1]	
Orientale	2,137	97.0	[94.6,98.4]	3.0	[1.6,5.4]	
Sud Kivu	1,033	92.4	[85.5,96.1]	7.6	[3.9,14.5]	
Total	18,827	95.0	[93.9,95.8]	5.0	[4.2,6.1]	

Source: DHS—2013-14

Multivariate findings

As mentioned in the analytical strategy, three models were performed. Among these three models, the full model including both individual- and household/community-level variables was the best model. This conclusion was confirmed with both *AIC* ($AIC = 4717.962$) and *BIC* ($BIC = 4984.625$) (Table 2). Therefore, this section focuses on findings in Table 3; Model 3.

Table 2:
Model selection of health insurance coverage among women in Democratic Republic of the Congo

Model	Aikake's Information Criterion (AIC)	Bayesian Information Criterion (BIC)
0	5171.725	5187.411
1	4841.876	4975.208

2	4909.624	5058.641
3	4717.962	4984.625

Source: DHS—2013-14

Table 3:
Multilevel logistic regression of individual and contextual factors associated with health insurance coverage among women in the Democratic Republic of the Congo

VARIABLES	Model 0	Model 1	Model 2	Model 3
Individual-level characteristics				
Women current age		1.010 [0.994 - 1.025]		1.008 [0.993 - 1.023]
Woman's education (in completed years)		1.128*** [1.095 - 1.162]		1.098*** [1.065 - 1.132]
Marital status (Ref.: Single)				
Married or cohabiting		0.489*** [0.286 - 0.836]		0.587* [0.343 - 1.006]
Formerly married or cohabiting		0.300*** [0.164 - 0.549]		0.364*** [0.198 - 0.666]
Religion (Ref.: Catholic)				
Protestant		0.859 [0.668 - 1.105]		0.863 [0.672 - 1.109]
Other Christians		0.861 [0.694 - 1.069]		0.830* [0.668 - 1.032]
Other religions		0.879 [0.500 - 1.544]		0.877 [0.499 - 1.541]
Working status (Ref.: No)		0.990 [0.824 - 1.188]		1.054 [0.877 - 1.265]
Index of media exposure		1.810*** [1.515 - 2.163]		1.488*** [1.245 - 1.778]
Children ever born		1.062** [1.010 - 1.117]		1.054** [1.003 - 1.108]
Antenatal care attendance (Ref.: No ANC)				
1-3 ANC visits		1.167 [0.708 - 1.925]		1.035 [0.624 - 1.718]
4+ ANC visits		1.071 [0.641 - 1.788]		0.926 [0.551 - 1.555]
Husband or Partner's education (Ref.: No education)				
Primary		0.668 [0.372 - 1.198]		0.705 [0.393 - 1.264]
Secondary		1.033 [0.630 - 1.693]		0.959 [0.585 - 1.573]
University or higher		3.072*** [1.816 - 5.197]		2.564*** [1.516 - 4.335]
Household- and community-level characteristics				
Household Head is Female (Ref.: Male)			0.777**	0.829*

			[0.636 - 0.948]	[0.668 - 1.029]
Household wealth index (Ref.: 40% poor)				
Middle (20%)			1.691**	1.375
			[1.095 - 2.612]	[0.887 - 2.130]
Rich (40%)			3.949***	2.501***
			[2.593 - 6.015]	[1.620 - 3.860]
Community Literacy Level				
(Ref.: Low 33%)				
Medium (33%)			0.822	0.649
			[0.467 - 1.446]	[0.370 - 1.139]
High (33%)			2.209**	1.173
			[1.087 - 4.488]	[0.573 - 2.403]
Community Socioeconomic Status				
(Ref.: 50% Low)				
Urban residence (Ref.: Rural)			0.942	0.866
			[0.623 - 1.425]	[0.570 - 1.314]
Province of residence (Ref.: Kinshasa)				
Bandundu			0.363***	0.408**
			[0.168 - 0.784]	[0.190 - 0.877]
Kongo Central			0.202***	0.308**
			[0.076 - 0.541]	[0.116 - 0.817]
Equateur			0.651	0.790
			[0.295 - 1.435]	[0.361 - 1.729]
Kasai Occidental			0.259***	0.350**
			[0.097 - 0.687]	[0.133 - 0.919]
Kasai Oriental			0.096***	0.135***
			[0.038 - 0.241]	[0.054 - 0.336]
Katanga			0.870	1.156
			[0.423 - 1.791]	[0.564 - 2.371]
Maniema			0.174***	0.225**
			[0.053 - 0.568]	[0.069 - 0.726]
Nord Kivu			0.941	1.162
			[0.406 - 2.181]	[0.502 - 2.689]
Orientale			0.684	0.874
			[0.318 - 1.473]	[0.408 - 1.874]
Sud Kivu			0.864	1.167
			[0.346 - 2.159]	[0.467 - 2.916]
Intra-class correlation (ICC)	0.613	0.429	0.352	0.341
	[0.534-0.679]	[0.359-0.504]	[0.268-0.425]	[0.275-0.415]
Observations	18,827	18,827	18,827	18,827
Number of groups	536	536	536	536

Confidence Intervals in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1

Source: DHS—2013-14

Before moving to estimates reported in Model 3, let's investigate Model 0 to see if the multilevel modeling was justified and relevant for this study. The intraclass correlation (*ICC*) was 0.613 (61.3%). This is quite large, and it justifies the utilization of multilevel modelling. The interpretation of findings in Model 3 starts with the association between two key independent

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3 variables: women's education (in completed years) and household wealth index (HWI), and the
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5 ownership health insurance. First, findings indicated that each additional year of women education
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7 increased by 10% the chance of owing a health insurance (AOR: 1.098; 95%CI: 1.065—1.132).
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10 Second, living in better-off households increased by 150% the chance of owing a health insurance
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12 (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households (referred
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14 to as 40% bottom HWI). This confirms the assumptions made in the study that HWI and women's
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16 education are key covariates to better understand the ownership of health insurance in the DRC.
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21 Model 3 in Table 3 also reported interesting results both at individual and household/community
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23 level. At individual level, Model 3 indicated that husband/partner's education is of chief
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25 importance. Specifically, husbands/partners with university or higher are pivotal to explain
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27 women's ownership of health insurance. Indeed, being married to husbands/partners with a
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29 university degree or higher increased by 156% the chance of owing a health insurance (AOR:
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31 2.564; 95%CI: 1.516—4.335). The index of media exposure also showed interesting results.
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34 Indeed, an increase of 1 unit of the index of media exposure increased by almost 50% the chance
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36 of owing a health insurance among women of reproductive ages (AOR: 1.488; 95%CI: 1.245—
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38 1.778). In contrast, marital status showed counter-intuitive results: ever married women were less
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40 likely to be covered by health insurance compared to never married women.
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47 At household/community-level, community socioeconomic status (CSES) was positively and
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49 significantly associated with the ownership of health insurance. Indeed, living in advantaged
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51 neighbourhoods increased by 223% the chance of owing a health insurance (AOR: 3.232; 95%CI:
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53 1.746—5.983).
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Discussion

While policymakers and stakeholders vowed that most countries in sub-Saharan Africa (SSA) align with Sustainable Development Goals (SDGs), less efforts have been done to monitor progress at national and sub-national levels. This paper contributes to the existing literature by examining disparities of health insurance coverage at sub-national level on one hand and using, on the other hand, the social determinants of health (SDoH) with an emphasis on education and socioeconomic status (SES) to better understand these disparities within the country.

First, health insurance is quite low at national as reported in previous studies with a marginal percentage (5%) of women of reproductive ages owning a health insurance.⁴ This finding has policy and programmatic implications in the DRC. Indeed, previous studies reported that maternal mortality ratio (MMR) in the DRC is very high, and it is estimated at 473 maternal deaths per 100,000 live births.⁵¹ This is alarming because it also means that the country won't reach the SDG 3.1 aiming at reducing, by 2030, the MMR at 70 maternal deaths per 100,000 live births. Yet, obstetrical complications such as bleeding, eclampsia, sepsis and unsafe abortions, accounting for nearly 80% of the MMR cases require urgent and appropriate care which can be ease with health insurance coverage. Second, there are important geographical variations regarding health insurance coverage ranging from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the Capital City. With these figures, it is very likely that the DRC is lagging very behind regarding the SDG Three.

Going back to the main hypothesis posited in this study, regarding the associations between education, SES, and health insurance coverage in the DRC, findings can be summarized as follows. An additional year of completed education increases by 10% the likelihood of owning health insurance among women of reproductive ages in the DRC. This finding is consistent with

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3 previous studies.^{12,16,18,37} However, the explanations offered in previous studies might be
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5 insufficient in the context of the DRC. Indeed, previous research stated that educated women may
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7 be exposed to much more health information which increases their likelihood to subscribe to
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9 health insurance coverage. In the context of higher unemployment rates, education per se might
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11 not suffice to explain why educated women are more likely to own health insurance coverage.
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13 Another plausible explanation, especially that health insurance coverage is more prevalent in
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15 Kinshasa the Capital City, is that educated women are more likely to work and therefore
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17 increasing their chances to own health insurance coverage. In fact, preliminary findings showed
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19 that 62% of surveyed women were working at the time of the survey. Surprisingly, the likelihood
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21 to own health insurance among these women was higher among not-working women compared
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23 with their working counterparts. Therefore, more research is needed to unpack this intriguing
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25 finding, and provide more plausible paths of influence. The fact that less educated women have
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27 lesser likelihood to own health insurance also means that policymakers and stakeholders working
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29 to improve health conditions in the DRC need to pay more attention to women's education as a
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31 precondition to increase access to health insurance. This finding holds at community level because
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33 women of reproductive ages living in better-off neighbourhoods were more likely to own health
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35 insurance.
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44 With regards to SES, findings indicated that women of reproductive ages living in better-off
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46 households and advantaged neighbourhoods had higher chances to own health insurance compared
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48 with their counterparts in poor households and disadvantaged neighbourhoods. This finding is
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50 corroborated in previous research.¹⁸ It is very unlike to reach SDG Three unless inequalities in
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52 accessing health insurance are tackled seriously. In the DRC, there are only fewer initiatives of
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54 spreading health insurance at individual and community levels. Yet, this is crucial if the country
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3 wants to achieve by 2030 the SDG Three. According to previous studies, unequal exposure to
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5 media might explain such inequalities in health insurance coverage.¹⁸ Yet, there are no clear
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7 policies in the DRC aimed at reducing the inequalities to media exposure, doubled with higher
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9 unemployment rates in the country which together limit the ability to seek correct health
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11 information among women of reproductive ages.
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14 15 16 17 **Conclusion**

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19 Universal Health Coverage (UHC) is pivotal to reach SDG Three. Findings showed that UHC is
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21 still low in SSA and in the DRC specifically. Programmatically, that means the RDC will not
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23 reach SDG Three on one hand, and on the other hand, the alarming disparities between provinces,
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25 and between poor and rich seriously call for action. To improve maternal and child health in the
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27 country, policymakers and stakeholders should tackle inequalities between poor and rich and
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29 devise interventions to equip poor to better understand the importance of health insurance
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31 coverage given the rampant and secular poverty which impedes people, especially uneducated and
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33 poor people to adhere to health insurance schemes in the communities. Unlike countries such as
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35 Ghana with a sustainable national health insurance scheme^{13,17,52,53}, the DRC has not yet developed
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37 and implemented a strong health insurance scheme to help people, especially poor, to freely access
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39 health care or at least at affordable cost. For instance, health care providers still ask patients to pay
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41 beforehand to get health care services. Yet, it is well known that out-of-pocket expenses can be a
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43 strong barrier to access good health care services with the immediate consequence of maintaining
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45 or increasing maternal mortality ratio in the country, therefore putting in jeopardy mothers and
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47 their children. It is time for action!
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13
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32 Program at <http://dhsprogram.com/publications/publication-fr221-dhs-final-reports.cfm>. Data are
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34 accessible free of charge upon a registration, through the website above, with the Demographic
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36 and Health Survey program (The DHS Program).
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38 39 40 **Ethics statement**

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42 **Patient consent for publication** Not required.
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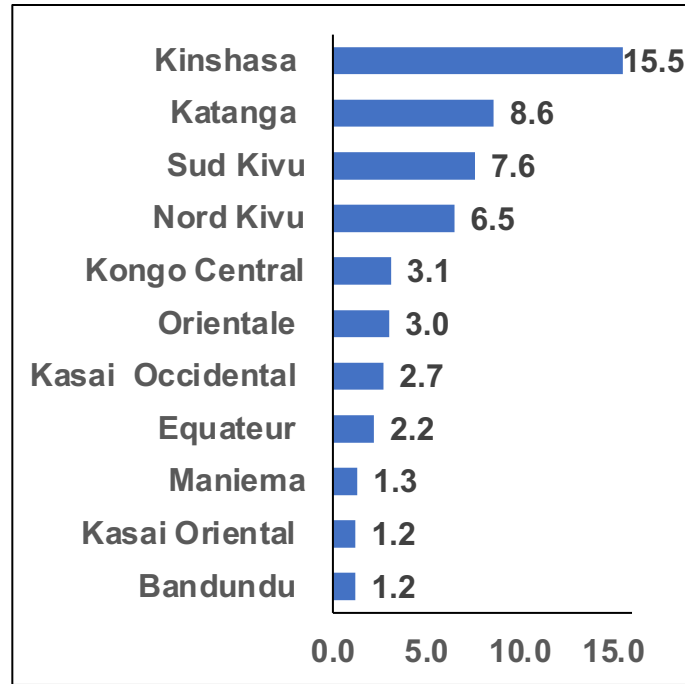
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Figure Legend:

Figure 1 - Percentage of women of reproductive ages owning health insurance in the Democratic Republic of the Congo

For peer review only



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CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	_____
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	_____
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	5-6
	2b	Specific objectives or hypotheses	5-6
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	_____
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	_____
Participants	4a	Eligibility criteria for participants	_____
	4b	Settings and locations where the data were collected	8
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	_____
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	_____
	6b	Any changes to trial outcomes after the trial commenced, with reasons	_____
Sample size	7a	How sample size was determined	_____
	7b	When applicable, explanation of any interim analyses and stopping guidelines	_____
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	_____
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	_____
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	_____
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	_____
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those	_____

		assessing outcomes) and how	
	11b	If relevant, description of the similarity of interventions	
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	12
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	12
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	
	13b	For each group, losses and exclusions after randomisation, together with reasons	
Recruitment	14a	Dates defining the periods of recruitment and follow-up	
	14b	Why the trial ended or was stopped	
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	13
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	16-17
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	3
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	3
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	
Other information			
Registration	23	Registration number and name of trial registry	
Protocol	24	Where the full trial protocol can be accessed, if available	
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	21

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.

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Health insurance coverage among women of reproductive ages in the Democratic Republic of the Congo: Do poverty and education matter?

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1
2
3 **Title:**

4
5 2 Health insurance coverage among women of reproductive ages in the Democratic
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7 3 Republic of the Congo: Do poverty and education matter?
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14 6 Zacharie Tsala Dimbuene, PhD^{1,2}

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16 7 Raphaël Muanza Nzuzi, M.Sc.¹

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18 8 Paul-Denis Nzita Kikhela, PhD¹

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32
33 14 ¹ Department of Population and Development Sciences, Faculty of Economics and
34
35 15 Management, University of Kinshasa, Democratic Republic of the Congo
36

37 16 ² Corresponding author:

38
39 17 Name: Zacharie Tsala Dimbuene

40
41
42 18 Affiliation: Department of Population and Development Sciences, University of Kinshasa,
43
44 19 Democratic Republic of the Congo
45

46 20 Email: zacharie.tsala.dimbuene@gmail.com
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3 **23 Abstract**

4
5 **24 Objective** To investigate inequalities of health insurance coverage (outcome) at sub-national level,
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7 and the effects of education and poverty on the outcome.
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9
10 **26 Design** Secondary analysis of Demographic and Health Surveys (DHS). The outcome variable was
11
12 health insurance ownership.
13

14 **28 Settings** The Democratic Republic of the Congo.

15
16 **29 Subjects** Women aged 15–49 years (n = 18,827).

17
18
19 **30 Results** Findings indicated significant spatial variations of the health insurance ownership which
20
21 ranged from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the Capital City.
22

23
24 **32** Furthermore, findings showed that an additional year of women education increased by 10% the
25
26 chance of health insurance ownership (Adjusted Odd Ratio—AOR: 1.098; 95%CI: 1.065—1.132).
27

28
29 **34** Finally, living in better-off households increased by 150% the chance of owing a health insurance
30
31 (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households.
32

33 **36 Conclusions** Given the low levels of health insurance coverage, the Democratic Republic of the
34
35 Congo will not reach the Sustainable Development Goal (SDG)—3, aimed at improving maternal
36
37 and child health unless a serious programmatic health shift is undertaken in the country to tackle
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39 inequalities among poor and uneducated women via universal health coverage (UHC).
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44 **Strengths and limitations**

- 45 • This paper used nationally representative data to disentangle inequalities of access to health
46 insurance at sub-national level.
- 47 • The cross-sectional nature of the data in the DHS limits the over-generalization of the findings,
48 making it impossible to infer causation between poverty, education, and health insurance
49 ownership.
- 50 • To better capture inequalities of health insurance coverage in the country, over-sampling of
51 women of reproductive ages in other provinces is necessary.
- 52 • Data collected in the DHSs may suffer from recall bias given the retrospective nature of self-
53 reported health insurance coverage among women.

54

56 Introduction

57 Health insurance serves as a protective mechanism in pooling financial resources of participants to
58 reduce the burden of out-of-pockets expenditures, which usually result in massive financial
59 barriers and impoverished life in the households.^{1,2} Previous studies pinpointed the financial
60 hardship of individuals and households resulting from a sub-optimal health insurance coverage.
61 They showed that direct healthcare spending in sub-Saharan Africa (SSA) is high and accounted
62 for 27% in Ghana,^{3,4} 37% in Ethiopia,⁵ and 42% in Kenya.⁶ Yet health insurance is pivotal for
63 SSA countries to achieve universal health care (UHC) and the reduction of maternal mortality.^{7,8}
64 For instance, studies from India found that health insurance promotes access to healthcare
65 utilisation and promotes equity.^{9,10} Furthermore, the inpatient rates of poor insured persons were
66 16.4% higher than poor uninsured persons.

67
68 In SSA, previous research found significant variations across countries in terms of health
69 insurance coverage.⁷ Indeed, health insurance coverage ranged from less than 1% in Chad to
70 62.4% in Ghana. This calls for context- or country-specific analyses to better understand
71 individual-level and community-level characteristics associated with health insurance coverage.
72 Ironically, while Japan is celebrating its 50th anniversary of UHC^{11,12} and countries like Thailand
73 and South Korea celebrate 30 years of UHC,^{13,14} alarmingly a marginal 8.5% of women of
74 reproductive ages in SSA have access to health insurance.⁷ As a result, most sub-Saharan Africa
75 (SSA) countries did not achieve Millennium Development Goals (MDG).^{15,16} Very likely, most
76 SSA countries will not achieve Sustainable Development Goals (SDG).¹⁷ Yet the United Nations
77 (UN) sought to promote “Health for all at all ages” by 2030, as reflected in the SDG Three.

78

79 Recent experiences in SSA countries showed promising results to expand health insurance to
80 community members.^{3,18–22} Evidence suggests that political involvement, good governance and
81 specifically strong and dynamic leadership are crucial to ensure the expansion of health in SSA
82 countries, and especially in the Democratic Republic of the Congo (DRC) where health insurance
83 coverage is extremely low at 5% among women of reproductive ages.^{7,23} There is currently no
84 publicly owned insurer,^{2,24,25} making it more difficult to own health insurance given the high
85 unemployment rates in the country since most health insurance schemes are offered through the
86 employer's plan.

87

88 **Social determinants of Health (SDoH) as a conceptual framework to analyze**

89 **optimal health insurance coverage**

90 This paper draws from the social determinants of health (SDoH) to better understand the effects of
91 poverty and education on health insurance coverage in the DRC. The first generation of studies on
92 population health emphasized medical conditions to understand how the health of populations are
93 shaped over time.²⁶ These studies showed significant drawbacks because they have neglected
94 social forces driving health of populations. Against this background, the second generation
95 included, in their inquiries to better understand the evolution of health over time, social forces that
96 interplay in shaping population health.^{26–28} This is referred to as the “social determinants of health
97 (SDoH)”.²⁹ The SDoH are a set of conditions in which people are born, grow up, work, live, and
98 age, and the wider set of forces and systems shaping the conditions of their daily life.³⁰ Studies by
99 Braveman and colleagues^{26,27} provide sound discussions about the influences of social factors on
100 health. In its initial format, the SDoH encompasses factors of multiple layers, including individual,
101 community, national and global level factors. Indeed, besides structural determinants (e.g., social
102 system, socioeconomic position, etc.), previous studies showed that material circumstances,

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3 103 behaviours, biological and psychological factors derived from the structural factors also affect the
4
5 104 health of populations.^{26,27} At the global level, there is increasing debate on the effects of climate
6
7 105 changes on health hazards.³¹
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12 107 This paper devotes a special attention to education and socioeconomic status proxied by household
13
14 108 wealth index (HWI) and their relationships with health insurance that is considered one's
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16 109 behaviours. It is hypothesized that holding health insurance coverage is contingent upon education
17
18 110 and HWI. Amid the scarcity of resources and rampant poverty, people might not consider health
19
20 111 insurance as a priority. Yet, out-of-pocket expenses are among the barriers that limit access to
21
22 112 affordable health care, and therefore exposing people to illnesses and deaths. The next two
23
24 113 sections focus on the interlinkages between education, poverty, and the ownership of health
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26 114 insurance.
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33 116 ***Education and health insurance.*** There are consistent findings across studies that education is
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35 117 positively and significantly associated with good health.^{32,33} According to this study, linkages
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37 118 between education and health can be understood via (i) work and economic conditions; (ii) social-
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39 119 psychological resources; and (iii) health lifestyle. Regarding health insurance, it is posited that the
40
41 120 effects of education are mediated through work and economic conditions. Indeed, more educated
42
43 121 people are more likely to be working and therefore benefit from employer's funded health
44
45 122 insurance scheme. Empirically, studies conducted in SSA countries confirmed this assumption.
46
47 123 For instance, a study in Burkina Faso showed that education level of head of household was
48
49 124 positively and significantly associated with knowledge and enrolment in health insurance
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51 125 scheme.³⁴ In contrast, a study in Ghana showed that education was not significantly associated
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53 126 with ownership of health insurance among women of reproductive ages even though the
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3 127 association went in the expected direction.³⁵ In a multi-country study including Kenya, Tanzania,
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5 128 Ghana and Nigeria, Amu et al.³⁶ found that education had a significant and positive association
6
7 129 with health insurance ownership for both females and males, even though the associations were
8
9 130 stronger in Kenya compared with other countries. For instance, females and males with higher
10
11 131 education were 15 times and 17 times more likely to own health insurance compared with their
12
13 132 counterparts with no education, respectively. Similar findings were reported in Kenya with
14
15 133 comparable datasets.³⁷
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21 135 ***Socioeconomic status and health insurance.*** There is abundant literature on the linkages between
22
23 136 socioeconomic status or position (hereafter, SES) and health. Previous research has established
24
25 137 that SES is a fundamental cause of inequalities.³¹⁻³³ On a theoretical point of view, and to be a
26
27 138 “fundamental cause of inequalities”, four criteria should be met. First, the cause influences multiple
28
29 139 health problems. It is important to stress out that the cause is not limited to one disease or health
30
31 140 problem. Second, the cause affects the disease through multiple risk factors. Third, the cause
32
33 141 determines access to other resources to avoid risks or mitigate the consequences of the disease
34
35 142 might it appears. Fourth, the effect of the cause on the disease should be reproduced over time via
36
37 143 the replacement of intervening mechanisms.³⁸ This theory emphasized the role of SES on health.
38
39 144 As with health insurance, it is posited that SES effects ownership of health insurance through
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41 145 lifestyles and behaviours. People with higher SES are more likely to be employed and therefore
42
43 146 they have more chances to own health insurance. Furthermore, people from higher SES are more
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45 147 likely to be educated and better understand the importance of health insurance. Indeed, resources
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47 148 of knowledge, power, money, prestige, and beneficial social connections are among others, factors
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49 149 that explain why people from a specific social class might benefit from good health.^{38,39} In fact,
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150 previous research emphasized the role of health behaviours to better understand the effect of
151 education on health.³²

152
153 Empirically, findings showed that poverty is a leading cause of economic loss and it increased the
154 vulnerability of the poor in Burkina Faso, Niger and Togo.⁴⁰ Likewise, Barasa et al.²³ showed that
155 SES was critical to further understanding of inequalities of health insurance coverage in SSA. This
156 study showed that health insurance coverage is inequitable in SSA, and it needs to be adequately
157 addressed if SSA countries want to reach SDG Three by 2030. A study conducted in Five
158 Francophone Africa countries (Benin, Madagascar, Mali, Niger, and Togo) using Demographic
159 and Health Surveys (DHSs) found that health insurance coverage was very low, ranging from
160 1.1% in Benin to 3.3% in Togo.⁴¹ Not only the study found significant variations between urban
161 and rural areas, it also reported that health insurance ownership was positively and significantly
162 associated with household wealth index. Overall, the likelihood of health insurance ownership was
163 higher among women living in better-off households compared with their counterparts in poor
164 households.

165
166 Although findings suggested a positive and significant relationship between SES and health
167 insurance ownership, one might be cautious to an over-generalization. Indeed, a systematic review
168 aimed at identifying barriers and facilitators to implementation, uptake, and sustainability of
169 community-based health insurance (CBHI) schemes in low- and middle-income countries
170 (LMICs) reported mixed effects of socioeconomic status on CBHI schemes.⁴² The pitfalls of this
171 conclusion rely on the variable measurement in the studies included in the systematic review.^{43–45}
172 These studies used different settings and various approaches to conceptualize and operationalize

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3 173 SES which might explain the mixed results observed in the papers included in the systematic
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5 174 review; therefore, the conclusion is debatable.
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9 176 **Methods**

10 177 **Data**

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14 178 The data utilized come from the 2013—2014 Demographic and Health Survey conducted in the
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17 179 Democratic Republic of the Congo (DRC-DHS 2013–14). This is a nationally representative
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19 180 survey, using a two-stage sampling design.⁴⁶ The first stage involved the selection of sample points
20
21 181 or clusters from an updated master sampling frame constructed in accordance with DRC's
22
23 182 administrative division in 26 provinces or domains. These domains were further stratified into
24
25 183 urban and rural areas. Urban areas neighbourhoods were sampled from cities and towns whereas
26
27 184 for rural areas villages and chiefdoms were sampled. The clusters were selected using systematic
28
29 185 sampling with probability proportional to size (PPS). Household listing was then conducted in all
30
31 186 the selected clusters to provide a sampling frame for the second stage selection of households. The
32
33 187 second stage of selection involved the systematic sampling of the households listed in each cluster,
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35 188 and households to be included in the survey were randomly selected from the list. The rationale for
36
37 189 the second stage selection was to ensure adequate numbers of completed individual interviews to
38
39 190 provide reliable estimates for key outcomes. DHSs collect information on households, women and
40
41 191 men of reproductive ages, anthropometric measures, contraception, and family planning among
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43 192 others. This paper reports on findings from women individual record file to construct the outcome
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45 193 and independent variables.
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52 195 **Variable measurement and operationalization**

53 196 ***Dependent variable***

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3 197 The outcome variable of this study was **health insurance ownership**. Women of reproductive
4
5 198 ages were asked a single question: “*Are you covered by any health insurance*”? The dependent
6
7 199 variable is coded 1 if the woman owned health insurance, 0 otherwise. Information about the type
8
9 200 of insurance was also collected (public vs. private). However, the low percentage of women owing
10
11 201 a health insurance did not allow an in-depth investigation to distinguish between public vs. private
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13 202 insurance.
14

15 203

19 204 ***Independent variables***

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21 205 The selection of independent variables included in the analyses was guided by the existing body of
22
23 206 literature on health insurance and universal health coverage.^{42,47,48} In the present study, variables
24
25 207 were grouped into two broad categories: individual- and household/community-level variables.
26
27

28 208 Individual-level variables included current women’s age (in years), education (in years
29
30 209 completed), marital status, religion, working status, index of media exposure, parity, antenatal care
31
32 210 attendance, and husband/partner’s education. The index of media exposure is a sum of three
33
34 211 questions pertaining to medias: watching television; listening radio; and reading newspapers.
35
36

37 212 Respondents were asked how often the watch TV, listen to radio, or read newspapers. Responses
38
39 213 were 0 “Not at all”; 1 “Less than once a week”; 2 “At least once a week”. The responses to these
40
41 214 three questions were summed up to get the index of media exposure. The higher the index of
42
43 215 media exposure, the more the woman was exposed to media influences. At household/community
44
45 216 level, the following variables were included: sex of the head of household; household wealth index
46
47 217 (HWI); community literacy level; community socioeconomic status; place of residence; and
48
49 218 province of residence. HWI was built using Principal Component Analysis (PCA); details have
50
51 219 been described elsewhere.⁴⁶ In this paper, a new grouping was done to include poor households
52
53 220 (40%), middle households (20%), and better-off households (40%). Community literacy measures
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221 the ability of women in the clusters to read effectively through the literacy variable *v155*. Women
222 in the cluster who can read was coded 1, and 0 otherwise. Thereafter, the average was computed,
223 and three terciles were defined as “*Low*”, “*Medium*” and “*Higher*”. Community socioeconomic
224 status (CSES) was defined using HWI. All better-off households in the cluster were coded 1, and a
225 mean was computed. Two quantiles were defined to get two categories of CSES: “*Low*” and
226 “*High*”.

228 **Analytical strategy**

229 ***Descriptive statistics***

230 The paper begins with bivariate analyses between the dependent variable and the set of putative
231 covariates using the Chi-square statistic to test significance associations. Given the nature of the
232 dependent variable (ownership of health insurance: 1 = Yes; 0 = No), only categorical variables
233 were included. There is a debate in the statistical literature on which variables to include in the
234 multivariable modeling based on the significance tests in bivariate analyses. In this paper, all
235 independent variables reaching statistical significance and there was no need to discuss this issue.

237 ***Modeling strategy***

238 For multivariate analyses, this paper utilizes multilevel modeling to investigate the effects of
239 context and to quantify the influences of women’s education and poverty on the ownership of
240 health insurance, controlling for variables at individual and household/community levels. This
241 choice is guided by the hierarchical nature of the data. Consequently, women from the same group
242 are assumably alike because they share a common set of characteristics, thus violating the standard
243 assumption of independence of observations, which could produce biased variance estimates when
244 failing to account for the clustering of observations. Additionally, multilevel modeling allows to

245 disentangle contextual from compositional effects by simultaneously modeling the effects of
 246 community- and individual-level predictors, with women as units of analysis.^{7,49} Two-level logistic
 247 regression models were performed as follows, in which i and j refer to individual- and community-
 248 level variables, respectively:

$$\text{logit}\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_0 + \sum_{k=1}^p \beta_k x_{ij}^k + \sum_{l=1}^q \delta_l z_j^l \quad (1.a)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (1.b)$$

250 The quantity π_{ij} is the probability that a sampled woman referenced (i, j) owns a health insurance;
 251 x_{ij}^k and z_j^l are the k^{th} individual-level covariate and l^{th} community-level covariate respectively; β_{0j}
 252 represents the intercept modelled to randomly vary across clusters; the estimates β_k and δ_l
 253 represent the regression coefficients of individual- and community-level covariates respectively;
 254 and u_{0j} is the random cluster residuals distributed as $N(0, \sigma_u^2)$.⁵⁰ Analyses were performed using
 255 STATA SE version 15 for macOS, accounting for the complex survey design of DHS data to
 256 ensure that findings are generalised to the entire population of women of reproductive ages in the
 257 country. Besides the null model allowing for a theoretical justification of multilevel modeling,
 258 three models were estimated. The first model included individual-level covariates to obtain
 259 adjusted odd ratios (AOR). The second model included household/community-level covariates.
 260 Finally, a full model including individual- and household/community-level covariates was
 261 performed.

263 **Model selection**

264 Model selection is largely discussed in the statistical literature.^{51–54} First, statistical literature
 265 suggests that p-values and tests based upon them can be less efficient, especially with large

266 samples.⁵³ Second, the goodness-of-fit used to assess the performance of model to fit the data can
267 be of limited utility in the presence of several candidate models.⁵⁵ In this paper, Aikake
268 Information Criterion (*AIC*) and Bayesian Information Criterion (*BIC*) are used to evaluate and
269 choose the best models.⁵²

271 **Ethics statement**

272 The DHS obtained ethical clearance from the Government recognised Ethical Review
273 Committees/Institutional Review Boards of the Democratic Republic of the Congo as well as the
274 Institutional Review Board of ICF International, USA, before the surveys were conducted. Written
275 informed consent was obtained from the women before participation. The authors of this paper
276 sought and obtained permission from the DHS programme to use the data. The data were
277 completely anonymised and therefore the authors did not seek further ethical clearance before their
278 use.

280 **Patient and public involvement**

281 Patients/public were not involved in the design or implementation of this study.

283 **Results**

284 ***Descriptive results***

285 Overall, 5% of women of reproductive ages in the DRC owns a health insurance (Table 1). Most
286 women owing a health insurance had an employer's plan (76%), while a sizeable percentage
287 (20%) of them subscribed in a mutual/community health insurance scheme. The paper is also
288 interested in spatial variations of health insurance ownership. Findings indicated significant

289 geographical variations of health insurance coverage in the DRC (Figure 1). While 15.5% of
 290 women of reproductive ages own a health insurance in Kinshasa the Capital City, a marginal
 291 percentage of 1.2% of women are insured in Bandundu, Kasai Occidental and Maniema. Put
 292 differently, health insurance coverage is a “new reality” in these provinces. From Table 1, findings
 293 indicated that women owing a health insurance lived in better-off households (10.4%), advantaged
 294 neighbourhoods (10.1%) and communities with high literacy level (10.6%); are urban residents
 295 (10.4%); and they are married to high-educated men (18.4%). Background characteristics of the
 296 sample and household/community-level factors are listed in online supplemental Table A.1.

297
 298 Table 1:
 299 Sociodemographics and health insurance among women of reproductive ages in the
 300 Democratic Republic of the Congo (*)

Variables	N (Weighted)	Dependent variable: Owns a health insurance				p-value
		%	No 95% CI	%	Yes 95% CI	
Individual-level characteristics						
Marital status						
Single	4,545	91.5	[89.5,93.1]	8.5	[6.9,10.5]	<0.001
Married or cohabiting	12,448	95.9	[94.9,96.7]	4.1	[3.3,5.1]	
Formerly married or cohabiting	1,834	97.8	[96.7,98.5]	2.2	[1.5,3.3]	
Religion						
Catholic	5,434	94.9	[93.1,96.2]	5.1	[3.8,6.9]	p = NS
Protestant	5,243	96	[94.5,97.1]	4.0	[2.9,5.5]	
Other Christians	7,377	94.2	[93.0,95.2]	5.8	[4.8,7.0]	
Other religions	773	96.2	[91.7,98.3]	3.8	[1.7,8.3]	
Working status						
No	6,979	93.5	[91.8,94.9]	6.5	[5.1,8.2]	p < 0.001
Yes	11,848	95.9	[95.0,96.6]	4.1	[3.4,5.0]	
Antenatal care attendance						
None	1,512	98.4	[97.2,99.1]	1.6	[0.9,2.8]	p < 0.001
1-3 ANC visits	12,230	94.6	[93.6,95.5]	5.4	[4.5,6.4]	
4+ ANC visits	5,085	95.0	[93.3,96.2]	5.0	[3.8,6.7]	
Husband/Partner's education						
No education	6,030	93.0	[91.3,94.4]	7.0	[5.6,8.7]	p < 0.001
Primary	3,375	99.1	[98.5,99.5]	0.9	[0.5,1.5]	
Secondary	8,294	97.1	[96.1,97.9]	2.9	[2.1,3.9]	
University or higher	1,128	81.6	[78.1,84.6]	18.4	[15.4,21.9]	
Household- and Community-level						

characteristics**Sex of household head**

Male	14,391	94.7	[93.5,95.6]	5.3	[4.4,6.5]	$p < 0.05$
Female	4,436	95.9	[94.6,96.9]	4.1	[3.1,5.4]	

Household Wealth Index

Poor (40%)	8,106	99.3	[98.9,99.6]	0.7	[0.4,1.1]	$p < 0.001$
Middle (20%)	3,655	98.6	[97.7,99.1]	1.4	[0.9,2.3]	
Rich (40%)	7,066	89.6	[87.9,91.2]	10.4	[8.8,12.1]	

Community Literacy Level

Low (33%)	6,342	98.7	[97.9,99.2]	1.3	[0.8,2.1]	$p < 0.001$
Medium (33%)	6,214	98.5	[97.3,99.2]	1.5	[0.8,2.7]	
High (34%)	6,271	89.4	[87.4,91.2]	10.6	[8.8,12.6]	

Community Socioeconomic Status

Low (50%)	11,868	98.7	[97.5,99.4]	1.3	[0.6,2.5]	$p < 0.001$
High (50%)	6,959	89.9	[87.9,91.6]	10.1	[8.4,12.1]	

Place of residence

Rural	12,157	98.2	[97.0,98.9]	1.8	[1.1,3.0]	$p < 0.001$
Urban	6,670	89.6	[87.7,91.3]	10.4	[8.7,12.3]	

Province of residence

Kinshasa	1,804	84.5	[81.2,87.3]	15.5	[12.7,18.8]	$p < 0.001$
Bandundu	2,473	98.8	[98.1,99.3]	1.2	[0.7,1.9]	
Kongo Central	945	96.9	[94.6,98.3]	3.1	[1.7,5.4]	
Equateur	2,696	97.8	[95.5,98.9]	2.2	[1.1,4.5]	
Kasai Occidental	1,461	97.3	[90.9,99.2]	2.7	[0.8,9.1]	
Kasai Oriental	2,073	98.8	[96.4,99.6]	1.2	[0.4,3.6]	
Katanga	2,196	91.4	[87.8,94.0]	8.6	[6.0,12.2]	
Maniema	855	98.7	[96.3,99.5]	1.3	[0.5,3.7]	
Nord Kivu	1,154	93.5	[84.9,97.3]	6.5	[2.7,15.1]	
Orientale	2,137	97.0	[94.6,98.4]	3.0	[1.6,5.4]	
Sud Kivu	1,033	92.4	[85.5,96.1]	7.6	[3.9,14.5]	
Total	18,827	95.0	[93.9,95.8]	5.0	[4.2,6.1]	

Note: (*) Table 1 includes only categorical variables. Continuous variables (age, education, index of media exposure, and number of children ever born) are not included here for practical reasons.

Source: DHS—2013-14

Multivariate findings

As mentioned in the analytical strategy, three models were performed. Using Aikake's Information Criteria (AIC) and Bayesian Information Criteria (BIC) to choose the best model among a set of candidate models, findings (Table 2) showed that the full model including both individual- and household/community-level variables better fit the data. This conclusion was confirmed in Table 2 with both *AIC* ($AIC = 4717.962$) and *BIC* ($BIC = 4984.625$). Therefore, this section focuses on findings in Table 3; Model 3.

314
 315 Table 2:
 316 Model selection of health insurance coverage among women in Democratic Republic of
 317 the Congo

Model	Aikake's Information Criterion (AIC)	Bayesian Information Criterion (BIC)
0	5171.725	5187.411
1	4841.876	4975.208
2	4909.624	5058.641
3	4717.962	4984.625

Source: DHS—2013-14

322 Table 3:
 323 Multilevel logistic regression of individual and contextual factors associated with health
 324 insurance coverage among women in the Democratic Republic of the Congo

VARIABLES	Model 0	Model 1	Model 2	Model 3
Individual-level characteristics				
Women current age		1.010 [0.994 - 1.025]		1.008 [0.993 - 1.023]
Woman's education (in completed years)		1.128*** [1.095 - 1.162]		1.098*** [1.065 - 1.132]
Marital status (Ref.: Single)				
Married or cohabiting		0.489*** [0.286 - 0.836]		0.587* [0.343 - 1.006]
Formerly married or cohabiting		0.300*** [0.164 - 0.549]		0.364*** [0.198 - 0.666]
Religion (Ref.: Catholic)				
Protestant		0.859 [0.668 - 1.105]		0.863 [0.672 - 1.109]
Other Christians		0.861 [0.694 - 1.069]		0.830* [0.668 - 1.032]
Other religions		0.879 [0.500 - 1.544]		0.877 [0.499 - 1.541]
Working status (Ref.: No)		0.990 [0.824 - 1.188]		1.054 [0.877 - 1.265]
Index of media exposure		1.810*** [1.515 - 2.163]		1.488*** [1.245 - 1.778]

Children ever born	1.062** [1.010 - 1.117]	1.054** [1.003 - 1.108]
Antenatal care attendance (Ref.: No ANC)		
1-3 ANC visits	1.167 [0.708 - 1.925]	1.035 [0.624 - 1.718]
4+ ANC visits	1.071 [0.641 - 1.788]	0.926 [0.551 - 1.555]
Husband or Partner's education (Ref.: No education)		
Primary	0.668 [0.372 - 1.198]	0.705 [0.393 - 1.264]
Secondary	1.033 [0.630 - 1.693]	0.959 [0.585 - 1.573]
University or higher	3.072*** [1.816 - 5.197]	2.564*** [1.516 - 4.335]
Household- and community-level characteristics		
Household Head is Female (Ref.: Male)		0.777** [0.636 - 0.948]
Household wealth index (Ref.: 40% poor)		0.829* [0.668 - 1.029]
Middle (20%)		1.691** [1.095 - 2.612]
Rich (40%)		3.949*** [2.593 - 6.015]
Community Literacy Level (Ref.: Low 33%)		
Medium (33%)		0.822 [0.467 - 1.446]
High (33%)		0.649 [0.370 - 1.139]
Community Socioeconomic Status—High (Ref.: 50% Low)		2.209** [1.087 - 4.488]
Urban residence (Ref.: Rural)		3.546*** [1.912 - 6.577]
Province of residence (Ref.: Kinshasa)		0.942 [0.623 - 1.425]
Bandundu		0.866 [0.570 - 1.314]
Kongo Central		0.363*** [0.168 - 0.784]
Equateur		0.408** [0.190 - 0.877]
Kasai Occidental		0.202*** [0.076 - 0.541]
Kasai Oriental		0.308** [0.116 - 0.817]
Katanga		0.651 [0.295 - 1.435]
Maniema		0.790 [0.361 - 1.729]
Nord Kivu		0.259*** [0.097 - 0.687]
Orientale		0.350** [0.133 - 0.919]
Sud Kivu		0.096*** [0.038 - 0.241]
		0.870 [0.423 - 1.791]
		1.156 [0.564 - 2.371]
		0.174*** [0.053 - 0.568]
		0.225** [0.069 - 0.726]
		0.941 [0.406 - 2.181]
		1.162 (0.502 - 2.689)
		0.684 [0.318 - 1.473]
		0.874 [0.408 - 1.874]
		0.864 [0.346 - 2.159]
		1.167 [0.467 - 2.916]

Intra-class correlation (ICC)	0.613 [0.534-0.679]	0.429 [0.359-0.504]	0.352 [0.268-0.425]	0.341 [0.275-0.415]
Observations	18,827	18,827	18,827	18,827
Number of groups	536	536	536	536

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327 Confidence Intervals in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1

328 AOR: Adjusted Odd Ratios in Models 1—3

329 Source: DHS—2013-14

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331 Before moving to estimates reported in Model 3, let's investigate Model 0 to see if the multilevel
 332 modeling is relevant for this study. The intraclass correlation (*ICC*) was 0.613 (61.3%). This is
 333 quite large, and it justifies the utilisation of multilevel modelling. The interpretation of findings in
 334 Model 3 starts with the association between two key independent variables: women's education (in
 335 completed years) and household wealth index (HWI), and health insurance ownership. First,
 336 findings indicated that each additional year of women education increased by 10% the chance of
 337 owing a health insurance (AOR: 1.098; 95%CI: 1.065—1.132). Second, living in better-off
 338 households increased by 150% the chance of owing a health insurance (AOR: 2.501; 95% CI:
 339 1.620—3.860) compared with women living in poor households (referred to as 40% bottom HWI).
 340 This confirms the assumptions that HWI and women's education are key covariates to better
 341 understand the ownership of health insurance in the DRC.

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343 Model 3 in Table 3 also reported interesting results both at individual and household/community
 344 level. At individual level, Model 3 indicated that husband/partner's education is of chief
 345 importance. Specifically, husbands/partners with university or higher are pivotal to explain
 346 women's ownership of health insurance. Indeed, being married to husbands/partners with a
 347 university degree or higher increased by 156% the chance of owing a health insurance (AOR:
 348 2.564; 95%CI: 1.516—4.335). The index of media exposure is also significantly associated with

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2
3 349 the ownership of health insurance. An increase of 1 unit of the index of media exposure increased
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5 350 by almost 50% the chance of owing a health insurance among women of reproductive ages (AOR:
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7 351 1.488; 95%CI: 1.245—1.778). In contrast, marital status showed counter-intuitive results: ever
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9 352 married women were less likely to be covered by health insurance compared to never married
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11 353 women.

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14 355 At household/community-level, community socioeconomic status (CSES) was positively and
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16 356 significantly associated with the ownership of health insurance. Indeed, living in advantaged
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18 357 neighbourhoods increased by 223% the chance of owing a health insurance (AOR: 3.232; 95%CI:
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20 358 1.746—5.983).

21 359 22 360 **Discussion**

23 361 From a policy perspective, most countries in sub-Saharan Africa (SSA) should align with
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25 362 Sustainable Development Goals (SDGs). However, less efforts have been done to improve the
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27 363 progress of SDGs at national and sub-national levels. This paper contributes to the existing
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29 364 literature in examining sub-national disparities of health insurance coverage using social
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31 365 determinants of health (SDoH) as a conceptual framework with an emphasis on education and
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33 366 socioeconomic status (SES) to better understand these disparities in the Democratic Republic of
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35 367 the Congo. Main findings of the paper are discussed below.

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38 369 First, health insurance coverage among women of reproductive ages is quite low at national as
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40 370 reported in previous studies with a marginal percentage (5%) having a health insurance.⁷ Similar
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42 371 studies reported extremely low percentage (2.8%) of health insurance ownership among women of
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44 372 reproductive ages in the DRC using same datasets.⁵⁶ Nonetheless, these findings have policy and

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3 373 programmatic implications in the DRC given the low coverage in health insurance. Such findings
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5 374 might also explain the poor quality of maternal and child health indicators in the DRC. Indeed,
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7 375 previous studies reported that maternal mortality ratio (MMR) in the DRC is very high, and it is
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9 376 estimated at 473 maternal deaths per 100,000 live births.⁵⁷ This is alarming because it also means
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11 377 that the country won't reach the SDG 3.1 aimed at reducing, by 2030, the MMR at 70 maternal
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13 378 deaths per 100,000 live births. Yet, obstetrical complications such as bleeding, eclampsia, sepsis
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15 379 and unsafe abortions, accounting for nearly 80% of the MMR cases require urgent and appropriate
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17 380 care which can be ease with health insurance coverage. Second, there are important geographical
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19 381 variations regarding health insurance coverage ranging from 1.2% in Bandundu and Kasai Oriental
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21 382 to 15.5% in Kinshasa the Capital City. With these figures, the DRC is lagging very behind
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23 383 regarding the SDG Three.
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30 385 Turning to the main hypothesis of the study, regarding the associations between education, SES,
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32 386 and health insurance coverage in the DRC, findings can be summarized as follows. An additional
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34 387 year of completed education increases by 10% the likelihood of owning health insurance among
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36 388 women of reproductive ages. This finding is consistent with previous studies.^{18,22,23,42} However,
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38 389 the plausible explanations from previous studies do not suffice in the context of the DRC. Indeed,
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40 390 previous research stated that educated women may be exposed to much more health information
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42 391 which increases their likelihood to subscribe to health insurance coverage. In the context of higher
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44 392 unemployment rates, education per se might not suffice to explain why educated women are more
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46 393 likely to own health insurance coverage. This study suggests another explanation given that health
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48 394 insurance coverage is higher in Kinshasa the Capital City compared with other provinces.
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50 395 Educated women are more likely to work and therefore increasing their chances to own health
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52 396 insurance coverage. In fact, preliminary findings showed that 62% of surveyed women were
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3 397 working at the time of the survey. Surprisingly, the likelihood to own health insurance was higher
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5 398 among not-working women compared with their working counterparts. DHSs do not capture the
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7 399 sector (public vs. private) where women work. The high unemployment rates in the country and
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9 400 the widespread of informal sector can explain this finding. If most women work in informal sector,
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11 401 it is likely that they will not have health insurance coverage. Therefore, more research is needed to
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13 402 unpack this intriguing finding, and to suggest other paths of influence. The fact that less educated
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15 403 women have lesser likelihood to own health insurance also means that policymakers and
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17 404 stakeholders working to improve health conditions in the DRC need to pay more attention to
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19 405 women's education as a precondition to increase access to health insurance. This finding also
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21 406 holds at community level because women of reproductive ages living in communities with high
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23 407 literacy level were more likely to own health insurance.
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30 409 With regards to SES, findings indicated that women of reproductive ages living in better-off
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32 410 households and advantaged neighbourhoods had higher chances to own health insurance compared
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34 411 with their counterparts in poor households and disadvantaged neighbourhoods. This finding is in
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36 412 lines with previous research.²³ In the DRC, there are fewer initiatives of spreading health insurance
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38 413 at individual and community levels. Yet, this is crucial for the country to achieve by 2030 the SDG
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40 414 Three. Previous posited that unequal exposure to media might explain such differences in health
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42 415 insurance coverage.²³ In sum, there are no clear policies in the DRC aimed at reducing the
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44 416 inequalities to media exposure, doubled with higher unemployment rates in the country which
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46 417 together limit the ability to seek correct health information among women of reproductive ages.
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53 419 The study has a few strengths and limitations. Using a nationally representative sample to analyse
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55 420 the disparities in health insurance at provincial level is an important strength, thereby providing
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3 421 robust estimates of observed associations between poverty, education, and ownership of health
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5 422 insurance. The use of multilevel modeling also helps to identify the potential factors of influence
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7 423 that policymakers can target to improve access to health insurance, to increase universal health
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9 424 coverage, and ultimately to reach the SDG Three in the DRC and other SSA countries. Finally,
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11 425 looking into health insurance at provincial level reinforce the importance of context-specific
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13 426 interventions because findings showed significant variations across provinces which needs to be
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15 427 considered to reduce health inequalities. The cross-sectional nature of data used in the paper is a
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17 428 limitation which does not allow determining causality between our main independent variables
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19 429 (HWI and education) and the ownership of health insurance. Therefore, findings in this paper
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21 430 should be interpreted in terms of associations and no definite conclusions can be drawn regarding
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23 431 the potential influences of poverty and education on health insurance coverage. Further research is
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25 432 needed to better understand these potential influences.
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33 434 **Conclusion**

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35 435 This cross-sectional study examined the associations between two key social determinants of
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37 436 health (poverty and education) and health insurance coverage in the Democratic Republic of the
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39 437 Congo. Findings showed that UHC is alarmingly low in the DRC like in other SSA countries. The
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41 438 study also found significant disparities across provinces, and between poor and rich.
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44 439 Programmatically, that means the RDC will not reach SDG Three aimed at improving maternal
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46 440 and child health. Yet Universal Health Coverage (UHC) is pivotal to achieve SDG Three in SSA
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48 441 countries. To improve maternal and child health in the country, policymakers and stakeholders
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50 442 should tackle inequalities between poor and rich and devise interventions to equip poor to better
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52 443 understand the importance of health insurance coverage given the existing rampant and secular
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54 444 poverty. Unlike countries such as Ghana with a sustainable national health insurance
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3 445 scheme,^{3,19,58,59} the DRC has not yet developed and implemented a strong health insurance scheme
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5 446 to help people, especially poor, to freely access health care or at affordable cost. The fact that out-
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7 447 of-pocket expenditures are the major mode of payments for health care in the DRC constitutes a
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9 448 serious threat to UHC and the achievement of SDG Three. It was shown that out-of-pocket
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11 449 expenses is a strong barrier to access good health care services with the immediate consequence of
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13 450 maintaining or increasing maternal mortality ratio in the country, therefore putting in jeopardy
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15 451 mothers and their children.
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20
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29
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31
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33
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35
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469 **Ethics statement**

470 **Patient consent for publication** Not required.

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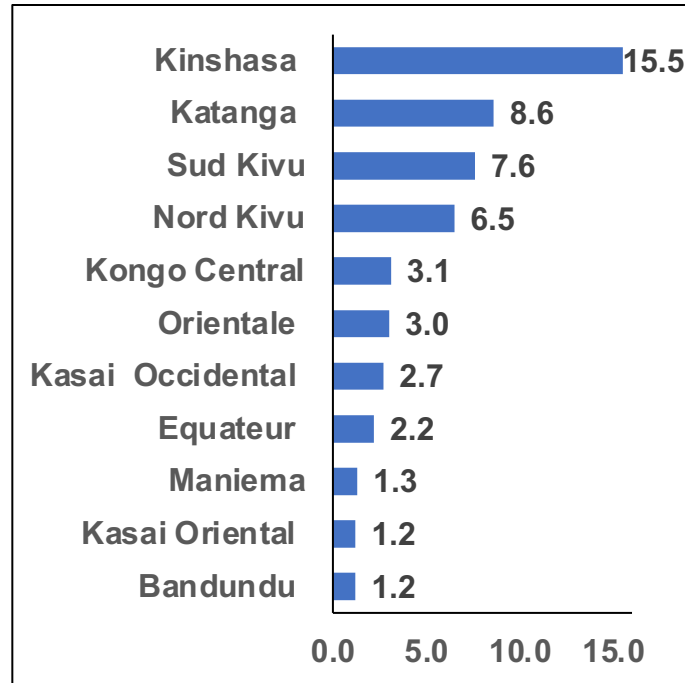
661 Figure Legend:

662 Figure 1 - Percentage of women of reproductive ages owning health insurance in the
663 Democratic Republic of the Congo

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Table A.1: Description of the sample

Variables	N	% or M±S.D.
Individual-level variables		
Age (in years)	18,827	28.1±9.3
Education (in years completed)	18,827	6.1±4.1
Marital status		
Single	4,545	26.0
Married or cohabiting	12,448	64.2
Formerly married or cohabiting	1,834	9.7
Religion		
Catholic	5,434	29.7
Protestant	5,243	26.8
Other Christians	7,377	40.0
Other religions	773	3.5
Is currently working		
Is not working	6,979	38.2
Is working	11,848	61.8
Number of antenatal care visits		
None	1,512	6.2
1-3 ANC visits	12,230	65.5
4+ ANC visits	5,085	28.2
Husband/Partner education		
No education	1,462	7.7
Primary	3,342	15.6
Secondary	8,095	43.7
Higher	926	7.0
Is Missing	4,224	26.0
Household- and Community-level variables		
Household Head is Female		
Male	14,391	76.2
Female	4,436	23.8
Household Wealth Index		
Poor (40%)	8,106	37.6
Middle (20%)	3,655	18.6
Rich (40%)	7,066	43.7
Community Literacy Level		
Low (33%)	6,342	26.0
Medium (33%)	6,214	34.2
High (34%)	6,271	39.8
Community Socioeconomic Status		
Low (50%)	11,868	57.3
High (50%)	6,959	42.7
Place of residence		
Rural	12,157	62.5
Urban	6,670	37.5
Province of residence		
Kinshasa	1,804	12.0
Bandundu	2,473	16.0
Kongo Central	945	4.6
Equateur	2,696	13.1
Kasai Occidental	1,461	6.4
Kasai Oriental	2,073	9.8
Katanga	2,196	9.6
Maniema	855	3.0
Nord Kivu	1,154	8.6
Orientale	2,137	9.7
Sud Kivu	1,033	7.3
Total	18,827	100



CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	_____
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	_____
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	4—8
	2b	Specific objectives or hypotheses	6
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	_____
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	_____
Participants	4a	Eligibility criteria for participants	_____
	4b	Settings and locations where the data were collected	9
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	_____
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	_____
	6b	Any changes to trial outcomes after the trial commenced, with reasons	_____
Sample size	7a	How sample size was determined	_____
	7b	When applicable, explanation of any interim analyses and stopping guidelines	_____
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	_____
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	_____
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	_____
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	_____
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those	_____

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1		assessing outcomes) and how	
2		11b If relevant, description of the similarity of interventions	
3	Statistical methods	12a Statistical methods used to compare groups for primary and secondary outcomes	11—13
4		12b Methods for additional analyses, such as subgroup analyses and adjusted analyses	11—13
5			
6	Results		
7	Participant flow (a	13a For each group, the numbers of participants who were randomly assigned, received intended treatment, and	
8	diagram is strongly	were analysed for the primary outcome	
9	recommended)	13b For each group, losses and exclusions after randomisation, together with reasons	
10	Recruitment	14a Dates defining the periods of recruitment and follow-up	
11		14b Why the trial ended or was stopped	
12	Baseline data	15 A table showing baseline demographic and clinical characteristics for each group	
13	Numbers analysed	16 For each group, number of participants (denominator) included in each analysis and whether the analysis was	
14		by original assigned groups	
15	Outcomes and	17a For each primary and secondary outcome, results for each group, and the estimated effect size and its	14—15
16	estimation	precision (such as 95% confidence interval)	
17		17b For binary outcomes, presentation of both absolute and relative effect sizes is recommended	14—17
18	Ancillary analyses	18 Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing	
19		pre-specified from exploratory	
20	Harms	19 All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	
21			
22	Discussion		
23	Limitations	20 Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	3, 21—22
24	Generalisability	21 Generalisability (external validity, applicability) of the trial findings	3, 21—22
25	Interpretation	22 Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	
26			
27	Other information		
28	Registration	23 Registration number and name of trial registry	
29	Protocol	24 Where the full trial protocol can be accessed, if available	
30	Funding	25 Sources of funding and other support (such as supply of drugs), role of funders	23

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.

BMJ Open

Poverty, education, and health insurance coverage among women of reproductive ages in the Democratic Republic of the Congo: a cross-sectional and multilevel analysis

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Keywords:	PUBLIC HEALTH, Community child health < PAEDIATRICS, Maternal medicine < OBSTETRICS

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3 **Title:**

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5 2 Poverty, education, and health insurance coverage among women of reproductive ages
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7 3 in the Democratic Republic of the Congo: a cross-sectional and multilevel analysis
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14 6 Zacharie Tsala Dimbuene, PhD^{1,2}

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16 7 Raphaël Muanza Nzuzi, M.Sc.¹

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18 8 Paul-Denis Nzita Kikhela, PhD¹

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31
32 14 ¹ Department of Population and Development Sciences, Faculty of Economics and

33
34 15 Management, University of Kinshasa, Democratic Republic of the Congo

35
36 16 ² Corresponding author:

37
38 17 Name: Zacharie Tsala Dimbuene

39
40 18 Affiliation: Department of Population and Development Sciences, University of Kinshasa,

41
42 19 Democratic Republic of the Congo

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44 20 Email: zacharie.tsala.dimbuene@gmail.com

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3 **23 Abstract**

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5 **24 Objective** To investigate inequalities of health insurance coverage (outcome) at sub-national level,
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7 and the effects of education and poverty on the outcome.
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10 **26 Design** Secondary analysis of Demographic and Health Surveys (DHS). The outcome variable was
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12 health insurance ownership.
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14 **28 Setting** The Democratic Republic of the Congo.

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16 **29 Subjects** Women aged 15–49 years (n = 18,827).

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18 **30 Results** Findings indicated significant spatial variations of the health insurance ownership which
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20 ranged from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the Capital City.
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24 **32** Furthermore, findings showed that an additional year of women education increased by 10% the
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26 chance of health insurance ownership (Adjusted Odd Ratio—AOR: 1.098; 95%CI: 1.065—1.132).
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29 **34** Finally, living in better-off households increased by 150% the chance of owing a health insurance
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31 (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households.
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33 **36 Conclusions** Given the low levels of health insurance coverage, the Democratic Republic of the
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35 Congo will not reach the Sustainable Development Goal (SDG)—3, aimed at improving maternal
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37 and child health unless a serious programmatic health shift is undertaken in the country to tackle
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39 inequalities among poor and uneducated women via universal health coverage (UHC).
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44 **Strengths and limitations**

- 45 • This paper used nationally representative data to disentangle inequalities of access to health
46 insurance at sub-national level.
- 47 • The cross-sectional nature of the data in the DHS limits the over-generalization of the findings,
48 making it impossible to infer causation between poverty, education, and health insurance
49 ownership.
- 50 • To better capture inequalities of health insurance coverage in the country, over-sampling of
51 women of reproductive ages in other provinces is necessary.
- 52 • Data collected in the DHSs may suffer from recall bias given the retrospective nature of self-
53 reported health insurance coverage among women.

54

56 Introduction

57 Health insurance serves as a protective mechanism in pooling financial resources of participants to
58 reduce the burden of out-of-pockets expenditures, which usually result in massive financial
59 barriers and impoverished life in the households.^{1,2} Previous studies pinpointed the financial
60 hardship of individuals and households resulting from a sub-optimal health insurance coverage.
61 They showed that direct healthcare spending in sub-Saharan Africa (SSA) is high and accounted
62 for 27% in Ghana,^{3,4} 37% in Ethiopia,⁵ and 42% in Kenya.⁶ Yet health insurance is pivotal for
63 SSA countries to achieve universal health care (UHC) and the reduction of maternal mortality.^{7,8}
64 For instance, studies from India found that health insurance promotes access to healthcare
65 utilisation and promotes equity.^{9,10} Furthermore, the inpatient rates of poor insured persons were
66 16.4% higher than poor uninsured persons.

67
68 In SSA, previous research found significant variations across countries in terms of health
69 insurance coverage.⁷ Indeed, health insurance coverage ranged from less than 1% in Chad to
70 62.4% in Ghana. This calls for context- or country-specific analyses to better understand
71 individual-level and community-level characteristics associated with health insurance coverage.
72 Ironically, while Japan is celebrating its 50th anniversary of UHC^{11,12} and countries like Thailand
73 and South Korea celebrate 30 years of UHC,^{13,14} alarmingly a marginal 8.5% of women of
74 reproductive ages in SSA have access to health insurance.⁷ As a result, most SSA countries did not
75 achieve Millennium Development Goals (MDG).^{15,16} Very likely, most SSA countries will not
76 achieve Sustainable Development Goals (SDG).¹⁷ Yet the United Nations (UN) sought to promote
77 “Health for all at all ages” by 2030, as reflected in the SDG Three.

78

79 Recent experiences in SSA countries showed promising results in expanding health insurance to
80 community members.^{3,18–22} Evidence suggests that political involvement, good governance and
81 specifically strong and dynamic leadership are crucial to ensure the expansion of health in SSA
82 countries, and especially in the Democratic Republic of the Congo (DRC) where health insurance
83 coverage is extremely low at 5% among women of reproductive ages.^{7,23} There is currently no
84 publicly owned insurer,^{2,24,25} making it more difficult to own health insurance given the high
85 unemployment rates in the country since most health insurance schemes are offered through the
86 employer's plan.

87

88 **Social determinants of Health (SDoH) as a conceptual framework to analyze**

89 **optimal health insurance coverage**

90 This paper draws from the social determinants of health (SDoH) to better understand the effects of
91 poverty and education on health insurance coverage in the DRC. The first generation of studies on
92 population health emphasized medical conditions to understand how the health of populations are
93 shaped over time.²⁶ These studies showed significant drawbacks because they have neglected
94 social forces driving health of populations. Against this background, the second generation
95 included, in their inquiries to better understand the evolution of health over time, social forces that
96 interplay in shaping population health.^{26–28} This is referred to as the “social determinants of health
97 (SDoH)”.²⁹ The SDoH are a set of conditions in which people are born, grow up, work, live, and
98 age, and the wider set of forces and systems shaping the conditions of their daily life.³⁰ Studies by
99 Braveman and colleagues^{26,27} provide sound discussions about the influences of social factors on
100 health. In its initial format, the SDoH encompasses factors of multiple layers, including individual,
101 community, national and global level factors. Indeed, besides structural determinants (e.g., social
102 system, socioeconomic position, etc.), previous studies showed that material circumstances,

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3 103 behaviours, biological and psychological factors derived from the structural factors also affect the
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5 104 health of populations.^{26,27} At the global level, there is increasing debate on the effects of climate
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7 105 change on health hazards.³¹
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12 107 This paper devotes a special attention to education and socioeconomic status proxied by household
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14 108 wealth index (HWI), and their relationships with health insurance that is considered one's
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16 109 behaviours. It is hypothesized that health insurance coverage is contingent upon education and
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18 110 HWI. Amid the scarcity of resources and rampant poverty, people might not consider health
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20 111 insurance as a priority. Yet, out-of-pocket expenses are among the barriers that limit access to
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22 112 affordable health care, and therefore exposing people to illnesses and deaths. The next two
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24 113 sections focus on the interlinkages between education, poverty, and the ownership of health
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26 114 insurance.
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33 116 ***Education and health insurance.*** There are consistent findings across studies that education is
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35 117 positively and significantly associated with good health.^{32,33} According to these studies, linkages
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37 118 between education and health can be understood via (i) work and economic conditions; (ii) social-
38
39 119 psychological resources; and (iii) health lifestyle. Regarding health insurance, it is posited that the
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41 120 effects of education are mediated through work and economic conditions. Indeed, more educated
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43 121 people are more likely to be working and therefore benefit from employer's funded health
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45 122 insurance scheme. Empirically, studies conducted in SSA countries confirmed this assumption.
46
47 123 For instance, a study in Burkina Faso showed that education level of head of household was
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49 124 positively and significantly associated with knowledge and enrolment in health insurance
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51 125 scheme.³⁴ In contrast, a study in Ghana showed that education was not significantly associated
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53 126 with ownership of health insurance among women of reproductive ages even though the
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3 127 association went in the expected direction.³⁵ In a multi-country study including Kenya, Tanzania,
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5 128 Ghana and Nigeria, Amu et al.³⁶ found that education had a significant and positive association
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7 129 with health insurance ownership for both females and males, even though the associations were
8
9 130 stronger in Kenya compared with other countries. For instance, females and males with higher
10
11 131 education were 15 times and 17 times more likely to own health insurance compared with their
12
13 132 counterparts with no education, respectively. Similar findings were reported in Kenya with
14
15 133 comparable datasets.³⁷
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21 135 ***Socioeconomic status and health insurance.*** There is abundant literature on the linkages between
22
23 136 socioeconomic status or position (hereafter, SES) and health. Previous research has established
24
25 137 that SES is a fundamental cause of inequalities.³¹⁻³³ On a theoretical point of view, and to be a
26
27 138 “fundamental cause of inequalities”, four criteria should be met. First, the cause influences multiple
28
29 139 health problems. It is important to stress out that the cause is not limited to one disease or health
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31 140 problem. Second, the cause affects the disease through multiple risk factors. Third, the cause
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33 141 determines access to other resources to avoid risks or mitigate the consequences of the disease
34
35 142 might it appears. Fourth, the effect of the cause on the disease should be reproduced over time via
36
37 143 the replacement of intervening mechanisms.³⁸ This theory emphasized the role of SES on health.
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39 144 As with health insurance, it is posited that SES affects ownership of health insurance through
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41 145 lifestyles and behaviours. People with higher SES are more likely to be employed and therefore
42
43 146 they have more chances to own health insurance. Furthermore, people from higher SES are more
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45 147 likely to be educated and better understand the importance of health insurance. Indeed, resources
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47 148 of knowledge, power, money, prestige, and beneficial social connections are among others, factors
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49 149 that explain why people from a specific social class might benefit from good health.^{38,39} In fact,
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150 previous research emphasized the role of health behaviours to better understand the effect of
151 education on health.³²

152
153 Empirically, findings showed that poverty was a leading cause of economic loss and it increased
154 the vulnerability of the poor in Burkina Faso, Niger and Togo.⁴⁰ Likewise, Barasa et al.²³ showed
155 that SES was critical to further our understanding of inequalities of health insurance coverage in
156 SSA. The study showed that health insurance coverage is inequitable in SSA, and it needs to be
157 adequately addressed if SSA countries want to reach SDG Three by 2030. A study conducted in
158 Five Francophone Africa countries (Benin, Madagascar, Mali, Niger, and Togo) using
159 Demographic and Health Surveys (DHSs) found that health insurance coverage was very low,
160 ranging from 1.1% in Benin to 3.3% in Togo.⁴¹ Not only the study found significant variations
161 between urban and rural areas, it also reported that health insurance ownership was positively and
162 significantly associated with household wealth index. Overall, the likelihood of health insurance
163 ownership was higher among women living in better-off households compared with their
164 counterparts in poor households.

165
166 Although findings suggested a positive and significant relationship between SES and health
167 insurance ownership, one might be cautious to an over-generalization. Indeed, a systematic review
168 aimed at identifying barriers and facilitators to implementation, uptake, and sustainability of
169 community-based health insurance (CBHI) schemes in low- and middle-income countries
170 (LMICs) reported mixed effects of socioeconomic status on CBHI schemes.⁴² The pitfalls of this
171 conclusion rely on variable measurement in the studies included in the systematic review.⁴³⁻⁴⁵
172 These studies used different settings and various approaches to conceptualize and operationalize

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3 173 SES which might explain the mixed results observed in the papers included in the systematic
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5 174 review; therefore, the conclusion is debatable.
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8 9 176 **Methods**

10 177 **Data**

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14 178 The data utilized come from the 2013—2014 Demographic and Health Survey conducted in the
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17 179 Democratic Republic of the Congo (DRC-DHS 2013–14). This is a nationally representative
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19 180 survey, using a two-stage sampling design.⁴⁶ The first stage involved the selection of sample points
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21 181 or clusters from an updated master sampling frame constructed in accordance with DRC's
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23 182 administrative division in 26 provinces or domains. These domains were further stratified into
24
25 183 urban and rural areas. Urban areas neighbourhoods were sampled from cities and towns whereas
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27 184 for rural areas villages and chiefdoms were sampled. The clusters were selected using systematic
28
29 185 sampling with probability proportional to size (PPS). Household listing was then conducted in all
30
31 186 the selected clusters to provide a sampling frame for the second stage selection of households. The
32
33 187 second stage of selection involved the systematic sampling of the households listed in each cluster,
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35 188 and households to be included in the survey were randomly selected from the list. The rationale for
36
37 189 the second stage selection was to ensure adequate numbers of completed individual interviews to
38
39 190 provide reliable estimates for key outcomes. Between November 2013 and February 2014, DHSs
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41 191 collect information on households, women (15—49 years) and men (15—59 years) of
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43 192 reproductive ages, including anthropometric measures, contraception, and family planning among
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45 193 others. This paper reports on findings from women individual record file to construct the outcome
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47 194 and independent variables.
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54 196 **Variable measurement and operationalization**

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3 197 ***Dependent variable***

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5 198 The outcome variable of this study was **health insurance ownership**. Women of reproductive
6
7 199 ages were asked a single question: “*Are you covered by any health insurance*”? The dependent
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9 200 variable is coded 1 if the woman owned health insurance, 0 otherwise. Information about the type
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11 201 of insurance was also collected (public vs. private). However, the low percentage of women owing
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13 202 a health insurance did not allow an in-depth investigation to distinguish between public vs. private
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15 203 insurance.
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21 205 ***Independent variables***

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23 206 The existing body of literature on health insurance and universal health coverage^{42,47,48} guided the
24
25 207 selection of independent variables included in the analyses, which were grouped into two broad
26
27 208 categories: individual- and household/community-level variables. Individual-level variables
28
29 209 included current women’s age (in years), education (in years completed), marital status, religion,
30
31 210 working status, index of media exposure, parity, antenatal care attendance, and husband/partner’s
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33 211 education. The index of media exposure is a sum of three questions related to medias: watching
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35 212 television; listening radio; and reading newspapers. Respondents were asked how often the watch
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37 213 TV, listen to radio, or read newspapers. Responses included 0 “Not at all”; 1 “Less than once a
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39 214 week”; 2 “At least once a week”. Responses to these three questions were summed up to get the
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41 215 index of media exposure. The higher the index of media exposure, the more the woman was
42
43 216 exposed to media influences. At household/community level, the following variables were
44
45 217 included: sex of the head of household; household wealth index (HWI); community literacy level;
46
47 218 community socioeconomic status; place of residence; and province of residence. HWI was built
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49 219 using Principal Component Analysis (PCA); details have been described elsewhere.⁴⁶ In this
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51 220 paper, a new grouping was done to include poor households (40%), middle households (20%), and
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221 better-off households (40%). Community literacy measures the ability of women in the clusters to
222 read effectively through the literacy from the variable *v155* in the original dataset. Women in the
223 cluster who can read was coded 1, and 0 otherwise. Thereafter, the average was computed, and
224 three terciles were defined as “*Low*”, “*Medium*” and “*Higher*”. Community socioeconomic status
225 (CSES) was defined using HWI. All better-off households in the cluster were coded 1, and the
226 mean was computed. Two quantiles were defined to get two categories of CSES: “*Low*” and
227 “*High*”.

229 **Analytical strategy**

230 ***Descriptive statistics***

231 The paper begins with bivariate analyses between the dependent variable and the set of putative
232 covariates using the Chi-square statistic to test significance associations. Given the nature of the
233 dependent variable (ownership of health insurance: 1 = *Yes*; 0 = *No*), only categorical variables
234 were included at this stage. There is a debate in the statistical literature on which variables to
235 include in the multivariable modeling based on the significance tests in bivariate analyses. In this
236 paper, all independent variables reached statistical significance and there was no need to further
237 discuss this issue.

239 ***Modeling strategy***

240 For multivariate analyses, this paper utilizes multilevel modeling to investigate the effects of
241 context and to quantify the influences of women’s education and poverty on the ownership of
242 health insurance, controlling for variables at individual and household/community levels. The
243 hierarchical nature of the data guided this choice. Since women from the same group are
244 assumably alike because they share a common set of characteristics, this violates the standard

245 assumption of independence of observations, which could produce biased variance estimates when
 246 failing to account for the clustering of observations. Furthermore, multilevel modeling allows to
 247 disentangle contextual from compositional effects by simultaneously modeling the effects of
 248 community- and individual-level predictors, with women as units of analysis.^{7,49} Two-level logistic
 249 regression models were performed as follows, in which i and j refer to individual- and community-
 250 level variables, respectively:

$$\text{logit}\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_0 + \sum_{k=1}^p \beta_k x_{ij}^k + \sum_{l=1}^q \delta_l z_j^l \quad (1.a)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (1.b)$$

251
 252 The quantity π_{ij} is the probability that a sampled woman referenced (i, j) owns a health insurance;
 253 x_{ij}^k and z_j^l are the k^{th} individual-level covariate and l^{th} community-level covariate respectively; β_{0j}
 254 represents the intercept modelled to randomly vary across clusters; the estimates β_k and δ_l
 255 represent the regression coefficients of individual- and community-level covariates respectively;
 256 and u_{0j} is the random cluster residuals distributed as $N(0, \sigma_u^2)$.⁵⁰ Analyses were performed using
 257 STATA SE version 15 for macOS, accounting for the complex survey design of DHS data to
 258 ensure that findings are generalised to the entire population of women of reproductive ages in the
 259 country. Besides the null model allowing for a theoretical justification of multilevel modeling,
 260 three models were estimated. The first model included individual-level covariates to obtain
 261 adjusted odd ratios (AOR). The second model included household/community-level covariates.
 262 Finally, a full model including individual- and household/community-level covariates was
 263 performed.

265 **Model selection**

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3 266 Model selection is discussed in the statistical literature.^{51–54} First, statistical literature suggests that
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5 267 p-values and tests based upon them can be less efficient, especially with large samples.⁵³ Second,
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7 268 the goodness-of-fit used to assess the performance of model to fit the data can be of limited utility
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10 269 in the presence of several candidate models.⁵⁵ In this paper, Aikake Information Criterion (*AIC*)
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12 270 and Bayesian Information Criterion (*BIC*) are used to evaluate and choose the best models.⁵²
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16 272 **Ethics statement**

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19 273 The DHS obtained ethical clearance from the Government recognised Ethical Review
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21 274 Committees/Institutional Review Boards of the Democratic Republic of the Congo as well as the
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23 275 Institutional Review Board of ICF International (United States of America), before the surveys
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26 276 were conducted. Written informed consent was obtained from the women before participation. The
27
28 277 authors of this paper sought and obtained permission from the DHS programme to use the data.
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30 278 The data were completely anonymised and therefore the authors did not seek further ethical
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33 279 clearance before their use.
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37 281 **Patient and public involvement**

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40 282 Patients/public were not involved in the design or implementation of this study.
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45 284 **Results**

47 285 ***Descriptive results***

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50 286 Overall, 5% of women of reproductive ages in the DRC owns a health insurance (Table 1). Most
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52 287 women owing a health insurance had an employer's plan (76%), while a sizeable percentage
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55 288 (20%) of them subscribed in a mutual/community health insurance scheme. The paper was also
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289 interested in spatial variations of health insurance ownership. Findings indicated significant
 290 geographical variations of health insurance coverage in the DRC (Figure 1). While 15.5% of
 291 women of reproductive ages own a health insurance in Kinshasa the Capital City, a marginal
 292 percentage of 1.2% of women are insured in Bandundu, Kasai Occidental and Maniema. Put
 293 differently, health insurance coverage is a “new reality” in these provinces. From Table 1, findings
 294 showed that women owing a health insurance lived in better-off households (10.4%), advantaged
 295 neighbourhoods (10.1%) and communities with high literacy level (10.6%); are urban residents
 296 (10.4%); and they are married to high-educated men (18.4%). Background characteristics of the
 297 sample and household/community-level factors are listed in online supplemental Table A.1.

299 Table 1:

300 Sociodemographics and health insurance among women of reproductive ages in the
 301 Democratic Republic of the Congo (*)

Variables	N (Weighted)	Dependent variable: Owns a health insurance				p-value
		%	No 95% CI	%	Yes 95% CI	
Individual-level characteristics						
Marital status						
Single	4,545	91.5	[89.5,93.1]	8.5	[6.9,10.5]	<0.001
Married or cohabiting	12,448	95.9	[94.9,96.7]	4.1	[3.3,5.1]	
Formerly married or cohabiting	1,834	97.8	[96.7,98.5]	2.2	[1.5,3.3]	
Religion						
Catholic	5,434	94.9	[93.1,96.2]	5.1	[3.8,6.9]	p = NS
Protestant	5,243	96	[94.5,97.1]	4.0	[2.9,5.5]	
Other Christians	7,377	94.2	[93.0,95.2]	5.8	[4.8,7.0]	
Other religions	773	96.2	[91.7,98.3]	3.8	[1.7,8.3]	
Working status						
No	6,979	93.5	[91.8,94.9]	6.5	[5.1,8.2]	p < 0.001
Yes	11,848	95.9	[95.0,96.6]	4.1	[3.4,5.0]	
Antenatal care attendance						
None	1,512	98.4	[97.2,99.1]	1.6	[0.9,2.8]	p < 0.001
1-3 ANC visits	12,230	94.6	[93.6,95.5]	5.4	[4.5,6.4]	
4+ ANC visits	5,085	95.0	[93.3,96.2]	5.0	[3.8,6.7]	
Husband/Partner's education						
No education	6,030	93.0	[91.3,94.4]	7.0	[5.6,8.7]	p < 0.001
Primary	3,375	99.1	[98.5,99.5]	0.9	[0.5,1.5]	
Secondary	8,294	97.1	[96.1,97.9]	2.9	[2.1,3.9]	

University or higher	1,128	81.6	[78.1,84.6]	18.4	[15.4,21.9]	
Household- and Community-level characteristics						
Sex of household head						
Male	14,391	94.7	[93.5,95.6]	5.3	[4.4,6.5]	$p < 0.05$
Female	4,436	95.9	[94.6,96.9]	4.1	[3.1,5.4]	
Household Wealth Index						
Poor (40%)	8,106	99.3	[98.9,99.6]	0.7	[0.4,1.1]	$p < 0.001$
Middle (20%)	3,655	98.6	[97.7,99.1]	1.4	[0.9,2.3]	
Rich (40%)	7,066	89.6	[87.9,91.2]	10.4	[8.8,12.1]	
Community Literacy Level						
Low (33%)	6,342	98.7	[97.9,99.2]	1.3	[0.8,2.1]	$p < 0.001$
Medium (33%)	6,214	98.5	[97.3,99.2]	1.5	[0.8,2.7]	
High (34%)	6,271	89.4	[87.4,91.2]	10.6	[8.8,12.6]	
Community Socioeconomic Status						
Low (50%)	11,868	98.7	[97.5,99.4]	1.3	[0.6,2.5]	$p < 0.001$
High (50%)	6,959	89.9	[87.9,91.6]	10.1	[8.4,12.1]	
Place of residence						
Rural	12,157	98.2	[97.0,98.9]	1.8	[1.1,3.0]	$p < 0.001$
Urban	6,670	89.6	[87.7,91.3]	10.4	[8.7,12.3]	
Province of residence						
Kinshasa	1,804	84.5	[81.2,87.3]	15.5	[12.7,18.8]	$p < 0.001$
Bandundu	2,473	98.8	[98.1,99.3]	1.2	[0.7,1.9]	
Kongo Central	945	96.9	[94.6,98.3]	3.1	[1.7,5.4]	
Equateur	2,696	97.8	[95.5,98.9]	2.2	[1.1,4.5]	
Kasai Occidental	1,461	97.3	[90.9,99.2]	2.7	[0.8,9.1]	
Kasai Oriental	2,073	98.8	[96.4,99.6]	1.2	[0.4,3.6]	
Katanga	2,196	91.4	[87.8,94.0]	8.6	[6.0,12.2]	
Maniema	855	98.7	[96.3,99.5]	1.3	[0.5,3.7]	
Nord Kivu	1,154	93.5	[84.9,97.3]	6.5	[2.7,15.1]	
Orientale	2,137	97.0	[94.6,98.4]	3.0	[1.6,5.4]	
Sud Kivu	1,033	92.4	[85.5,96.1]	7.6	[3.9,14.5]	
Total	18,827	95.0	[93.9,95.8]	5.0	[4.2,6.1]	

Note: (*) Table 1 includes only categorical variables. Continuous variables (age, education, index of media exposure, and number of children ever born) are not included here for practical reasons.

Source: DHS—2013-14

Multivariate findings

As mentioned in the analytical strategy, three models were performed. Using Aikake's Information Criteria (AIC) and Bayesian Information Criteria (BIC) to choose the best model among a set of candidate models, findings (Table 2) showed that the full model including both individual- and household/community-level variables better fit the data. This conclusion was confirmed in Table 2

313 with both *AIC* ($AIC = 4717.962$) and *BIC* ($BIC = 4984.625$). Therefore, this section focuses on
 314 findings of Model 3 in Table 3.

315
 316 Table 2:
 317 Model selection of health insurance coverage among women in Democratic Republic of
 318 the Congo

Model	Aikake's Information Criterion (AIC)	Bayesian Information Criterion (BIC)
0	5171.725	5187.411
1	4841.876	4975.208
2	4909.624	5058.641
3	4717.962	4984.625

320
 321 Source: DHS—2013-14

322
 323 Table 3:
 324 Multilevel logistic regression of individual and contextual factors associated with health
 325 insurance coverage among women in the Democratic Republic of the Congo

VARIABLES	Model 0	Model 1	Model 2	Model 3
Individual-level characteristics				
Women current age		1.010 [0.994 - 1.025]		1.008 [0.993 - 1.023]
Woman's education (in completed years)		1.128*** [1.095 - 1.162]		1.098*** [1.065 - 1.132]
Marital status (Ref.: Single)				
Married or cohabiting		0.489*** [0.286 - 0.836]		0.587* [0.343 - 1.006]
Formerly married or cohabiting		0.300*** [0.164 - 0.549]		0.364*** [0.198 - 0.666]
Religion (Ref.: Catholic)				
Protestant		0.859 [0.668 - 1.105]		0.863 [0.672 - 1.109]
Other Christians		0.861 [0.694 - 1.069]		0.830* [0.668 - 1.032]
Other religions		0.879		0.877

Working status (Ref.: No)	0.990	1.054
	[0.500 - 1.544]	[0.499 - 1.541]
Index of media exposure	1.810***	1.488***
	[0.824 - 1.188]	[0.877 - 1.265]
Children ever born	1.062**	1.054**
	[1.515 - 2.163]	[1.245 - 1.778]
Antenatal care attendance (Ref.: No ANC)		
1-3 ANC visits	1.167	1.035
	[0.708 - 1.925]	[0.624 - 1.718]
4+ ANC visits	1.071	0.926
	[0.641 - 1.788]	[0.551 - 1.555]
Husband or Partner's education (Ref.: No education)		
Primary	0.668	0.705
	[0.372 - 1.198]	[0.393 - 1.264]
Secondary	1.033	0.959
	[0.630 - 1.693]	[0.585 - 1.573]
University or higher	3.072***	2.564***
	[1.816 - 5.197]	[1.516 - 4.335]
Household- and community-level characteristics		
Household Head is Female (Ref.: Male)	0.777**	0.829*
	[0.636 - 0.948]	[0.668 - 1.029]
Household wealth index (Ref.: 40% poor)		
Middle (20%)	1.691**	1.375
	[1.095 - 2.612]	[0.887 - 2.130]
Rich (40%)	3.949***	2.501***
	[2.593 - 6.015]	[1.620 - 3.860]
Community Literacy Level (Ref.: Low 33%)		
Medium (33%)	0.822	0.649
	[0.467 - 1.446]	[0.370 - 1.139]
High (33%)	2.209**	1.173
	[1.087 - 4.488]	[0.573 - 2.403]
Community Socioeconomic Status—High (Ref.: 50% Low)	3.546***	3.232***
	[1.912 - 6.577]	[1.746 - 5.983]
Urban residence (Ref.: Rural)	0.942	0.866
	[0.623 - 1.425]	[0.570 - 1.314]
Province of residence (Ref.: Kinshasa)		
Bandundu	0.363***	0.408**
	[0.168 - 0.784]	[0.190 - 0.877]
Kongo Central	0.202***	0.308**
	[0.076 - 0.541]	[0.116 - 0.817]
Equateur	0.651	0.790
	[0.295 - 1.435]	[0.361 - 1.729]
Kasai Occidental	0.259***	0.350**
	[0.097 - 0.687]	[0.133 - 0.919]
Kasai Oriental	0.096***	0.135***
	[0.038 - 0.241]	[0.054 - 0.336]
Katanga	0.870	1.156
	[0.423 - 1.791]	[0.564 - 2.371]
Maniema	0.174***	0.225**
	[0.053 - 0.568]	[0.069 - 0.726]
Nord Kivu	0.941	1.162

			[0.406 - 2.181]	(0.502 - 2.689)
	Orientale		0.684	0.874
			[0.318 - 1.473]	[0.408 - 1.874]
	Sud Kivu		0.864	1.167
			[0.346 - 2.159]	[0.467 - 2.916]
	Intra-class correlation (ICC)	0.613	0.429	0.352
		[0.534-0.679]	[0.359-0.504]	[0.268-0.425]
	Observations	18,827	18,827	18,827
	Number of groups	536	536	536

327

328 Confidence Intervals in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1

329 AOR: Adjusted Odd Ratios in Models 1—3

330 Source: DHS—2013-14

331

332 Before moving to estimates reported in Model 3, let's investigate Model 0 to see if the multilevel
 333 modeling is relevant for this study. The intraclass correlation (*ICC*) was 0.613 (61.3%). This is
 334 quite large, and it justifies the utilization of multilevel modelling. The interpretation of findings in
 335 Model 3 starts with the association between health insurance ownership and the two key
 336 independent variables: women's education (in completed years) and household wealth index
 337 (HWI). First, findings indicated that each additional year of women education increased by 10%
 338 the chance of owing a health insurance (AOR: 1.098; 95%CI: 1.065—1.132). Second, living in
 339 better-off households increased by 150% the chance of owing a health insurance (AOR: 2.501;
 340 95% CI: 1.620—3.860) compared with women living in poor households (referred to as 40%
 341 bottom HWI). This confirmed the assumptions that HWI and women's education are key
 342 covariates to better understand health insurance ownership in the DRC.

343

344 Model 3 in Table 3 also reported interesting results both at individual and household/community
 345 level. At individual level, Model 3 indicated that husband/partner's education is of chief
 346 importance. Specifically, husbands/partners with university or higher are pivotal to explain
 347 women's ownership of health insurance. Being married to husband/partner with a university

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3 348 degree or higher increased by 156% the chance of owing a health insurance (AOR: 2.564; 95%CI:
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5 349 1.516—4.335). The index of media exposure is also significantly associated with the ownership of
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7 350 health insurance. An increase of 1 unit of the index of media exposure increased by almost 50%
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9 351 the chance of owing a health insurance among women of reproductive ages (AOR: 1.488; 95%CI:
10 352 1.245—1.778). In contrast, marital status showed counter-intuitive results: ever married women
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12 353 were less likely to be covered by health insurance compared to never married women.
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17 355 At household/community-level, community socioeconomic status (CSES) was positively and
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19 356 significantly associated with the ownership of health insurance. Indeed, living in advantaged
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21 357 neighbourhoods increased by 223% the chance of owing a health insurance (AOR: 3.232; 95%CI:
22
23 358 1.746—5.983).
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30 360 **Discussion**

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32 361 From a policy perspective, most countries in sub-Saharan Africa (SSA) should align with
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34 362 Sustainable Development Goals (SDGs) to ensure that all people have access to affordable
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36 363 healthcare. However, less efforts have been done to improve the progress of SDG—3 aimed at
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38 364 improving maternal and child health at national and sub-national levels. This paper contributes to
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40 365 the existing literature in examining sub-national disparities of health insurance coverage using
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42 366 social determinants of health (SDoH) as a conceptual framework with an emphasis on education
43
44 367 and socioeconomic status (SES) to better understand these disparities in the Democratic Republic
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46 368 of the Congo. Main findings of the paper are discussed below.
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51 370 First, health insurance coverage among women of reproductive ages in the DRC was quite low at
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53 371 national level as reported in previous studies with a marginal percentage (5%) having a health
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3 372 insurance.⁷ Similar studies reported extremely low percentage (2.8%) of health insurance
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5 373 ownership among women of reproductive ages in the DRC using same datasets.⁵⁶ These findings
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7 374 have policy and programmatic implications in the DRC given the low coverage in health
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9 375 insurance, and they might explain the poor quality of maternal and child health indicators in the
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11 376 DRC. Indeed, previous studies reported that maternal mortality ratio (MMR) in the DRC was very
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13 377 high, and it was estimated at 473 maternal deaths per 100,000 live births.⁵⁷ This is alarming
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15 378 because it also means that the country won't reach the SDG 3.1 aimed at reducing, by 2030, the
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17 379 MMR at 70 maternal deaths per 100,000 live births. Yet, obstetrical complications such as
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19 380 bleeding, eclampsia, sepsis and unsafe abortions, accounting for nearly 80% of the MMR cases
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21 381 require urgent and appropriate care through health insurance coverage as a pathway to access
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23 382 affordable healthcare. Second, there were important geographical variations regarding health
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25 383 insurance coverage ranging from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the
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27 384 Capital City. With these figures, the DRC is lagging very behind regarding the SDG Three.
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35 386 Turning to the main hypothesis of the study, regarding the associations between education, SES,
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37 387 and health insurance coverage in the DRC, findings can be summarized as follows. An additional
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39 388 year of completed education increased by 10% the likelihood of owning health insurance among
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41 389 women of reproductive ages. This finding is consistent with previous studies.^{18,22,23,42} However,
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43 390 plausible explanations from previous studies are insufficient in the context of the DRC. Indeed,
44
45 391 previous research stated that educated women may be exposed to much more health information
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47 392 which increases their likelihood to subscribe to health insurance coverage. In the context of higher
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49 393 unemployment rates, education per se might not suffice to explain why educated women are more
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51 394 likely to own health insurance coverage. This study suggested another explanation given that
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53 395 health insurance coverage was higher in Kinshasa the Capital City compared with other provinces.
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3 396 Educated women were more likely to work and therefore increasing their chances to own health
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5 397 insurance coverage. In fact, preliminary findings showed that 62% of surveyed women were
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7 398 working at the time of the survey. Surprisingly, the likelihood to own health insurance was higher
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10 399 among not-working women compared with their working counterparts. DHSs do not capture the
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12 400 sector (public vs. private) where women work. The high unemployment rates in the country and
13
14 401 the widespread of informal sector can explain this finding. If most women work in informal sector,
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16 402 it is likely that they will not have health insurance coverage. Therefore, more research is needed to
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18 403 unpack this intriguing finding, and to suggest other paths of influence. The fact that less educated
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20 404 women have lesser likelihood to own health insurance also means that policymakers and
21
22 405 stakeholders working to improve health conditions in the DRC need to pay more attention to
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24 406 women's education as a precondition to increase access to health insurance. This finding also held
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26 407 at community level because women of reproductive ages living in communities with high literacy
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28 408 level were more likely to own health insurance.
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35 410 With regards to SES, findings indicated that women of reproductive ages living in better-off
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37 411 households and advantaged neighbourhoods had higher chances to own health insurance compared
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39 412 with their counterparts in poor households and disadvantaged neighbourhoods. This finding was in
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41 413 lines with previous research.²³ In the DRC, there are fewer initiatives of spreading health insurance
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43 414 at individual and community levels. Yet, this is crucial for the country to achieve by 2030 the SDG
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45 415 Three. Previous studies posited that unequal exposure to media might explain such differences in
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47 416 health insurance coverage.²³ Overall, there are no clear policies in the DRC aimed at reducing the
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49 417 inequalities to media exposure, doubled with higher unemployment rates in the country which
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51 418 together limit the ability to seek correct health information among women of reproductive ages.
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3 420 The study has a few strengths and limitations. Using a nationally representative sample to analyze
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5 421 the disparities in health insurance at provincial level is an important strength, thereby providing
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7 422 robust estimates of observed associations between poverty, education, and ownership of health
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9 423 insurance. The use of multilevel modeling allowed to identify the potential factors of influence
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11 424 that policymakers can target to improve access to health insurance, to increase universal health
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13 425 coverage, and ultimately to reach the SDG Three in the DRC and other SSA countries. Finally,
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15 426 looking into health insurance at provincial level reinforce the importance of context-specific
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17 427 interventions. Indeed, findings showed significant variations across provinces and that to be
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19 428 accounted for to reduce health inequalities. The cross-sectional nature of data used in the paper is a
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21 429 limitation which does not allow determining causality between our main independent variables
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23 430 (HWI and education) and health insurance ownership. Therefore, findings in this paper should be
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25 431 interpreted in terms of associations and no definite conclusions can be drawn regarding the
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27 432 potential influences of poverty and education on health insurance coverage. Further research is
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29 433 needed to better understand these potential influences.
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435 **Conclusion**

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39 436 This cross-sectional study examined the associations between two key social determinants of
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41 437 health (poverty and education) and health insurance coverage in the Democratic Republic of the
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43 438 Congo. Findings showed that UHC is alarmingly low in the DRC like in other SSA countries. The
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45 439 study also found significant disparities across provinces, and between poor and rich.

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47 440 Programmatically, that means the RDC will not reach SDG Three aimed at improving maternal
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49 441 and child health. Yet Universal Health Coverage (UHC) is pivotal to achieve SDG Three in SSA
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51 442 countries. To improve maternal and child health in the country, policymakers and stakeholders
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53 443 should tackle inequalities between poor and rich and devise interventions to equip poor to better
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3 444 understand the importance of health insurance coverage given the existing rampant and secular
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5 445 poverty. Unlike countries such as Ghana with a sustainable national health insurance
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7 446 scheme,^{3,19,58,59} the DRC has not yet developed and implemented a strong health insurance scheme
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10 447 to help people, especially poor, to freely access health care or at affordable cost. The fact that out-
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12 448 of-pocket expenditures are the major mode of payments for health care in the DRC constitutes a
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14 449 serious threat to UHC and the achievement of SDG Three. It was shown that out-of-pocket
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16 450 expenses is a strong barrier to access good health care services with the immediate consequence of
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19 451 maintaining or increasing maternal mortality ratio in the country, therefore putting in jeopardy
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21 452 mothers and their children.
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25
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36
37 459 the data analysis, interpreted the results, and drafted the manuscript. PNK contributed to study
38
39 460 design, data analysis, interpretation, policy implications and critical revision of the manuscript. All
40
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468 **Data sharing statement** Not applicable.

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470 **Ethics statement**

471 **Patient consent for publication** Not required.

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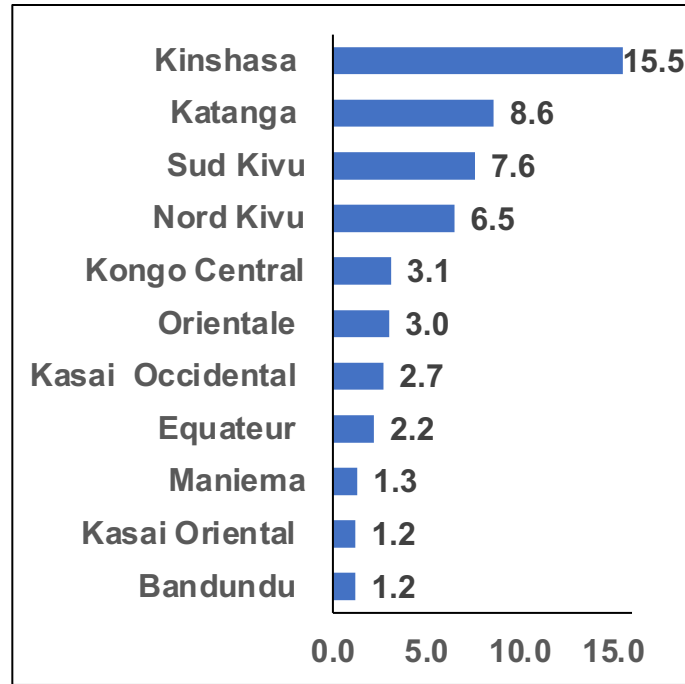
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662 Figure Legend:

663 Figure 1 - Percentage of women of reproductive ages owning health insurance in the
664 Democratic Republic of the Congo

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Table A.1: Description of the sample

Variables	N	% or M±S.D.
Individual-level variables		
Age (in years)	18,827	28.1±9.3
Education (in years completed)	18,827	6.1±4.1
Marital status		
Single	4,545	26.0
Married or cohabiting	12,448	64.2
Formerly married or cohabiting	1,834	9.7
Religion		
Catholic	5,434	29.7
Protestant	5,243	26.8
Other Christians	7,377	40.0
Other religions	773	3.5
Is currently working		
Is not working	6,979	38.2
Is working	11,848	61.8
Number of antenatal care visits		
None	1,512	6.2
1-3 ANC visits	12,230	65.5
4+ ANC visits	5,085	28.2
Husband/Partner education		
No education	1,462	7.7
Primary	3,342	15.6
Secondary	8,095	43.7
Higher	926	7.0
Is Missing	4,224	26.0
Household- and Community-level variables		
Household Head is Female		
Male	14,391	76.2
Female	4,436	23.8
Household Wealth Index		
Poor (40%)	8,106	37.6
Middle (20%)	3,655	18.6
Rich (40%)	7,066	43.7
Community Literacy Level		
Low (33%)	6,342	26.0
Medium (33%)	6,214	34.2
High (34%)	6,271	39.8
Community Socioeconomic Status		
Low (50%)	11,868	57.3
High (50%)	6,959	42.7
Place of residence		
Rural	12,157	62.5
Urban	6,670	37.5
Province of residence		
Kinshasa	1,804	12.0
Bandundu	2,473	16.0
Kongo Central	945	4.6
Equateur	2,696	13.1
Kasai Occidental	1,461	6.4
Kasai Oriental	2,073	9.8
Katanga	2,196	9.6
Maniema	855	3.0
Nord Kivu	1,154	8.6
Orientale	2,137	9.7
Sud Kivu	1,033	7.3
Total	18,827	100

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	Item No	
Title and abstract p.1—2	1	<p>Poverty, education, and health insurance coverage among women of reproductive ages in the Democratic Republic of the Congo: a cross-sectional multilevel analysis</p> <hr/> <p>Objective To investigate inequalities of health insurance coverage (outcome) at sub-national level, and the effects of education and poverty on the outcome.</p> <p>Design Secondary analysis of Demographic and Health Surveys (DHS). The outcome variable was health insurance ownership.</p> <p>Setting The Democratic Republic of the Congo.</p> <p>Subjects Women aged 15–49 years (n = 18,827).</p> <p>Results Findings indicated significant spatial variations of the health insurance ownership which ranged from 1.2% in Bandundu and Kasai Oriental to 15.5% in Kinshasa the Capital City. Furthermore, findings showed that an additional year of women education increased by 10% the chance of health insurance ownership (Adjusted Odd Ratio—AOR: 1.098; 95%CI: 1.065—1.132). Finally, living in better-off households increased by 150% the chance of owing a health insurance (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households.</p> <p>Conclusions Given the low levels of health insurance coverage, the Democratic Republic of the Congo will not reach the Sustainable Development Goal (SDG)—3, aimed at improving maternal and child health unless a serious programmatic health shift is undertaken in the country to tackle inequalities among poor and uneducated women via universal health coverage (UHC).</p>
Introduction		
Background/rationale p. 4—8	2	<p>Poverty and education have been reported as important social determinants of health. While education has been positively associated with health, poverty significantly play a negative role. Access to good healthcare, which is proxied by health insurance ownership, determines one's health, especially in Low- and Middle-Income countries (LMICs) like the Democratic Republic of the Congo. Recent debates showed that health insurance is of chief importance to reach universal health coverage (UHC) in LMICs. If not addressed correctly, LMICs would not reach the universal health coverage (UHC) as a precondition towards Sustainable Development Goal (SDG)—3 aimed at improving maternal and child health.</p>
Objectives p. 6	3	<p>To investigate inequalities of health insurance coverage (outcome) at sub-national level, and the effects of education and poverty on the outcome.</p>
Methods		
Study design p.9	4	<p>We did a secondary data analysis of the nationally representative 2013—14 Demographic and Health Survey (DHS) which collected health information from women of reproductive ages in the Democratic Republic of the Congo. We also examined spatial differences of health insurance ownership and the associations between poverty and education with health insurance ownership using multilevel modelling.</p>
Setting	5	<p>The Demographic and Health Survey (DHS) is a nationally representative survey</p>

		which collected information about sociodemographics and health information, among others. In this paper, health information on women of reproductive ages was utilised. Data were collected between November 2013 and February 2014
p.9		
Participants	6	All women of reproductive ages (15–49 years) in selected households were eligible for this study without further restrictions. These women were selected using two-stage sampling design: Stage 1—selection of clusters; Stage 2—selection of households.
p.9		
Variables	7	The outcome variable was “health insurance ownership” while key independent variables were poverty and education at household and community levels.
p.9–11		
Data sources/ measurement	8*	The outcome variable was “health insurance ownership”, a binary variable taking the value of “1” if respondent reported owing health insurance, and “0” otherwise. The key independent variables were (1) poverty proxied by the household wealth index (HWI) and community socioeconomic status; (2) women’s education (in completed years). HWI and community literacy level is a composite variable. The methodology of constructing this variable has been presented elsewhere (https://preview.dhsprogram.com/programming/wealth%20index/Steps_to_constructing_the_new_DHS_Wealth_Index.pdf). In this study, a new grouping was done from five categories in the original variables to three categories. Community literacy level was constructed using information about the number of women in the cluster able to read. Finally, women’s education was used in completed single years.
p.9–11		
Bias	9	The estimate of the outcome was compared with the DHS report, and related published papers on the topic
p.3		
Study size	10	This study included “ all women of reproductive ages present in the dataset: $N = 18,827$ ” without further restrictions. The number of women of reproductive ages were obtained in interviewing eligible women in selected households.
p.13		
Quantitative variables	11	Women’s education ranged from 0 to 18 years of education. We analysed (result not shown) the bivariate associations between women’s education and the odds of health insurance ownership among women of reproductive ages in the country.
p.14		
Statistical methods	12	This study used a two-level multilevel modelling: Level 1 (women), and Level 2 (communities). Specifically, Intra cluster correlation (ICC) was computed first to ensure that multilevel modelling was justified. Second, three models were estimated: a) Adjusted Odds Ratio (AOR) were computed in model including all individual-level variables; b) AOR in model including all community-level variables; and c) a full model including both individual- and community-level variables. Finally, Aikake Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used to select to best models, and 95% Confidence Intervals were also reported.
p.11–13		
Results		
Participants	13*	Sample size $N = 18,827$ women of reproductive ages
p.9		
Descriptive data	14*	The study included 18,827 women of reproductive ages (15–49 years). No missing values were observed.
p.13–14		
Outcome data	15*	Overall, only 5% of women aged 15–49 years owned a health insurance, with significant variations across provinces, ranging from 1.5% in Bandundu to 15.5% in Kinshasa.
p.13–14		

1 2 3 4 5 6 7 8 9	Main results p.13—19	16	Findings showed that an additional year of women education increased by 10% the chance of health insurance ownership (Adjusted Odd Ratio—AOR: 1.098; 95%CI: 1.065—1.132). Also, living in better-off households increased by 150% the chance of owning a health insurance (AOR: 2.501; 95% CI: 1.620—3.860) compared with women living in poor households.
10 11 12 13	Other analyses p.13	17	The study also checked with type of health insurance women owned. This information couldn't be analysed in depth (women's background characteristics) because of small cell sizes.
14	Discussion		
15 16 17 18 19	Key results p. 19	18	Among 18,827 women included in the study, only 5% has health insurance coverage. Furthermore, women's education and poverty was significantly associated with health insurance ownership. Specifically, women's education and living in better-off households significantly increased the odds of health insurance ownership.
20 21 22 23 24 25 26 27 28 29	Limitations p.3	19	<ul style="list-style-type: none"> • The cross-sectional nature of the data in the DHS limits the over-generalization of the findings, making it impossible to infer causation between poverty, education, and health insurance ownership. • To better capture inequalities of health insurance coverage in the country, over-sampling of women of reproductive ages in other provinces is necessary. • Data collected in the DHSs may suffer from recall bias given the retrospective nature of self-reported health insurance coverage among women.
30 31 32 33	Interpretation p.19	20	The study findings are in line with the social determinants of health (SDoH) framework which consistently showed that education and socioeconomic status are key factors to understand health inequalities.
34 35 36 37	Generalisability p.3	21	Although the findings align with SDoH, the cross-national nature of data limits its over-generalization. Therefore, findings were interpreted as associations but causation.
38	Other information		
39 40 41 42	Funding p.23	22	<ul style="list-style-type: none"> • No funding source

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.