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## Improving access to healthcare for women in low-income countries by addressing socio-economic determinants and health insurance: a generalized ordered logistic regression model

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1 **Improving access to healthcare for women in low-income countries by addressing socio-**

2 **economic determinants and health insurance: a generalized ordered logistic regression**

3 **model**

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1 **ABSTRACT**

2 **Objective:** This study aimed to use generalized ordered logistic regression model to explore the

3 factors associated with problems in accessing healthcare among women in Tanzania as an

4 example of low-income countries.

5 **Design:** Population-based cross-sectional survey

6 **Setting:** Nationwide representative data for women of reproductive age obtained from the 2015-

7 2016 Tanzania Demographic Health Survey were analyzed.

8 **Primary outcome measures:** A composite variable called "problems in accessing healthcare"

9 with five (0-4) categories was created based on the number of problems reported: getting

10 permission to go to the doctor, getting money for advice or treatment, distance to a health facility

11 and not wanting to go alone. Respondents who reported less or more of the problems were

12 placed in lower or higher categories respectively.

13 **Results:** A total of 13,266 women aged 15-49 years, with a median age (IQR) of 27 (20–36)

14 years were interviewed and included in this analysis. About two-thirds (65.53%) of the

15 respondents reported at least one of the four major problems in accessing healthcare.

16 Furthermore, after controlling for other variables included in the final model, women without

17 any type of health insurance, those belonged to the poorest class of wealth index, those who had

18 not attended any type of formal education, those who were not employed for cash, each year of

19 increased age, and those who were divorced, separated or widowed were associated with greater

20 problems in accessing healthcare.

2

1   **Conclusion:** This study found that a high proportion of women face problems in accessing

2   healthcare in Tanzania. It also highlighted the influence of socio-economic determinants as well

3   as the role of health insurance in accessing healthcare. The study recommends that, Ministry of

4   Health, policy-makers, together with other agencies responsible for maternal health services,

5   provide education for women regarding the importance of health insurance as a first-step in

6   reducing problems associated with accessing healthcare.

7   **Strengths and limitations of this study**

8     ➢ This is the first study conducted in this region to explore the factors associated with

9         problems in accessing healthcare for women using data obtained from a nationally

10       representative sample with the application of a generalized ordered logistic regression

11       model.

12     ➢ The use of a generalized ordered logistic regression model provided a significantly better

13         fit to our data while at the same times being much more parsimonious; therefore, it

14       clearly validated the factors associated with problems in accessing healthcare among

15       women.

16     ➢ A statistical approach was used to adjust for the clustering effect and to weight the

17       estimates to correct for non-responses and disproportionate sampling used during the

18       design of the study.

19     ➢ The validity constraints of self-reported outcome and independent variables that cannot

20       be externally validated may have resulted in misclassification bias.

21     ➢ As a cross-sectional study design was used, causality assumptions cannot be made;

22       therefore, the results should be interpreted with caution.

23

1    **INTRODUCTION**

2    Despite the substantial decline in the global maternal mortality ratio (MMR), this victory

3    cannot be celebrated in many low-income countries that continue to have high maternal death

4    rates[1,2] which have been described as an "area of shameful failures of development."[3,4]   In

5    Tanzania, the current statistics shows that the MMR has increased significantly by more than

6    20% over the past 5 years,[5,6] despite an increased coverage of maternal health services.[6] The

7    current high MMR (556 maternal deaths per 100,000 live-births) in Tanzania poses the question

8    of whether the country can achieve the Sustainable Development Goals (SDGs) target of less

9    than 140 maternal deaths per 100,000 live-births by the year 2030.[7,8] the majority of avoidable

10   and unnecessary maternal deaths experienced in this region likely result from poor utilization of

11   skilled maternal health services.[9]

12   Many social, cultural, geographical factors as well as education level and poverty

13   reportedly play roles in the poor utilization of health services.[10–12] However, access to healthcare

14   has been highlighted as the major barrier towards the utilization of maternal health services in

15   low-income countries, especially in sub-Saharan Africa (SSA).[9,13,14] Access to healthcare can be

16   broadly defined using four dimensions: availability, affordability, accessibility and

17   acceptability,[15] but simply referred  as the timely use of health services to achieve the desired

18   health outcomes. Despite the fact that access to health care must be universal and guaranteed for

19   all on an equitable basis,[16] women continue to face significant inequities in accessing and

20   utilizing healthcare.[17]

21   Several problems have been mentioned as possible barriers for women in accessing

22   healthcare,[9] and these can be grouped into two categories: the supply side, in which the facility

4

1   fails to provide good quality of healthcare and the demand side, in which the clients fail to utilize

2   the available services because of their own personal reasons.[15,18,19]  Despite the fact that it is

3   important to understand both sides, the current study will focus on the demand side (women), as

4   this side determines whether or not the healthcare services are used regardless of the presence of

5   barriers.

6       Identifying the problems that women may experience in accessing healthcare, is

7   important for addressing the barriers to maternal healthcare in many SSA countries including

8   Tanzania.[6,20] This has led some studies to assess factors associated with access to healthcare.

9   However, limited information is available regarding the type and characteristics of women who

10  are collectively more likely to report having problems associated with access to healthcare in

11  low-income countries such as Tanzania. Therefore, the current study explored the factors

12  associated with problems in accessing health care among women in Tanzania.

13  **Generalized ordered logistic regression**

14      When the outcome variable has more than two categories that are ordered in nature, the

15  most appropriate model is the one that can account for the ordering of multiple categories. The

16  ordered logistic regression (ologit) model is the most commonly fitted model for this type of

17  variable since it estimates the probability of the outcome belonging to a higher category rather

18  than a less-than or equal to a given category. In the ologit model, the influence of each

19  explanatory variable is presumed to be equal across the categories of outcome variable. This

20  implies that the model provides the same odds ratio (OR) across the categories of outcome

21  variable, thereby simplifying the interpretations.[21,22] However, the use of this OR across all

22  categories is appropriate only when the proportional odds (parallel regression) assumption,

23  which means the "equality of the log-odds across the different categories of the outcome

5

1    variable," is met.[23] However, this assumption is often violated because it is very common for one

2    or more of the coefficients or ORs to differ across the categories of outcome variable.[24] In such

3    cases, it is advisable to use a non-ordinal model, such as multinomial logistic regression (mlogit).

4    Unfortunately, such models are not only less parsimonious and difficult to interpret, compared

5    with ologit models, but they also do not consider the ordinal nature of the variable.[25]

6    Generalized ordered logistic regression (gologit) established by Fu and later by William

7    has been found to be an appropriate model for such cases[24,26] since it relaxes the proportional

8    assumptions by allowing the effect of each explanatory variable to vary across different

9    categories of outcome variable without modifying the data.[27] The gologit model can be written

10   using the following formula (1):

11
$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i \beta_j)}{1 + \exp(\alpha_j + X_i \beta_j)}, j = 1, 2, \ldots, M - 1 \tag{1}$$

12   Where M is the number of categories of the ordinal dependent variable ($Y$), however, the logit

13   model is a special case of the gologit model when $M = 2$. When $M > 2$, is equivalent to the series

14   of binary logistic regressions, such as category 1 versus categories 2, 3, 4 and 5 ($Y>1$); categories

15   1 and 2 versus categories 3, 4, and 5 ($Y>2$); categories 1, 2, and 3 versus categories 4 and 5

16   ($Y>3$); and categories 1, 2, 3, and 4 versus category 5 ($Y>4$). Additionally, the ologit model is

17   also a special case of the gologit model when the betas are the same for each value of j as shown

18   in formula (2):

19
$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i \beta)}{1 + \exp(\alpha_j + X_i \beta)}, j = 1, 2, \ldots, M - 1 \tag{2}$$

20   When the betas change for some variables while for the other variables remain the same, the

21   fitted model is described as being partial constrained, since it only allows the betas of the

22   variables that met the proportional assumptions to be constrained while those not met the

6

1    aforementioned assumptions allowed to vary freely without constraint.[28,29] The gologit2

2    command in Stata is responsible for producing this type of model, and as shown in formula (3)

3    below, the betas for X1 and X2 are constrained but the betas for X3 are not.

4
$$P(Y_i > j) = \frac{\exp(\alpha_j + X1_i\beta1 + X2_i\beta2 + X3_i\beta3_j)}{1 + \exp(\alpha_j + X1_i\beta1 + X2_i\beta2 + X3_i\beta3_j)}, j = 1, 2, \dots, M-1 \qquad (3)$$

5    To the best of our knowledge, there are no published articles that have used a gologit

6    model to explore factors associated with problems in accessing health care. Therefore the current

7    study used gologit regression model to explore the factors associated with problems in accessing

8    healthcare among women in Tanzania as an example of a low-income country.

9

7

1 **METHODS**

2 **Data sources**

3 The current study analyzed data from the 2015-2016 Tanzania Demographic Health

4 Survey and Malaria Indicator Survey (TDHS-MIS). The survey was conducted by the National

5 Bureau of Statistics (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar,

6 in collaboration with the Ministry of Health, Community Development, Gender, Elderly, and

7 Children (MoHCDGEC) of the Tanzania Mainland and the Ministry of Health (MoH), Zanzibar.

8 **Study design**

9 This is study analyzed a nationwide population-based cross-sectional survey that used

10 information obtained from interviewed women (15-49 years old) who were either residents or

11 visitors in the household on the night before the survey.

12 **Sample size and sampling technique**

13 The 2015-2016 TDHS-MIS used a two stage cluster sampling technique. In the first stage,

14 sample points (a total of 608 clusters) consisting of enumeration areas delineated for the 2012

15 Tanzania Population and Housing Census were selected. In the second stage, households were

16 selected systematically. A complete listing of households was established for all 608 selected

17 clusters prior to the fieldwork. From this list, 22 households were then systematically selected

18 from each cluster, yielding a representative probability sample of 13,376 households. Then, all

19 eligible women and men between the ages of 15-49 years who were either residents or visitors in

20 the household on the night before the survey were interviewed. Finally, a total of 13,266

21 women and 3,514 men were interviewed.[6]

22

8

**Data collection and processing**

The 2015-2016 TDHS-MIS used four main types of questionnaires during data collection; however the current study used data collected by Woman's Questionnaire. After pre-testing of the questionnaires, the finalized and corrected version was used in the main survey data collection from August 22, 2015, through February 14, 2016. The data collection was performed by 64 female nurses who were trained and qualified the series of practical tests and examinations to be interviewers. Following the training, 16 teams were formed (3 for Zanzibar and 13 for Tanzania Mainland). Data entry was done concurrently with data collection in the field. After the paper questionnaires were completed, edited, and checked by both the field editor and the supervisor, the data was entered into a tablet equipped with a data entry programme. Data entry process included 100% double entry to minimize keying errors, and editing, were completed on March 21, 2016, while data cleaning and finalization were completed on April 22, 2016.

**Measurement of variables**

**Outcome variable:** In this survey women were asked whether each of the following four factors was a problem in seeking medical advice or treatment when they were sick: getting permission to go to the doctor/health facility; getting money for advice, consultation or treatment; distance to the health facility; and not wanting to go alone. Then, a new composite variable called "problems in accessing healthcare" was created based on the number of problems reported with respondents who reported less or more were placed in lower or higher categories, respectively. The categories were assigned as 1, 2, 3, 4 and 5 for women who reported "no," "one," "two," "three," and "four" problems to accessing healthcare, respectively. These

9

1  categories of a composite (outcome) variable were treated as ordinal numbers, with the

2  assumption that conceptual differences between categories were exactly the same.

3  **Independent variables:** The current study included several independent variables that

4  have been empirically and theoretically linked with the accessibility of healthcare among women.

5  The respondents' ages were categorized into groups of "15-19," "20-34," and "35-49" years;

6  marital status was grouped into "never married," "married/living together," and "divorced,

7  separated or widowed." Education level was grouped into "none," "primary," "secondary," and

8  "highest," (including college and all university level). Employment in the last 12 months was

9  grouped into "not employed," "employed for cash" and "employed but paid in-kind." The area of

10  residence was grouped into "urban" and "rural". Health insurance ownership was grouped as "no"

11  for women who did not have any type of health insurance and "yes" for those who had any type

12  of health insurance. The wealth index was computed based on household assets and housing

13  characteristic. During the computation the households were given scores based on the number

14  and kinds of consumer goods they owned, ranging from a television to a bicycle or car, plus

15  housing characteristics, such as the source of drinking water, toilet facilities, and flooring

16  materials. These scores were derived using a principal component analysis. National wealth

17  quintiles were compiled by assigning the household score to each usual (de jure) household

18  member, ranking each person in the household population by their score, and then dividing the

19  distribution into five equal categories, each with 20% of the population, as "poorest, "poorer,"

20  "middle," "richer", and "richest." [6]

21

1  **Statistical approaches**

2     In descriptive analyses, categorical variables were summarized using proportions and

3  then presented in tables while quantitative variables were summarized using median and

4  Interquartile Range (IQR).

5     **Model Fitting:** Since the outcome variable "problems in accessing healthcare" was

6  ordinal in nature (a score based on the number of different reported problems), in which the

7  order of its values corresponding to a hierarchy in meaning as in this study, therefore, the

8  application of ordered logistic regression was recommended.[30]   Stata 14 (StataCorp, College

9  Texas) was used for the analysis in the current study. For all the analyses, the Stata survey set

10 commands were used to adjust for the variability of clustering and all the estimates were

11 weighted to correct for non-response and disproportionate sampling.

12    **Proportional ordered logistic model:** As the current study contained several factors to

13 be considered in the models, a simple (binary) ordered logistics analysis was first performed to

14 identify variables to be included in the multivariate models. Then, a proportional ordered logistic

15 regression (ologit) model was used to assess the significance between outcome and independent

16 variables. Although the ologit model provides results that are straightforward and easily to

17 interpret the assumptions of a parallel-lines model (parallel regression) must be met for a correct

18 interpretation. This assumption can be tested using the Brant test, which provides evidence of

19 whether the assumption is violated.[31]   If the Brant test provides a significant *P*-value (less than

20 0.05), the assumption of parallel regression is violated; hence, the results from this model may

21 lead to invalid interpretations.[32]

1    **Generalized ordered logistic model:** Since the Brant test command cannot work on

2    weighted and svyset data like that used in the current analysis, a generalized ordered logistic

3    (gologit) model was used instead, as this model provides results similar to the series of binary

4    logistic regressions estimated using the Brant test.[24] The gologit compares higher categories to

5    categories lower than or equal to the current category. Hence, positive coefficients indicate that

6    higher values of independent variables make it more likely that the respondent will be classified

7    in a higher category of the outcome variable (greater difficulties in assessing healthcare) than the

8    current category. Conversely, negative coefficients indicate that higher values of the independent

9    variable increase the likelihood of belonging to the current or lower category. However, the

10   problem with the gologit model is that it frees all the variables from parallel-lines constraints,

11   even though the assumption may be violated by one or a few of the variables.[24]

12   **Partially generalized ordered logistic model: the g**ologit2 with "autofit" option

13   command can be used to overcome the previous limitation of gologit model by fitting another

14   model known as the partial proportional odds. This model allows some variables to be modeled

15   with the proportional odds assumption while the parallel line constraint is relaxed for variables in

16   which the assumption was not met. The model is less restrictive as it allows the coefficient of the

17   variables to vary for the different categories that are compared. But, if this is not the case for all

18   the variables, the model is called a partially constrained logistic model, which is model

19   recommended for cases involving ordinal data.[28,33] However, the model does not appear to be

20   parsimonious; therefore, an alternative (gamma) parameterization was performed to make the

21   model more parsimonious and provide further understanding of the parallel regression

22   assumptions. The model with gamma parameterization provides beta coefficients that have the

23   similar coefficients for all pairs of categories of outcome variables. Also, the model provides

12

1    gamma coefficients that show the extent to which the parallel regression assumption is violated

2    by the variable. Hence, if the gamma coefficients for an independent variable are all equal to "0",

3    then the parallel regression assumption is met for that variable; otherwise the assumption is

4    considered to be violated. If all the gamma coefficients are equal to "0" then the ologit model

5    will be obtained.

6    **Ethics statement**

7        This study was based on an analysis of existing public domain survey data sets that are

8    freely available online with all identifier information detached. The survey was approved by the

9    Ethics Committee of the ICF Macro at Calverton in the USA and by the National Institute of

10   Medical Research Ethics Committee in Tanzania. Informed consent was requested and obtained

11   from the participants prior to the interview.

12   **Patient and Public Involvement Statement**

13       Patient and public were not involved in the analysis of this study.

1 **RESULTS**

2 **Respondents' characteristics**

3    As shown in table 1, a total of 13,266 women between the ages 15-49 years were

4 interviewed and included in this analysis. The median age (IQR) of the respondents was 27 (20–

5 36) years. Overall, 8,210 respondents (61.89%) were living with their spouse at the time of the

6 interview. Only 183 (1.38%) had attained the highest level of education (college or university).

7 A total of 6,197 (46.71%) were employed for cash and 8,455 (63.73%) were living in a rural

8 residence, but only 1,200 (9.05%) reported having any kind of health insurance and 3,596

9 (27.11%) were categorized in the richest quintile. Almost half the respondents (49.49%),

10 reported that getting money for healthcare was the greatest problem in accessing healthcare.

11 Furthermore, about two-third (65.53%) of the respondents reported at least one of the four

12 problems in accessing healthcare.

13 **Table 1 Percent distribution of women between the ages 15-49 by selected background**

14 **characteristics, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | Frequency (n=weighted) | Percentage (%=weighted) |
|---|---|---|
| **Age** (Median (IQR)=27, (20-36) | | |
| 15-19 | 2,904 | 21.89 |
| 20-34 | 6,359 | 47.94 |
| 35-49 | 4,002 | 30.17 |
| **Marital status** | | |
| Never married | 3,353 | 25.27 |
| Married/living together | 8,210 | 61.89 |
| Divorced/separated/widowed | 1,703 | 12.84 |
| **Education** | | |
| None | 1,947 | 14.67. |
| Primary | 8,211 | 61.90 |
| Secondary | 2,925 | 22.05 |

14

| | | |
|---|---|---|
| Highest | 183 | 1.38 |
| **Employed last 12 months** | | |
| Not employed | 3,033 | 22.86 |
| Employed for cash | 6,197 | 46.71 |
| Employed but paid in-kind | 4,036 | 30.43 |
| **Residence** | | |
| Urban | 4,811 | 36.27 |
| Rural | 8,455 | 63.73 |
| **Health insurance** | | |
| No | 12,066 | 90.95 |
| Yes | 1,200 | 9.05 |
| **Wealth quintile** | | |
| Lowest | 2,246 | 16.93 |
| Second | 2,274 | 17.14 |
| Middle | 2,328 | 17.55 |
| Fourth | 2,822 | 21.27 |
| Highest | 3,596 | 27.11 |
| **Type of Problems*** | | |
| Getting money | 6,565 | 49.49 |
| Distance to facility | 5,615 | 42.33 |
| Not want to go alone | 3,962 | 29.87 |
| Getting permission | 1,900 | 14.32 |
| **No. of problems in accessing health** | | |
| None | 4,574 | 34.48 |
| One problem | 3,291 | 24.81 |
| Two problems | 2,547 | 19.20 |
| Three problems | 1,759 | 13.26 |
| Four problems | 1,095 | 8.25 |

1  Note: *n and % do not add up to 13,266 and 100 %, respectively, because multiple responses were

2  possible

3  **Proportional ordered logistic regression (ologit) model**

4     The results from the final ologit model are shown in Table 2. In this model, the number

5  of problems in accessing health care was significantly lower for women who had health

6  insurance [POR=0.622, 95%CI: 0.531-0.728], a primary level of education; [POR=0.888,

15

1 95%CI: 0.796-0.992], a secondary level of education [POR=0.679, 95%CI: 0.580-0.796] a

2 highest level of education [POR= 0.506, 95%CI: 0.351-0.731], a middle wealth status

3 [POR=0.737, 95%CI; 0.640-0.848], a richer wealth status [POR=0.512, 95%CI: 0.433-0.604] a

4 richest wealth status [POR=0.342, 95%CI: 0.276-0.423], while the number of problems was

5 significantly higher for each year increase in age [POR=1.006, 95%CI: 1.001-1.011], for those

6 who were divorced, separated or widowed [POR=1.188, 95%CI: 1.025-1.377] and for those who

7 were employed nut paid in kind [POR=1.221, 95%CI: 1.069-1.394].

8 **Table 2 Results of ologit model using problems in accessing health care as a response with**

9 **four categories, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | Coef | Std error | P-value | POR [95% CI] |
|---|---|---|---|---|
| **Health insurance** (ref: No) | | | | |
| Yes | -.475 | .081 | 0.000 | 0.622 [0.531-0.728] |
| **Residence** (ref: Urban) | | | | |
| Rural | -.149 | .0827 | 0.072 | 0.862 [0.732-1.013] |
| **Age** (as continous) | .006 | .002 | 0.015 | 1.006 [1.001-1.011] |
| **Marital status** ref: Never married) | | | | |
| Married/living together | -.093 | .061 | 0.127 | 0.911 [0.809-1.027] |
| Divorced/separated/widowed | .172 | .075 | 0.022 | 1.188 [1.025-1.377] |
| **Education** (ref: None) | | | | |
| Primary | -.118 | .056 | 0.035 | 0.888 [0.796-0.992] |
| Secondary | -.387 | .060 | 0.000 | 0.679 [0.580-0.796] |
| Highest | -.681 | .187 | 0.000 | 0.506 [0.351-0.731] |
| **Wealth status** (ref: Poorest) | | | | |
| Poorer | -.154 | .080 | 0.055 | 0.858 [0.733-1.003] |
| Middle | -.306 | .072 | 0.000 | 0.737 [0.640-0.848] |
| Richer | -.670 | .085 | 0.000 | 0.512 [0.433-0.604] |
| Richest | -1.074 | .109 | 0.000 | 0.342 [0.276-0.423] |
| **Employed last 12 months** (ref: Not employed | | | | |
| Employed for cash | -.014 | .060 | 0.809 | 0.987 [0.877-1.108] |
| Employed but paid in kind | .200 | .068 | 0.003 | 1.221 [1.069-1.394] |

1 **Gologit2 as separate binary logistic regression models**

2    Table 3 shows the four separate binary logistic from the gologit2 model that were used to

3 assess the parallel regression assumption. The results indicate that the coefficients for all

4 categories of each of the independent variables were significant different except for age, wealth

5 status (richest), and marital status (divorced/separated/widowed). This means that age, wealth

6 and marital status failed to satisfy the parallel regression assumption hence the use of a

7 proportion odds ratio was not appropriate for these variables. Since the model frees all the

8 variables from parallel-lines constraints, we next used a partial gologit2 model.

9 **Table 3 Estimated coefficients from four binary regression variables of gologit for assessing**

10 **the parallel regression assumption, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | y>1 | y>2 | y>3 | y>4 |
|---|---|---|---|---|
| **Health insurance** (ref: No) | | | | |
| Yes | -.487 | -.484 | -.400 | -.221 |
| **Residence** (ref: Urban) | | | | |
| Rural | -.151 | -.098 | -.244 | -.303 |
| **Age** (as continous) | .013 | .004 | .002 | .003 |
| **Marital status** ref: Never married) | | | | |
| Married/living together | -.142 | -.053 | -.110 | -.103 |
| Divorced/separated/widowed | .332 | .187 | .035 | .272 |
| **Education** (ref: None) | | | | |
| Primary | -.185 | -.140 | -.103 | -.091 |
| Secondary | -.438 | -.351 | -.444 | -.212 |
| Highest | -.736 | -.500 | -.835 | -1.057 |
| **Wealth status** (ref: Poorest) | | | | |
| Poorer | -.170 | -.239 | -.124 | .101 |
| Middle | -.359 | -.399 | -.267 | -.029 |
| Richer | -.723 | -.764 | -.696 | -.331 |
| Richest | -1.233 | -1.038 | -.861 | -.469 |

17

| **Employed last 12 months** (ref: Not employed | | | | |
|---|---|---|---|---|
| Employed for cash | -.076 | -.003 | -.076 | .124 |
| Employed but paid in kind | .223 | .171 | .223 | .352 |

1  **Partial Gologit model with alternative gamma parameterization**

2  Table 4 shows the results of the partially constrained gologit model with alternative

3  (gamma) parameterization for the outcome variable of problems in accessing healthcare. The

4  results show an insignificant Wald test statistics, indicating that the model does not violate the

5  proportional odds/parallel regression assumptions. However, constraints for parallel lines were

6  not imposed for age, wealth status (richest) and marital status (divorced, separated or widowed).

7  The remaining variables that met the parallel assumption can be interpolated in the same manner

8  as for the ologit model as follows.  The odds of reporting problems in accessing healthcare were

9  38% less among women who had any type of health insurance versus those who did not [POR =

10  0.622, 95%CI; 0.531-0.731]. Also, the odds of reporting problems in accessing healthcare were

11  12%, 32% and 48% less among women who attained primary [POR = 0.883, 95%CI; 0.788-

12  0.990], secondary [POR = 0.683, 95%CI; 0.582-0.800], or the highest level of education [POR =

13  0.516, 95%CI; 0.360-0.741] respectively, versus those who reported not having attended any

14  type of formal education. Additionally,  the odds of reporting problems in accessing health care

15  were 15%, 28% and 51% less among women who had a poorer [POR = 0.854, 95%CI; 0.726-

16  1.006], middle [POR = . 0.725, 95%CI; 0.626-0.840], or richer class of wealth status [POR =

17  0.496, 95%CI; 0.417-0.590) respectively, versus those who were in the poorest class of wealth

18  status. Furthermore, the odds of reporting problems in accessing healthcare were 22% higher

19  among women who were employed but paid in-kind [POR = 1.220, 95%CI; 1.067-1.395],

20  compared with those who were unemployed for the last 12 months before the survey.

1    The variables for which the constraints for parallel lines were not imposed were

2    interpreted as follows; the coefficients for age and marital status (divorced, separated or

3    widowed) were consistently positive, while those for wealth status (richest) were negative but

4    decreased across the cut-points. This means that for each year of increase in age and being

5    divorced, separated or widowed, women were more likely to report having a large number of

6    problems in accessing healthcare, with the greatest differences being that as the age increased

7    and for women who were divorced, separated or widowed, women were less likely to report

8    themselves as having few problems in accessing healthcare. Also, the women who were richest

9    tend to be less likely to report having many problems in accessing healthcare than the women

10   who were poorest, with the greatest differences being that the richest women were less likely to

11   report themselves as having many problems in accessing health care.

12   **Table 4 partially constrained gologit2 model with alternative gamma parameterization,**

13   **Tanzania DHS-MIS 2015-16 (N=13,266)**

|  | Variable | Coef | Std error | *P*-value | POR [95% CI] |
|---|---|---|---|---|---|
| **Beta** | **Health insurance** (ref: No) | | | | |
|  | Yes | -.474 | .081 | 0.000 | 0.622 [0.531-0.731] |
|  | **Residence** (ref: Urban) | | | | |
|  | Rural | -.153 | .084 | 0.072 | 0.858 [0.728-1.012] |
|  | **Age** (as continous) | .011 | .003 | 0.015 | 1.010 [1.001-1.017] |
|  | **Marital status** ref: Never married) | | | | |
|  | Married/living together | -.104 | .060 | 0.127 | 0.901 [0.801-1.014] |
|  | Divorced/separated/widowed | .349 | .096 | 0.022 | 1.418 [1.175-1.712] |
|  | **Education** (ref: None) | | | | |
|  | Primary | -.124 | .058 | 0.035 | 0.883 [0.788-0.990] |
|  | Secondary | -.382 | .081 | 0.000 | 0.683 [0.582-0.800] |
|  | Highest | -.661 | .184 | 0.000 | 0.516 [0.360-0.741] |

| | | | | | |
|---|---|---|---|---|---|
| **Wealth status** (ref: Poorest) | | | | | |
| | Poorer | -.157 | .083 | 0.055 | 0.854 [0.726-1.006] |
| | Middle | -.321 | .075 | 0.000 | 0.725 [0.626-0.840] |
| | Richer | -.701 | .088 | 0.000 | 0.496 [0.417-0.590] |
| | Richest | -1.234 | .114 | 0.000 | 0.291 [0.233-0.364] |
| **Employed last 12 months** (ref: Not employed | | | | | |
| | Employed for cash | -.025 | .059 | 0.809 | 0.975 [0.869-1.095] |
| | Employed but paid in-kind | .199 | .068 | 0.003 | 1.220 [1.067-1.395] |
| **Gamma_2** | **Age** | -.007 | .002 | 0.000 | 0.993 [0.989-0.998] |
| | **Wealth status** (Richest) | .246 | .059 | 0.000 | 1.279 [1.140-1.435] |
| | **Marital status** (Divorced/separated/widowed) | -.206 | .076 | 0.007 | 0.814 [0.701-0.945] |
| **Gamma_3** | **Age** | .008 | .003 | 0.018 | 0.993 [0.986-0.999] |
| | **Wealth status** (Richest) | .415 | .092 | 0.000 | 1.515 [1.265-1.814] |
| | **Marital status** (Divorced/separated/widowed) | -.288 | .093 | 0.002 | 0.749 [0.625-0.899] |
| **Gamma_4** | **Age** | -.0131 | .005 | 0.005 | 0.987 [0.978-0.996] |
| | **Wealth status** (Richest) | .671 | .133 | 0.000 | 1.957 [1.508-2.540] |
| | **Marital status** (Divorced/separated /widowed) | -.570 | .153 | 0.000 | 0.566 [0.419-0.764] |

1  Note: Wald test of parallel lines assumption for the final model:  $F_{(33, 517)} = 1.110$,  $P = 0.310$.

2  An insignificant test statistic indicates that the final model does not violate the proportional odds/

3  parallel lines assumption

4  *POR= Proportional odds ratio

5

1    **DISCUSSION**

2    The aim of this study was to determine the factors associated with problems in accessing

3    healthcare among women in Tanzania as an example of low-income country. To best of our

4    knowledge, this is the first study in this region to explore the factors associated with problems in

5    accessing healthcare using data obtained from a nationally representative sample with the

6    application of generalized ordered logistic regression models. The study revealed that about two-

7    thirds of women reported at least one of four major problems in accessing healthcare.

8    Furthermore, after controlling for other variables included in the final model, women who did

9    not have any type of health insurance, those who belonged to the poorest class of wealth index,

10    those who did not have any type of formal education, those who were employed on a payment

11    in-kind basis, each year of increased age and those who were divorced, separated or widowed

12    were associated with greater problems in accessing healthcare.

13    The high proportion of women who reported problems (at least one problem) in accessing

14    healthcare observed in this study is in agreement with the finding of a study performed in the

15    Netherlands  (69%) that assessed undocumented immigrant women.[34]  Despite the Netherlands

16    being a developed country and the differences in the methodological aspects between these two

17    studies, the similarities observed might be due to the fact that the study population involved in

18    the previous study in the Netherlands included only undocumented immigrants who did not have

19    a residence permit giving them temporary residence. This study population is widely known to

20    have many problems related in accessing healthcare,[34–37] compared with the general population.

21    Having health insurance is an essential element for timely access to healthcare and better

22    health-related outcomes.[38,39] The current study found that less than one-tenth of the women

21

1 reported having any type of health insurance, furthermore, those women who had health

2 insurance were found to be less likely to report having problems associated with access to

3 healthcare. This result can be explained by the fact that having any type of health insurance

4 makes someone not only more comfortable with receiving a wide range of service but also

5 provides information regarding where and when to obtain healthcare without being afraid of the

6 cost, which is usually covered by the insurance company. Similar finding have been reported in

7 study conducted among Hispanics living in El Paso County, Texas.[40]

8     Money is critical to obtain health services such as medical treatment, and its absence may

9 lead the greatest difficulty in accessing healthcare[41] The current study found that about half of

10 the women reported that money was a major problem in accessing healthcare. However, money

11 and wealth are not synonymous: money can be used to obtain assets to build a household's

12 wealth. This study found that women who were in the poorest class of the wealth index were

13 more likely to report having many problems associated with access to healthcare, compared with

14 women who were in the middle, richer and richest classes. Similar findings have been reported in

15 a study conducted in Serbia[42] which found that respondents who were in the poorest class of the

16 wealth index were less likely to access healthcare compared with those in middle, richer and

17 richest. This finding may be explained by the fact that being in the poorest class requires

18 individuals to spend their income on basic needs such as food; hence, healthcare costs are

19 unlikely to be affordable.[43] Therefore, they are more likely to report having many problems in

20 accessing healthcare.

21     Evidence from several studies shows that unemployment is associated with problems in

22 accessing healthcare.[44,45] in contrast, to these previous studies and our expectations, the current

23 study found an unclear relationship between employment status and access to healthcare. The

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1  study revealed an insignificant association between unemployment and problems in accessing

2  healthcare. The difference in findings might be due to differences in socio-cultural and economic

3  determinants, since the previous studies were conducted in developed countries while the current

4  study was conducted in a developing country. In developing countries, despite the fact that

5  someone has employment there are a number of barriers that prevent women from accessing

6  healthcare such as gender inequality,  poor infrastructure, a lack of knowledge regarding

7  maternal health services[46,47] and socio-cultural aspect such as  poor perception toward young or

8  male physicians.[48] Additionally, in poor resource settings, payment in-kind such as food, clothes,

9  and other goods instead of cash is still practiced. In agreement with this conclusion, the current

10 study found that women who were employed but paid in-kind were more likely to report having

11 greater number of problems in accessing healthcare compared with unemployed women.

12  The current study applied the gologit2 command with an alternative parameterization so

13 to allow the coefficients of variables that violated the parallel lines assumptions to vary among

14 the categories of outcome variable.  The variables age, wealth status (richest), and marital status

15 (divorced, separated, or widowed) were found to vary for each category of outcome variable.

16 However, the findings indicated that for each year of increase in age, women were more likely to

17 report problems in accessing healthcare. This finding is in agreement to that from a study

18 conducted in the United States, which found that an older age was associated with barriers in

19 accessing healthcare.[49] Despite differences in environmental, geographical, cultural, economic,

20 and study population involved in these studies: previous study included both men and women

21 who were 65 years or older, while the current study included only women between ages of 15-49

22 years older, still increase in age is associate with problems in accessing health. This might be due

23 to that in age is more likely accompanied with decreased in working capability hence low

1   income, be retired and uninsured.[50,51] Also, women who were divorced, separated or widowed,

2   were more likely to report difficulties in accessing healthcare than those who were never married.

3   This finding can be explained by the fact that the women who were divorced, separated, or

4   widowed were more likely to be older than those who had never married or were living with

5   their partners. As mentioned earlier, older women were more likely to report having a larger

6   number of problems associated with access to healthcare.

7   The current study subjected to some limitations such as misclassification bias. This might

8   be introduced due to lack of external validation of self-reported information that could have

9   affected the categorization of outcome variable. However, we reduce this effect by categorizing

10   the outcome variable into five groups and used of gologit model that clearly validated the factors

11   associated with problems in accessing healthcare among women in low-income countries. Also,

12   being a cross-sectional in nature, the causality assumptions cannot be made; therefore, the results

13   should be interpreted with caution.

14   **CONCLUSION**

15   Despite the SDG 3 and 5 emphasis on reducing the global maternal mortality ratio to less

16   than 70 per 100 000 live births by the end of 2030 and to "leave no one behind" as a strategy to

17   empower women, the current study revealed that a significantly high proportion of women have

18   difficulty accessing healthcare in Tanzania. The present study also highlighted the influence of

19   some socio-economic determinants as well as the role of health insurance in the ability of women

20   to access healthcare. The study suggests that the Ministry of Health together with other agencies

21   such as Non-Governmental Organizations (NGOs) responsible for maternal health services,

22   should provide education about the importance of health insurance as a first-step in reducing

1  problems associated with accessing healthcare. Additionally, employment on a payment in-kind

2  basis should be discouraged, as it seems to hinder women from accessing healthcare.

3  **Contributors**

4  DB originated the design of the study, performed statistical analysis, interpretation and

5  drafted the manuscript. KN contributed to the design of the study and the interpretation advice of

6  data. KS contributed to interpretation advice of data and drafted the manuscript. Both DB, KN &

7  KS critically revised the draft manuscript. All authors read and approved the final manuscript.

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14  **Competing interest**

15  None to declare.

16  **Provenance and peer review**

17  Not commissioned; externally peer reviewed.

18  **A data sharing statement**

19  The datasets used for the current analysis was generated from the original survey of

20  Tanzania DHS-MIS datasets available from within the DHS program repository:

21  http://dhsprogram.com/data/available-datasets.cfm

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic | Item # | Recommendation | Reported on page # |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | Page 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | Page 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | Page 5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | Page 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | Page 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | Page 8-9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | Page 8 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | Page 9-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | Page 9-10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | Page 3, 8 |
| Study size | 10 | Explain how the study size was arrived at | Page 8 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Page 10 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | Page 10-12 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | Page 10-12 |
| | | (*c*) Explain how missing data were addressed | N/A |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Page 10 |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | Page 13 |
|---|---|---|---|
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | Page 14 and Table 1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | Page 14 and Table 1 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Table 2,3,4 |
| | | (*b*) Report category boundaries when continuous variables were categorized | Table 1 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | Table 4 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | Page 18-9, Table 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | Page 24 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | Page 24 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Page 24 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | N/A |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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.

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## Improving access to healthcare for women in low-income countries by addressing socio-economic determinants and health insurance: a generalized ordered logistic regression model

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1 **Improving access to healthcare for women in low-income countries by addressing socio-**

2 **economic determinants and health insurance: a generalized ordered logistic regression**

3 **model**

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1 **ABSTRACT**

2 **Objective:** This study aimed to explore the factors associated with accumulation of multiple

3 problems in accessing healthcare among women in Tanzania as an example of a low-income

4 country.

5 **Design:** Population-based cross-sectional survey

6 **Setting:** Nationwide representative data for women of reproductive age obtained from the 2015-

7 2016 Tanzania Demographic Health Survey were analyzed.

8 **Primary outcome measures:** A composite variable called "problems in accessing healthcare"

9 with five (0-4) categories were created based on the number of problems reported: getting

10 permission to go to the doctor, getting money for advice or treatment, distance to a health facility

11 and not wanting to go alone. Respondents who reported less or more of the problems were

12 placed in lower or higher categories respectively.

13 **Results:** A total of 13,266 women aged 15-49 years, with a median age (IQR) of 27 (20–36)

14 years were interviewed and included in this analysis. About two-thirds (65.53%) of the

15 respondents reported at least one of the four major problems in accessing healthcare.

16 Furthermore, after controlling for other variables included in the final model, women without

17 any type of health insurance, those who belonged to the poorest class of wealth index, those who

18 had not attended any type of formal education, those who were not employed for cash, each year

19 of increased age, and those who were divorced, separated or widowed were associated with

20 greater problems in accessing healthcare.

2

1  2  3  **Conclusion:** Despite available interventions, failure to address women's problems in a

4  5  6  cumulative manner limits the efforts to eliminate problems in accessing healthcare for women in

7  8  9  low-income countries such as Tanzania. The study recommends improving the uptake of health

10  11  insurance and addressing socio-economic determinants as the first-step towards reducing

12  13  women's problems associated with accessing healthcare.

**Strengths and limitations of this study**

➤ This is the first study conducted in this region to explore the factors associated with problems in accessing healthcare for women using data obtained from a nationally representative sample with the application of a generalized ordered logistic regression model.

➤ The use of a generalized ordered logistic regression model provided a significantly better fit to our data while at the same times is much more parsimonious; therefore, it clearly validated the factors associated with problems in accessing healthcare among women.

➤ A statistical approach was used to adjust for the clustering effect and to weight the estimates to correct for non-responses and disproportionate sampling used during the design of the study.

➤ The validity constraints of self-reported outcome and independent variables that cannot be externally validated may have resulted in misclassification bias.

➤ As a cross-sectional study design was used, causality assumptions cannot be made; therefore, the results should be interpreted with caution.

1 **INTRODUCTION**

2    Despite the substantial decline in the global Maternal Mortality Ratio (MMR), this

3 victory cannot be celebrated in many low-income countries that continue to have high maternal

4 death rates[1,2] which have been described as being in an "area of shameful failures of

5 development."[3,4]    In Tanzania, the current statistics show that the MMR has increased

6 significantly by more than 20% over the past 5 years, despite the government efforts to

7 strengthen its health system increasing the coverage of health facilities.[5–7] Through this, each

8 ward has at least one dispensary and/or health centre, each district has at least one hospital, while

9 each region has at least one referral hospital.  Regardless of the differences in the level of these

10 facilities in terms of functions, expertise, availability of services, and population coverage all of

11 them are expected to provide basic maternal health services together with basic emergency

12 obstetric care.[7] This resulted in an increased coverage of maternal health services such as

13 antenatal care provided by a skilled provider (96 to 98%), facility delivery (50 to 63%), and

14 births assisted by skilled providers (51 to 64%) between 2010 to 2016 respectively.[5,6] Therefore,

15 reported high MMR (556 maternal deaths per 100,000 live-births) in Tanzania poses the question

16 of whether the country can achieve the Sustainable Development Goals (SDGs) target of less

17 than 140 maternal deaths per 100,000 live-births by the year 2030.[8,9] the majority of avoidable

18 and unnecessary maternal deaths experienced in this region likely result from poor utilization of

19 skilled maternal health services.[10]

20    Many social, cultural, geographical factors as well as education level and poverty

21 reportedly play roles in the poor utilization of health services.[11–13] However, access to healthcare

22 has been highlighted as the major barrier towards the utilization of maternal health services in

23 low-income countries, especially in sub-Saharan Africa (SSA).[10,14,15] Access to healthcare can be

4

1  broadly defined using four dimensions: availability, affordability, accessibility and

2  acceptability,[16] but simply to referred as the timely use of health services to achieve the desired

3  health outcomes. Despite the fact that access to health care must be universal and guaranteed for

4  all on an equitable basis,[17] women continue to face significant inequities in accessing and

5  utilizing healthcare.[18]

6  Several problems have been mentioned as possible barriers for women in accessing

7  healthcare,[10] and these can be grouped into two categories: the supply side, in which the facility

8  fails to provide good quality of healthcare and the demand side, in which the clients fail to utilize

9  the available services because of their own personal reasons.[16,19,20] Despite the fact that it is

10  important to understand both sides, the current study will focus on the demand side (women), as

11  this side determines whether or not the healthcare services are used regardless of the presence of

12  barriers. Therefore, it is mainly based on providing insights into problems that women

13  experienced in accessing healthcare for understanding the challenges embedded in interpersonal

14  relations.

15  Based on the evidence from previous scholars many problems linked to women on the

16  demand-side have been reported to be associated with access to healthcare. However, the

17  following four; getting permission,[21,22] getting money,[23] distance to the health facility,[24] and not

18  wanting to go alone (lack of spouse or family member escort)[25,26] were the major ones reported

19  and discussed. Although it is uncertain whether women with multiple problems encounter greater

20  difficulties in accessing healthcare, most of the previous studies assessed and discussed each of

21  the four problems independently. Limited evidence of whether women with an accumulation of

22  problems are more difficulty in accessing healthcare raised a need to create a composite variable

23  that included all four problems to identify the women in the more disadvantaged group. A similar

5

1    approach has been used by researchers in another field to assess the severity of problems in

2    accessing healthcare among individuals with disability in four African countries.[27] Moreover,

3    evidence from recent studies determined that age, education, residence, health insurance

4    ownership, wealth status, and occupation are strongly linked with access to healthcare.[28–32] The

5    current study has also hypothesized that those factors have a relationship with the proposed

6    composite outcome variable "problems in accessing healthcare." Therefore, this study used a

7    generalized ordered logistics regression model to explore the factors associated with

8    accumulation of multiple problems in accessing healthcare among women in Tanzania as an

9    example of a low-income country.

1 **METHODS**

2 **Data sources**

3 The current study analyzed data from the 2015-2016 Tanzania Demographic Health

4 Survey and Malaria Indicator Survey (TDHS-MIS). The survey was conducted by the National

5 Bureau of Statistics (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar,

6 in collaboration with the Ministry of Health, Community Development, Gender, Elderly, and

7 Children (MoHCDGEC) of the Tanzania Mainland and the Ministry of Health (MoH), Zanzibar.

8 **Study design**

9 This study analyzed a nationwide population-based cross-sectional survey that used

10 information obtained from interviewed women  (15-49 years old) who were either residents or

11 visitors in the household on the night before the survey.

12 **Sample size and sampling technique**

13 The 2015-2016 TDHS-MIS used a two-stage cluster sampling technique in order to

14 obtain a sample designed to provide nationally-representative results for all 30 Tanzania regions.

15 In the first stage, sample points (a total of 608 clusters) consisting of enumeration areas

16 delineated for the 2012 Tanzania Population and Housing Census were selected. In the second

17 stage, households were selected systematically. A complete listing of households was established

18 for all 608 selected clusters prior to the fieldwork. From this list, 22 households were then

19 systematically selected from each cluster, yielding a representative probability sample of 13,376

20 households. Then, all eligible women and men between the ages of 15-49 years who were either

21 residents or visitors in the household on the night before the survey were interviewed. Finally, a

22 total of  13,266 women and 3,514 men were interviewed.[6]

7

1 **Data collection and processing**

2      The 2015-2016 TDHS-MIS used four main types of questionnaires during data

3 collection; however, the current study used data collected by the Woman's Questionnaire

4 segment of the TDHS-MIS. After pre-testing of the questionnaires, the finalized and corrected

5 version was used in the main survey data collected between August 22, 2015 and February 14,

6 2016. The data collection was performed by 64 female nurses who were trained and qualified by

7 a series of practical tests and examinations to be interviewers. Following the training, 16 teams

8 were formed (3 for Zanzibar and 13 for Tanzania Mainland). The data entry was done

9 concurrently with data collection in the field. After the paper questionnaires were completed,

10 edited, and checked by both the field editor and the supervisor, the data was entered into a tablet

11 equipped with a data entry programme. The data entry process included 100% double entry to

12 minimize keying errors, and editing was completed on March 21, 2016, while data cleaning and

13 finalization were completed on April 22, 2016.

14 **Measurement of variables**

15      **Outcome variable:** In this survey women were asked whether each of the following four

16 factors was a problem in seeking medical advice or treatment when they were sick: getting

17 permission to go to the doctor/health facility; getting money for advice, consultation or

18 treatment; distance to the health facility; and not wanting to go alone. Then, a new composite

19 variable called "problems in accessing healthcare" was created based on the number of problems

20 reported with respondents who reported less or more were placed in lower or higher categories,

21 respectively. The categories were assigned as 1, 2, 3, 4 and 5 for women who reported "no,"

22 "one," "two," "three," and "four" problems to accessing healthcare, respectively. These

1    categories of a composite (outcome) variable were treated as ordinal numbers, with the

2    assumption that conceptual differences between categories were exactly the same.

3    **Independent variables:** The current study included several independent variables that

4    have been empirically and theoretically linked with the accessibility of healthcare among women.

5    The respondents' ages were categorized into groups of "15-19," "20-34," and "35-49" years;

6    marital status was grouped into "never married," "married/living together," and "divorced,

7    separated or widowed." Education level was grouped into "none," "primary," "secondary," and

8    "highest," (including college and all university level). Employment in the last 12 months was

9    grouped into "not employed," "employed for cash" and "employed but paid in-kind." The area of

10    residence was grouped into "urban" and "rural". Health insurance ownership was grouped as "no"

11    for women who did not have any type of health insurance and "yes" for those who had any type

12    of health insurance. The wealth index was computed based on household assets and housing

13    characteristic. During the computation, the households were given scores based on the number

14    and kinds of consumer goods they owned, ranging from a television to a bicycle or car, plus

15    housing characteristics, such as the source of drinking water, toilet facilities, and flooring

16    materials. These scores were derived using a principal component analysis. National wealth

17    quintiles were compiled by assigning the household score to each usual (de jure) household

18    member, ranking each person in the household population by their score, and then dividing the

19    distribution into five equal categories, each with 20% of the population, as "poorest, "poorer,"

20    "middle," "richer", and "richest."[6] The selection of these variables was based on studies that

21    were conducted elsewhere.[28–32]

1 **Statistical approaches**

2     In descriptive analyses, categorical variables were summarized using proportions and

3 then presented in tables while quantitative variables were summarized using the median and

4 Interquartile Range (IQR).

5     **Model Fitting:** Since the outcome variable "problems in accessing healthcare" was

6 ordinal in nature (a score based on the number of different reported problems), in which the

7 order of its values corresponding to a hierarchy in meaning as in this study, therefore, the

8 application of ordered logistic regression was recommended.[33]  Stata 14 (StataCorp, College

9 Texas) was used for the analysis in the current study. For all the analyses, the Stata survey set

10 commands were used to adjust for the variability of clustering and all the estimates were

11 weighted to correct for non-response and disproportionate sampling.

12     **Proportional ordered logistic model:** As the current study contained several factors to

13 be considered in the models, a simple (binary) ordered logistics analysis was first performed to

14 identify variables to be included in the multivariate models. Then, a proportional ordered logistic

15 regression model was used to assess the significance of outcome and independent variables.

16 Although the ordered logistic regression model provides results that are straightforward and easy

17 to interpret the assumptions of a parallel-lines model (parallel regression) must be met for a

18 correct interpretation.[34–36] This assumption can be tested using the Brant test, which provides

19 evidence of whether the assumption is violated.[37]  If the Brant test provides a significant *P*-value

20 (less than 0.05), the assumption of parallel regression is violated; hence, the results from this

21 model may lead to invalid interpretations.[38]

10

1     **Generalized ordered logistic regression model:** Since the Brant test command cannot

2     work on weighted and svyset data like that used in the current analysis, a generalized ordered

3     logistic regression model was used instead, as this model provides results similar to the series of

4     binary logistic regressions estimated using the Brant test.[39] The model compares higher

5     categories to categories lower than or equal to the current category.[40] Hence, positive coefficients

6     indicate that higher values of independent variables make it more likely that the respondent will

7     be classified in a higher category of the outcome variable (greater difficulties in assessing

8     healthcare) than the current category. Conversely, negative coefficients indicate that higher

9     values of the independent variable increase the likelihood of belonging to the current or lower

10    category. However, the problem with the generalized ordered logistic regression model is that it

11    frees all the variables from parallel-lines constraints, even though the assumption may be

12    violated by one or a few of the variables.[39] (see online supplementary table S1)

13     **Partially generalized ordered logistic regression model:** When this model has the

14    "autofit" option command applied to it in Stata, it overcomes the previous limitation of the

15    generalized ordered logistic regression model by fitting another model known as the "partial

16    proportional odds." This model allows some variables to be modeled with the proportional odds

17    assumption while the parallel line constraint is relaxed for variables in which the assumption was

18    not met. The model is less restrictive as it allows the coefficient of the variables to vary for the

19    different categories that are compared.[41] But if this is not the case for all the variables, the model

20    is called a "partially constrained logistic model," which is a model recommended for cases

21    involving ordinal data.[42,43] However, the model does not appear to be parsimonious; therefore, an

22    alternative (gamma) parameterization was performed to make the model more parsimonious and

23    provide for further understanding of the parallel regression assumptions. The model with gamma

11

1 parameterization provides beta coefficients that have the similar coefficients for all pairs of

2 categories of outcome variables. Also, the model provides gamma coefficients that show the

3 extent to which the parallel regression assumption is violated by the variable. Hence, if the

4 gamma coefficients for an independent variable are all equal to "0", then the parallel regression

5 assumption is met for that variable; otherwise, the assumption is considered to be violated. If all

6 the gamma coefficients are equal to "0" then the ordered logistic regression model will be

7 obtained, for more details (see online supplementary word document file S2).

8 **Ethics statement**

9 This study was based on an analysis of existing public domain survey data sets that are

10 freely available online with all identifier information detached. The original TDHS-MIS

11 protocols were reviewed equivalent by Institution Review Board (IRB) of ICF Macro at

12 Calverton in the United States (U.S) and by the National Institute of Medical Research (NIMR)

13 IRB in Tanzania. The ICF IRB ensures that the survey complied with the U.S. Department of

14 Health and Human Services regulations for the protection of human subjects (45 CFR 46), while

15 NIMR-IRB ensures that the surveys complied with laws and norms of Tanzania. Before

16 interviews were performed, informed consent was requested and obtained from the participants.

17 The participants were adequately informed about all relevant aspects of the survey, including its

18 objective and interview procedures. All participants accepted to participate in the study signed an

19 informed consent form.

20 **Patient and Public Involvement Statement**

21 Patient and public were not involved in the analysis of this study.

1 **RESULTS**

2 **Respondents' characteristics**

3　　As shown in table 1, a total of 13,266 women between the ages 15-49 years were

4 interviewed and included in this analysis. The median age (IQR) of the respondents was 27 (20–

5 36) years. Overall, 8,210 respondents (61.89%) were living with their spouse at the time of the

6 interview. Only 183 (1.38%) had attained the highest level of education (college or university).

7 A total of 6,197 (46.71%) were employed for cash and 8,455 (63.73%) were living in a rural

8 residence, but only 1,200 (9.05%) reported having any kind of health insurance and 3,596

9 (27.11%) were categorized in the richest quintile. Almost half the respondents (49.49%),

10 reported that getting money for healthcare was the greatest problem in accessing healthcare.

11 Furthermore, about two-thirds (65.53%) of the respondents reported at least one of the four

12 problems in accessing healthcare.

13 **Table 1 Percent distribution of women between the ages 15-49 by selected background**

14 **characteristics, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | N (%) (Weighted) |
|---|---|
| **Age** (Median (IQR)=27, (20-36) | |
| 15-19 | 2904 (21.89) |
| 20-34 | 6360 (47.94) |
| 35-49 | 4002 (30.17) |
| **Marital status** | |
| Never married | 3353 (25.27) |
| Married/living together | 8210 (61.89) |
| Divorced/separated/widowed | 1703 (12.84) |
| **Education** | |
| None | 1947 (14.67) |
| Primary | 8211 (61.90) |
| Secondary | 2925 (22.05) |
| Highest | 183 (1.38) |
| **Employed last 12 months** | |
| Not employed | 3033 (22.86) |

13

| | |
|---|---|
| Employed cor cash | 6197 (46.71) |
| Employed but paid-in-kind | 4036 (30.43) |
| **Residence** | |
| Urban | 4811 (36.27) |
| Rural | 8455 (63.73) |
| **Health insurance ownership** | |
| Yes | 12066 (90.95) |
| No | 1200 (9.05) |
| **Health quintile** | |
| Lowest | 2246 (16.93) |
| Second | 2274 (17.14) |
| Middle | 2328 (17.55) |
| Fourth | 2822 (21.27) |
| highest | 3596 (27.11) |
| **Type of problems*** | |
| Getting money | 6565 (49.49) |
| Distance to facility | 5615 (42.33) |
| Not want to alone | 3962 (29.87) |
| Getting permission | 1900 (14.32) |
| **Number of problems in accessing healthcare** | |
| None | 4574 (34.48) |
| One problem | 3291 (24.81) |
| Two problems | 2547 (19.20) |
| Three problems | 1759 (13.26) |
| Four problems | 1095 (8.25) |

Note: *n and % do not add up to 13,266 and 100 %, respectively, because multiple responses were

possible


**Proportional ordered logistic regression model**

The results from the final ordered logistic regression model are shown in Table 2. In this

model, for women who had any type of health insurance [POR = 0.622, 95%CI; 0.531-0.728],

the odds of being in higher categories of problems in accessing healthcare versus lower or equal

to a reference category were 0.622 times lower than those who did not. For each year increase in

age [POR = 1.006, 95%CI; 1.001-1.011], the odds of being in higher categories of problems in

accessing healthcare versus lower or equal to a reference category were 1.006 times greater. For

women who were divorced, separated, or widowed [POR = 1.188, 95%CI; 1.025-1.377], the

14

1    odds of being in higher categories of problems in accessing healthcare versus lower or equal to a

2    reference category were 1.188 times greater than those who were never married. For women who

3    attained primary [POR = 0.888, 95%CI; 0.796-0.992], secondary [POR = 0.679, 95%CI; 0.580-

4    0.796], or the highest level of education [POR = 0.506, 95%CI; 0.351-0.731], the odds of being

5    in higher categories of problems in accessing healthcare versus lower or equal to a reference

6    category were 0.888, 0.679, and 0.506 times lower than those who reported not having attended

7    any type of formal education respectively. For women who belonged to the poor [POR = 0.858,

8    95%CI; 0.733-1.003] middle [POR = 0.737, 95%CI; 0.640-0.848], richer [POR = 0.512, 95%CI;

9    0.433-0.604], or richest class of wealth status [POR = 0.342, 95%CI; 0.276-0.423], the odds of

10    being in higher categories of problems in accessing healthcare versus lower or equal to a

11    reference category were 0.858, 0737, 0.512, and 0.342 times lower than those who were in the

12    poorest class respectively.

13    **Table 2 Results of ordered logistic regression model using problems in accessing health**

14    **care as a response with four categories, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | POR [95% CI] | *P*-value |
|---|---|---|
| **Health insurance** (ref: No) | | |
| Yes | 0.622 [0.531-0.728] | 0.000 |
| **Residence** (ref: Urban) | | |
| Rural | 0.862 [0.732-1.013] | 0.072 |
| **Age** (as continous) | 1.006 [1.001-1.011] | 0.015 |
| **Marital status** ref: Never married) | | |
| Married/living together | 0.911 [0.809-1.027] | 0.127 |
| Divorced/separated/widowed | 1.188 [1.025-1.377] | 0.022 |
| **Education** (ref: None) | | |
| Primary | 0.888 [0.796-0.992] | 0.035 |
| Secondary | 0.679 [0.580-0.796] | 0.000 |
| Highest | 0.506 [0.351-0.731] | 0.000 |
| **Wealth status** (ref: Poorest) | | |
| Poorer | 0.858 [0.733-1.003] | 0.055 |

15

| | | |
|---|---|---|
| Middle | 0.737 [0.640-0.848] | 0.000 |
| Richer | 0.512 [0.433-0.604] | 0.000 |
| Richest | 0.342 [0.276-0.423] | 0.000 |
| **Employed last 12 months** (ref: Not employed | | |
| Employed for cash | 0.987 [0.877-1.108] | 0.809 |
| Employed but paid in kind | 1.221 [1.069-1.394] | 0.003 |

**The partial generalized ordered logistic regression model with alternative gamma parameterization**

Table 3 shows the results of the partially constrained generalized ordered logistic regression model with alternative (gamma) parameterization for the outcome variable of problems in accessing healthcare. The results show insignificant Wald test statistics, indicating that the model does not violate the proportional odds/parallel regression assumptions. However, constraints for parallel lines were not imposed for age, wealth status (richest) and marital status (divorced, separated or widowed). The remaining variables that met the parallel assumption can be interpolated in the same manner as for the ordered logistic regression model as follows. For women who had any type of health insurance [POR = 0.622, 95%CI; 0.531-0.731], the odds of being in higher categories of problems in accessing healthcare versus lower or equal to a reference category were 0.622 times lower than those who did not, given that other variables were held constant in the model. Also, for women who attained primary [POR = 0.883, 95%CI; 0.788-0.990], secondary [POR = 0.683, 95%CI; 0.582-0.800], or the highest level of education [POR = 0.516, 95%CI; 0.360-0.741], the odds of being in higher categories of problems in accessing healthcare versus lower or equal to a reference category were 0.883, 0.683, and 0.516 times lower than those who reported not having attended any type of formal education respectively, given that other variables were held constant in the model. Additionally, for women who belonged to middle [POR = 0.725, 95%CI; 0.626-0.840] or richer class of wealth status [POR = 0.496, 95%CI; 0.417-0.590), the odds of being in higher categories of problems in

16

1  accessing healthcare versus lower or equal to a reference category were 0.725 and 0.496 times

2  lower than those who were in the poorest class respectively given that other variables were held

3  constant in the model. Furthermore, for women who were employed but paid-in-kind [POR =

4  1.220, 95%CI; 1.067-1.395], the odds of being in higher categories of problems in accessing

5  healthcare versus lower or equal to a reference category were 1.22 times higher than those who

6  were unemployed for the last 12 months before the survey, given that the other variables were

7  held constant in the model.

8     The variables for which the constraints for parallel lines were not imposed were

9  interpreted as follows; the coefficients for age and marital status (divorced, separated or

10  widowed) were consistently positive, while those for wealth status (richest) were negative but

11  decreased across the cut-points. This means that for each year of increase in age and being

12  divorced, separated or widowed, women were more likely to report having a large number of

13  problems in accessing healthcare, with the greatest differences being that as the age increased

14  and for women who were divorced, separated or widowed, women were less likely to report

15  themselves as having few problems in accessing healthcare. Also, the women who were richest

16  tend to be less likely to report having many problems in accessing healthcare than the women

17  who were poorest, with the greatest differences being that the richest women were less likely to

18  report themselves as having many problems in accessing health care.

19  **Table 3 partially constrained generalized ordered logistic regression model with alternative**

20  **gamma parameterization, Tanzania DHS-MIS 2015-16 (N=13,266)**

| | Variable | POR [95% CI] | *P*-value |
|---|---|---|---|
| **Beta** | **Health insurance** (ref: No) | | |
| | Yes | 0.622 [0.531-0.731] | 0.000 |
| | **Residence** (ref: Urban) | | |
| | Rural | 0.858 [0.728-1.012] | 0.069 |

17

| | | | |
|---|---|---|---|
| **Age** (as continous) | | 1.010 [1.001-1.017] | 0.000 |
| **Marital status** ref: Never married) | | | |
| | Married/living together | 0.901 [0.801-1.014] | 0.085 |
| | Divorced/separated/widowed | 1.418 [1.175-1.712] | 0.000 |
| **Education** (ref: None) | | | |
| | Primary | 0.883 [0.788-0.990] | 0.033 |
| | Secondary | 0.683 [0.582-0.800] | 0.000 |
| | Highest | 0.516 [0.360-0.741] | 0.000 |
| **Wealth status** (ref: Poorest) | | | |
| | Poorer | 0.854 [0.726-1.006] | 0.059 |
| | Middle | 0.725 [0.626-0.840] | 0.000 |
| | Richer | 0.496 [0.417-0.590] | 0.000 |
| | Richest | 0.291 [0.233-0.364] | 0.000 |
| **Employed last 12 months** (ref: Not employed | | | |
| | Employed for cash | 0.975 [0.869-1.095] | 0.668 |
| | Employed but paid in kind | 1.220 [1.067-1.395] | 0.004 |
| Gamma_2 | Age | 0.993 [0.989-0.998] | 0.000 |
| | Wealth status (Richest) | 1.279 [1.140-1.435] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.814 [0.701-0.945] | 0.007 |
| Gamma_3 | Age | 0.993 [0.986-0.999] | 0.018 |
| | Wealth status (Richest) | 1.515 [1.265-1.814] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.749 [0.625-0.899] | 0.002 |
| Gamma_4 | Age | 0.987 [0.978-0.996] | 0.005 |
| | Wealth status (Richest) | 1.957 [1.508-2.540] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.566 [0.419-0.764] | 0.000 |

1 Note: Wald test of parallel lines assumption for the final model: $F_{(33, 517)} = 1.110$, $P = 0.310$.

2 An insignificant test statistic indicates that the final model does not violate the proportional odds/

3 parallel lines assumption

4 *POR= Proportional odds ratio

5

1 **DISCUSSION**

2     The aim of this study was to explore the factors associated with accumulation of multiple

3 problems in accessing healthcare among women in Tanzania as an example of a low-income

4 country. To best of our knowledge, this is the first study to explore the factors associated with

5 problems in accessing healthcare by considering the accumulation of multiple problems someone

6 has experienced. Furthermore, the study used a nationally representative sample from Tanzania

7 with the application of generalized ordered logistic regression models, that provided the best

8 models for ordinal data to validate the factors associated with problems in accessing healthcare.

9 The study revealed that about two-thirds of women reported at least one of four major problems

10 in accessing healthcare. Furthermore, after controlling for other variables included in the final

11 model, women who did not have any type of health insurance, those who belonged to the poorest

12 class of wealth index, those who did not have any type of formal education, those who were

13 employed on a payment-in-kind basis, each year of increased age and those who were divorced,

14 separated or widowed were associated with greater problems in accessing healthcare.

15     The high proportion of women who reportedly had problems (at least one problem) in

16 accessing healthcare observed in this study is in agreement with the finding of a previous study

17 performed in the Egypt.[44]  These findings provide evidence that demand-side barriers such as

18 cost of care, permission from their spouse, lack of someone to escort, and distance to the

19 facility,[45,46]  still ruin efforts of many African women in accessing healthcare. Because of

20 cultural, social, and traditional perceptions in Africa that assumes maternal health is only a

21 woman's responsibility, existing and new interventions should influence health service

22 utilization to start at individual, households and community level as the one step towards

23 eliminating demand-side barriers.[23,47]

19

1       Having health insurance is an essential element for timely access to healthcare and better

2   health-related outcomes.[48,49] Despite the availability of National Health Insurance Fund (NHIF)

3   in Tanzania since 2001 through Act No. 8 of 1999, more than 90% of women still are

4   uninsured.[29,50] The current study found that less than one-tenth of the women reported having

5   any type of health insurance. Moreover, those women who had health insurance were found to be

6   less likely to report having the multiple numbers of problems associated with access to

7   healthcare. This result can be explained by the fact that having any type of health insurance

8   makes someone not only more comfortable with receiving a wide range of service but also

9   provides information regarding where and when to obtain healthcare without being afraid of the

10   cost, which is usually covered by the insurance company. A similar finding has been reported in

11   a study conducted Ghana.[28] The similarity of the findings between these studies might be due to

12   both having used secondary data collected by a DHS program that applied similar methodology.

13   Furthermore, study participants in these two studies were from SSA. Therefore, both might have

14   similar socio-economic determinants.

15       Money is critical to obtain health services such as medical treatment, and its absence may

16   lead to the greatest difficulty in accessing healthcare[51] The current study found that about half of

17   the women reported that money was a major problem in accessing healthcare. However, money

18   and wealth are not synonymous: money can be used to obtain assets to build a household's

19   wealth. This study found that women who were in the poorest class of the wealth index were

20   more likely to report having many problems associated with access to healthcare, compared with

21   women who were in the middle, richer and richest classes. Similar findings have been reported in

22   a study conducted in Serbia[52] which found that respondents who were in the poorest class of the

23   wealth index were less likely to access healthcare compared with those in middle, richer and

20

1  richest. This finding may be explained by the fact that being in the poorest class requires

2  individuals to spend their income on basic needs such as food; hence, healthcare costs are

3  unlikely to be affordable.[53] Therefore, they are more likely to report having many problems in

4  accessing healthcare.

5  Evidence from several studies shows that unemployment is associated with problems in

6  accessing healthcare.[54,55] In contrast to these previous studies and our expectations, the current

7  study found an unclear relationship between employment status and access to healthcare. The

8  study revealed an insignificant association between unemployment and problems in accessing

9  healthcare. The difference in findings might be due to differences in socio-cultural and economic

10  determinants since the previous studies were conducted in developed countries while the current

11  study was conducted in a developing country. In developing countries, despite the fact that

12  someone has employment there are a number of barriers that prevent women from accessing

13  healthcare such as gender inequality,  poor infrastructure, a lack of knowledge regarding

14  maternal health services[30,56] and socio-cultural aspect such as poor perception toward young or

15  male physicians.[44] Additionally, in poor resource settings, payment-in-kind such as food, clothes,

16  and other goods instead of cash is still practiced. In agreement with this conclusion, the current

17  study found that women who were employed but paid-in-kind were more likely to report having

18  the greater number of problems in accessing healthcare compared with unemployed women.

19  The current study applied the generalized ordered logistics regression with an alternative

20  parameterization so to allow the coefficients of variables that violated the parallel lines

21  assumptions to vary among the categories of the outcome variable.  The variables age, wealth

22  status (richest), and marital status (divorced, separated, or widowed) were found to vary for each

23  category of the outcome variable. However, the findings indicated that for each year of increase

21

1   in age, women were more likely to report problems in accessing healthcare. This finding is in

2   agreement to that from the study conducted in the Ethiopia, which found that an older age was

3   associated with problems in accessing maternal healthcare.[57,58] This might be due to that increase

4   in age is more likely accompanied by a decrease in working capability (hence low income),

5   being retired and being uninsured.[59,60] Also, women who were divorced, separated or widowed,

6   were more likely to report difficulties in accessing healthcare than those who were never married.

7   This finding can be explained by the fact that the women who were divorced, separated, or

8   widowed were more likely to be older than those who had never married or were living with

9   their partners. As mentioned earlier, older women were more likely to report having a larger

10  number of problems associated with access to healthcare.

11      The current study was subjected to some limitations such as misclassification bias. This

12  might be introduced due to lack of external validation of self-reported information that could

13  affect the categorization of the outcome variable. However, we reduced this effect by

14  categorizing the outcome variable into five groups and by the use of a generalized ordered

15  logistics regression model that clearly validated the factors associated with problems in accessing

16  healthcare among women in low-income countries. Also, being cross-sectional in nature, the

17  causality assumptions cannot be made; therefore, the results should be interpreted with caution.

18  **CONCLUSION**

19      Despite several interventions that have been placed to increase women accessibility to

20  healthcare, failure to address women's problems in a cumulative manner starting at individual,

21  households and community levels limit the efforts to remove the demand-side barrier to

22  accessing healthcare for women in low-income countries such as Tanzania. The study suggests

23  that the Tanzanian government together with other agencies responsible for maternal health

22

1 services should emphasize that women be enrolled in any type of health insurance and that the

2 addressing socio-economic determinants through health education interventions be the first-step

3 forward to reducing problems associated with accessing healthcare.

15 **Competing interest**

16      None to declare.

17 **Provenance and peer review**

18      Not commissioned; externally peer reviewed.

19 **A data sharing statement**

1    The datasets used for the current analysis was generated from the original survey of

2    Tanzania DHS-MIS datasets available from within the DHS program repository:

3    http://dhsprogram.com/data/available-datasets.cfm

4

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11

**Supplementary Table S1: Estimated coefficients from four binary regression variables of generalized ordered logistics regressions for assessing the parallel regression assumption, Tanzania DHS-MIS 2015-16 (N=13,266)**

| Variable | y>1 | y>2 | y>3 | y>4 |
|---|---|---|---|---|
| **Health insurance** (ref: No) | | | | |
|   Yes | -.487 | -.484 | -.400 | -.221 |
| **Residence** (ref: Urban) | | | | |
|   Rural | -.151 | -.098 | -.244 | -.303 |
| **Age** (as continous) | .013 | .004 | .002 | .003 |
| **Marital status** ref: Never married) | | | | |
|   Married/living together | -.142 | -.053 | -.110 | -.103 |
|   Divorced/separated/widowed | .332 | .187 | .035 | .272 |
| **Education** (ref: None) | | | | |
|   Primary | -.185 | -.140 | -.103 | -.091 |
|   Secondary | -.438 | -.351 | -.444 | -.212 |
|   Highest | -.736 | -.500 | -.835 | -1.057 |
| **Wealth status** (ref: Poorest) | | | | |
|   Poorer | -.170 | -.239 | -.124 | .101 |
|   Middle | -.359 | -.399 | -.267 | -.029 |
|   Richer | -.723 | -.764 | -.696 | -.331 |
|   Richest | -1.233 | -1.038 | -.861 | -.469 |
| **Employed last 12 months** (ref: Not employed | | | | |
|   Employed for cash | -.076 | -.003 | -.076 | .124 |
|   Employed but paid in kind | .223 | .171 | .223 | .352 |

Note: The Table presents four separate binary logistic from the generalized ordered logistics regressions model that were used to assess the parallel regression assumption. The results indicate that the coefficients for all categories of each of the independent variables were significant different except for age, wealth status (richest), and marital status (divorced/separated/widowed). This means that age, wealth and marital status failed to satisfy the parallel regression assumption hence the use of a proportion odds ratio was not appropriate for these variables. Since the model frees all the variables from parallel-lines constraints, the partial generalized ordered logistics model were the right model for this case.

**Supplementary document S2: Explain in details about the generalized logistic regression model that was used in the analysis of the current study.**

**Generalized ordered logistic regression model**

When the outcome variable has more than two categories that are ordered in nature, the most appropriate model is the one that can account for the ordering of multiple categories. The ordered logistic regression model is the most commonly fitted model for this type of variable since it estimates the probability of the outcome belonging to a higher category rather than a less-than or equal to a given category. In the ordered logistic regression model, the influence of each explanatory variable is presumed to be equal across the categories of outcome variable. This implies that the model provides the same odds ratio (OR) across the categories of outcome variable, thereby simplifying the interpretations. However, the use of this OR across all categories is appropriate only when the proportional odds (parallel regression) assumption, which means the "equality of the log-odds across the different categories of the outcome variable," is met. Moreover, this assumption is often violated because it is very common for one or more of the coefficients or ORs to differ across the categories of outcome variable. In such cases, it is advisable to use a non-ordinal model, such as multinomial logistic regression. Unfortunately, such models are not only less parsimonious and difficult to interpret, compared with ordered logistic regression models, but also they do not consider the ordinal nature of the variable.

Generalized ordered logistic regression established by Fu and later by William has been found to be an appropriate model for such cases, since it relaxes the proportional assumptions by allowing the effect of each explanatory variable to vary across different categories of outcome

variable without modifying the data. The generalized ordered logistic regression model can be written using the following formula (1):

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i\beta_j)}{1 + \exp(\alpha_j + X_i\beta_j)}, j = 1, 2, \ldots, M - 1 \qquad (1)$$

Where M is the number of categories of the ordinal dependent variable ($Y$), however, the logit model is a special case of the gologit model when M = 2. When M > 2, is equivalent to the series of binary logistic regressions, such as category 1 versus categories 2, 3, 4 and 5 ($Y>1$); categories 1 and 2 versus categories 3, 4, and 5 ($Y>2$); categories 1, 2, and 3 versus categories 4 and 5 ($Y>3$); and categories 1, 2, 3, and 4 versus category 5 ($Y>4$). Additionally, the ordered logistic regression model is also a special case of the generalized ordered logistic regression model when the betas are the same for each value of j as shown in formula (2):

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i\beta)}{1 + \exp(\alpha_j + X_i\beta)}, j = 1, 2, \ldots, M - 1 \qquad (2)$$

When the betas change for some variables while for the other variables remain the same, the fitted model is described as being partial constrained, since it only allows the betas of the variables that met the proportional assumptions to be constrained while those that have not met the aforementioned assumptions are allowed to vary freely without constraint. The gologit2 command in Stata is responsible for producing this type of model, and as shown in formula (3) below, the betas for X1 and X2 are constrained but the betas for X3 are not.

$$P(Y_i > j) = \frac{\exp(\alpha_j + X1_i\beta1 + X2_i\beta2 + X3_i\beta3_j)}{1 + \exp(\alpha_j + X1_i\beta1 + X2_i\beta2 + X3_i\beta3_j)}, j = 1, 2, \ldots, M - 1 \qquad (3)$$

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic | Item # | Recommendation | Reported on page # |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | Page 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | Page 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | Page 5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | Page 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | Page 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | Page 8-9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | Page 8 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | Page 9-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | Page 9-10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | Page 3, 8 |
| Study size | 10 | Explain how the study size was arrived at | Page 8 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Page 10 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | Page 10-12 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | Page 10-12 |
| | | (*c*) Explain how missing data were addressed | N/A |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Page 10 |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | Page 13 |
|---|---|---|---|
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | Page 14 and Table 1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | Page 14 and Table 1 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Table 2,3,4 |
| | | (*b*) Report category boundaries when continuous variables were categorized | Table 1 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | Table 4 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | Page 18-9, Table 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | Page 24 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | Page 24 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Page 24 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | N/A |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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.

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## Improving access to health care for women in Tanzania by addressing socioeconomic determinants and health insurance

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Manuscripts

1 **Improving access to health care for women in Tanzania by addressing socioeconomic**

2 **determinants and health insurance**

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1

1  **ABSTRACT**

2  **Objective:** This study was performed to explore the factors associated with accumulation of

3  multiple problems in accessing health care among women in Tanzania as an example of a low-

4  income country.

5  **Design:** Population-based cross-sectional survey

6  **Setting:** Nationwide representative data for women of reproductive age obtained from the 2015

7  – 2016 Tanzania Demographic Health Survey were analyzed.

8  **Primary outcome measures:** A composite variable, "problems in accessing health care," with

9  five $(0 - 4)$ categories was created based on the number of problems reported: obtaining

10  permission to go to the doctor, obtaining money to pay for advice or treatment, distance to a

11  health facility, and not wanting to go alone. Respondents who reported fewer or more problems

12  placed in lower and higher categories, respectively.

13  **Results:** A total of 13266 women aged $15 - 49$ years, with a median age (IQR) of 27 $(20 - 36)$

14  years were interviewed and included in the analysis. About two-third s (65.53%) of the

15  respondents reported at least one of the four major problems in accessing health care.

16  Furthermore, after controlling for other variables included in the final model, women without

17  any type of health insurance, those belonging to the poorest class according to the wealth index,

18  those who had not attended any type of formal education, those who were not employed for cash,

19  each year of increasing age, and those who were divorced, separated, or widowed were

20  associated with greater problems in accessing health care.

21

1  **Conclusion:** This study indicated the additive effects of barriers to health care in low-

2  income countries such as Tanzania. Based on these results, improving uptake of health insurance

3  and addressing social determinants of health are the first steps toward reducing women's

4  problems associated with accessing health care.

5  **Strengths and limitations of this study**

6  ➢ This is the first study to show additive effects of problems in accessing health care and

7  associated factors among women in Tanzania.

8  ➢ The study used a nationally representative sample with high response rate and robust

9  sampling procedure.

10  ➢ As a cross-sectional study design was used, causality assumptions could not be made.

11  Therefore, the results should be interpreted with caution.

3

1 **INTRODUCTION**

2      Despite the substantial decline in global maternal mortality ratio (MMR), low-income

3 countries have not seen the same decline in MMR as those with higher incomes[1,2]; this situation

4 is described as an "area of shameful failures of development."[3,4]  Current statistics show that the

5 MMR has increased significantly by more than 20% over the past 5 years in Tanzania, despite

6 the governmental efforts to strengthen the health system by increasing the coverage of health

7 care facilities.[5–7] Each ward now has at least one dispensary and/or health center, each district

8 has at least one hospital, while each region has at least one referral hospital.  Regardless of

9 differences in the levels of these facilities in terms of function, expertise, availability of services,

10 and population coverage, all are expected to provide basic maternal health services together with

11 basic emergency obstetric care.[7] This resulted in an increase in coverage of maternal health

12 services, such as antenatal care by skilled providers (96% – 98%), delivery at a health care

13 facility (50% – 63%), and births assisted by skilled providers (51% – 64%) between 2010 and

14 2016.[5,6] Persistent high MMR (556 maternal deaths per 100000 live births) in Tanzania raises

15 concerns reading whether the country can achieve the Sustainable Development Goals (SDGs)

16 target of less than 140 maternal deaths per 100000 live births by 2030.[8,9] The majority of

17 avoidable and unnecessary maternal deaths experienced in this region likely result from poor

18 utilization of skilled maternal health services.[10]

19      Many social, cultural, and geographical factors as well as education level and poverty

20 have been reported to play roles in the poor utilization of health services.[11–13] Access to health

21 care has been highlighted as the major barrier toward the utilization of maternal health services

22 in low-income countries, especially in sub-Saharan Africa (SSA).[10,14,15] Access to health care can

23 be broadly defined based on availability, affordability, accessibility and acceptability,[16] but is

4

1    simply referred to as the timely use of health services to achieve the desired health outcomes.

2    Despite agreement that access to health care must be universal and guaranteed for all on an

3    equitable basis,[17] women continue to face significant inequities in accessing and utilizing health

4    care particularly in low-income countries.[18]

5    In relation to the problems experienced by women in accessing health care, the following

6    four major problems have been addressed in previous studies: obtaining permission,[19,20]

7    obtaining money,[21] distance to the health facility,[22] and not wanting to go alone (lack of spouse

8    or family member escort).[23,24] Although it is unclear whether women with multiple problems

9    encounter greater difficulties in accessing health care, most previous studies assessed and

10   discussed each of these four problems independently. The limited evidence regarding whether

11   women facing multiple problems have less access to health care suggested the need to create a

12   composite variable that includes all four problems to identify groups of women at a greater

13   disadvantage. A similar approach has been used to assess the severity of problems in accessing

14   health care among individuals with disability in four African countries.[25] Moreover, recent

15   studies indicated that age, education, residence, possession of health insurance, socioeconomic

16   status, and occupation are strongly linked to access to health care.[26–30] The present study was

17   performed to explore the factors associated with accumulation of multiple problems in accessing

18   health care among women in Tanzania.

19   **METHODS**

20   **Data sources**

21   The present study used data from the 2015 – 2016 Tanzania Demographic Health Survey

22   and Malaria Indicator Survey (TDHS-MIS) conducted by the National Bureau of Statistics

5

1  (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar, in collaboration with

2  the Ministry of Health, Community Development, Gender, Elderly, and Children (MoHCDGEC)

3  of the Tanzania Mainland and the Ministry of Health (MoH), Zanzibar. The technical support for

4  the surveys was provided by ICF International under DHS program.

5  **Study design**

6  This study analyzed a nationwide population-based cross-sectional survey using

7  information obtained by interviewing women (15 – 49 years old) who were either residents or

8  visitors in the household on the night before the survey.

9  **Sample size and sampling technique**

10  The 2015 – 2016 TDHS-MIS used a two-stage cluster sampling technique to obtain a

11  sample designed to provide nationally representative results according to all 30 regions of

12  Tanzania. In the first stage, sample points (a total of 608 clusters) consisting of enumeration

13  areas delineated for the 2012 Tanzania Population and Housing Census were selected. In the

14  second stage, households were selected systematically. A complete listing of households was

15  established for all 608 selected clusters prior to the fieldwork. From this list, 22 households were

16  then systematically selected from each cluster, yielding a representative probability sample of

17  13376 households. All eligible women in the selected households and men in subsample of one –

18  third of selected households between the ages of 15 and 49 years who were either residents or

19  visitors in the household on the night before the survey were then interviewed. Finally, a total of

20  13266 women and 3514 men were interviewed.[6]

21  **Data collection and processing**

22  The 2015 – 2016 TDHS-MIS used four main types of questionnaires during data

23  collection. However, only data collected with the Women's Questionnaire were used in the

6

1 present study. After pre-testing of the questionnaires, the finalized and corrected version was

2 used in the main survey from August 22, 2015, through February 14, 2016. Data collection was

3 performed by 64 female nurses who were trained and qualified to be interviewers through a

4 series of practical tests and examinations. Following the training, 16 teams were formed (three

5 for Zanzibar and 13 for Tanzania Mainland). Data entry was performed concurrently with data

6 collection in the field. After the paper questionnaires were completed, edited, and checked by

7 both the field editor and the supervisor, the data were entered into a tablet equipped with a data

8 entry program. A 100% double entry data entry process was used to minimize keying errors, and

9 editing was completed on March 21, 2016, while data cleaning and finalization were completed

10 on April 22, 2016.

11 **Measurement of variables**

12     **Outcome variable:** In this survey women were asked whether each of the following four

13 factors was a problem in seeking medical advice or treatment when they were ill: obtaining

14 permission to go to the doctor/health facility; obtaining money to pay for advice, consultation or

15 treatment; distance to the health facility; and not wanting to go alone. A new composite variable

16 called "problems in accessing health care" was then created based on the number of problems

17 reported, with respondents reporting fewer or more problems placed in lower and higher

18 categories, respectively. The categories were assigned as 1, 2, 3, 4, and 5 for women who

19 reported "no," "one," "two," "three," and "four" problems in accessing health care, respectively.

20 These categories of a composite (outcome) variable were treated as ordinal numbers, with the

21 assumption that conceptual differences between categories were identical.

22     **Independent variables:** Several independent variables that have been linked both

23 empirically and theoretically with the accessibility of health care among women were included in

7

1  the present study. The respondents were divided into groups according to age as follows: 15 – 19,

2  20 – 34, and 35 – 49 years. Women were grouped according to marital status as "never married,"

3  "married/living together," and "divorced, separated, or widowed." Education level was classified

4  as "none," "primary," "secondary," and "higher" (including college and all university levels).

5  Employment in the last 12 months was grouped into "not employed," "employed for cash," and

6  "employed but paid-in-kind." The area of residence was grouped into "urban" and "rural."

7  Possession of health insurance was grouped as "no" for women who did not have any type of

8  health insurance and "yes" to those who had any type of health insurance. The wealth index was

9  computed based on household assets and housing characteristics. During computation, the

10  households were given scores based on the number and kinds of consumer goods they owned,

11  ranging from a television to a bicycle or car, plus housing characteristics, such as the source of

12  drinking water, toilet facilities, and flooring materials. These scores were derived using principal

13  component analysis. National wealth quintiles were compiled by assigning the household score

14  to each usual (de jure) household member, ranking each person in the household by their score,

15  and then dividing the distribution into five equal categories, each with 20% of the population, as

16  "poorest," "poorer," "middle," "richer," and "richest."[6] The selection of these variables was

17  based on previous studies.[26–30]

**Statistical approaches**

19  In descriptive analyses, categorical variables were summarized using proportions and

20  then presented in tables, while quantitative variables were summarized using the median and

21  interquartile range (IQR).

22  As the outcome variable "problems in accessing health care" was ordinal in nature (a

23  score based on the number of different reported problems), in which the order of values

8

1    corresponded to a hierarchy in meaning as in this study, the application of ordered logistic

2    regression was recommended.[31]  Stata 14 (StataCorp, College Station, TX) was used for analysis

3    in the present study. For all analyses, the Stata survey set commands were used to adjust for the

4    variability of clustering and all the estimates were weighted to correct for non-responses and

5    disproportionate sampling.

6        When assessing the associations between selected independent variables and the outcome

7    variable, four models were tested for fit: a proportional ordered logistic model, a generalized

8    ordered logistic regression model, and a generalized ordered logistic regression model with and

9    without alternative parameterization. The generalized ordered logistic regression model with

10   alternative parameterization was chosen as the best fit. This model allows some variables to be

11   modeled with the proportional odds assumption while the parallel line constraint is relaxed for

12   variables in which the assumption is not met. The model is less restrictive as it allows the

13   coefficient of the variables to vary for the different categories that are compared.[32] The model

14   provides gamma coefficients that show the extent to which the parallel regression assumption is

15   violated by the variable.

16   **Ethics statement**

17       This study was based on an analysis of existing public domain survey data sets that are

18   freely available online with all identifier information detached. The original TDHS-MIS

19   protocols were reviewed by the Institution Review Board (IRB) of ICF Macro at Calverton in the

20   USA and by the National Institute of Medical Research (NIMR) IRB in Tanzania. The ICF IRB

21   ensured that the survey complied with the US Department of Health and Human Services

22   regulations for the protection of human subjects (45 CFR 46), while NIMR-IRB ensured that the

23   surveys complied with the laws and norms of Tanzania. The participants were adequately

1 informed about all relevant aspects of the survey, including its objective and interview

2 procedures. All participants accepted participating in the study signed informed consent prior to

3 the interviews.

**Patient and Public Involvement Statement**

4

5 Patients and the public were not involved in the analysis of this study.

**RESULTS**

6

**Respondents' characteristics**

7

8 As shown in Table 1, a total of 13266 women between 15 and 49 years old were

9 interviewed and included in the analysis. The median age (IQR) of the respondents was 27 (20 –

10 36) years. About 62% of the respondents were living with their spouse at the time of the

11 interview. Less than 2% had attained the highest level of education (college or university).

12 Nearly two-thirds were employed but paid-in-kind and one-tenth reported having any type of

13 health insurance. Almost half of the respondents reported that obtaining money for health care

14 was the major problem in accessing health care. Furthermore, about two-thirds of the

15 respondents reported at least one of the four problems in accessing health care.

16 **Table 1 Percent distribution of women between the ages 15 – 49 years by selected**

17 **background characteristics, Tanzania DHS-MIS 2015 – 2016 (n = 13266)**

| Variable | *n* (%) (Weighted) |
|---|---|
| **Age** (Median (IQR)=27, (20-36)) | |
| 15-19 | 2904 (21.89) |
| 20-34 | 6360 (47.94) |
| 35-49 | 4002 (30.17) |
| **Marital status** | |
| Never married | 3353 (25.27) |
| Married/living together | 8210 (61.89) |
| Divorced/separated/widowed | 1703 (12.84) |

10

**Education**

| | |
|---|---|
| None | 1947 (14.67) |
| Primary | 8211 (61.90) |
| Secondary | 2925 (22.05) |
| Highest | 183 (1.38) |

**Employed last 12 months**

| | |
|---|---|
| Not employed | 3033 (22.86) |
| Employed for cash | 6197 (46.71) |
| Employed but paid-in-kind | 4036 (30.43) |

**Residence**

| | |
|---|---|
| Urban | 4811 (36.27) |
| Rural | 8455 (63.73) |

**Health insurance ownership**

| | |
|---|---|
| Yes | 12066 (90.95) |
| No | 1200 (9.05) |

**Health quintile**

| | |
|---|---|
| Lowest | 2246 (16.93) |
| Second | 2274 (17.14) |
| Middle | 2328 (17.55) |
| Fourth | 2822 (21.27) |
| Highest | 3596 (27.11) |

**Types of problems***

| | |
|---|---|
| Obtaining money | 6565 (49.49) |
| Distance to facility | 5615 (42.33) |
| Not want to go alone | 3962 (29.87) |
| Obtaining permission | 1900 (14.32) |

**Number of problems in accessing health care**

| | |
|---|---|
| None | 4574 (34.48) |
| One problem | 3291 (24.81) |
| Two problems | 2547 (19.20) |
| Three problems | 1759 (13.26) |
| Four problems | 1095 (8.25) |

1  Note: *$n$ and % do not add up to 13266 and 100%, respectively, because multiple responses were possible.

2  **Partial generalized ordered logistic regression model with alternative gamma**

3  **parameterization**

4      Table 2 shows the results of the partially constrained generalized ordered logistic

5  regression model with alternative (gamma) parameterization for the outcome variable of

6  problems in accessing health care. The results showed non-significant Wald test statistics,

7  indicating that the model did not violate the proportional odds/parallel regression assumptions.

11

1 However, constraints for parallel lines were not imposed for age, wealth status (richest), and

2 marital status (divorced, separated, or widowed). The remaining variables that met the parallel

3 assumption can be interpolated in the same manner as for the ordered logistic regression model

4 as follows. The odds of being in higher categories of problems in accessing health care versus

5 lower or equal to a reference category were 0.622 times lower for women who had health

6 insurance than those who did not, given constant values for the other variables in the model.

7 Furthermore, the odds of being in higher categories of problems in accessing health care versus

8 less than or equal to a reference category were 1.22 times higher for women who were employed

9 but paid-in-kind than those who were unemployed for the last 12 months before the survey

10 keeping the other variables constant in the model.

11 The variables for which constraints for parallel lines were not imposed were interpreted

12 as follows: the coefficients for age and marital status (divorced, separated, or widowed) were

13 consistently positive, while those for wealth status (richest) were negative but decreased across

14 the cut-points. Therefore, for each year of increase in age and being divorced, separated, or

15 widowed, women were more likely to report having a larger number of problems in accessing

16 health care. The greatest differences were seen with increasing age and for those who were

17 divorced, separated, or widowed, women were less likely to report having few problems in

18 accessing health care. In addition, the women in the richest economic group tended to be less

19 likely to report having many problems in accessing health care than those in the poorest group,

20 with the greatest differences because the richest women were less likely to report having many

21 problems in accessing health care.

22

12

1 **Table 2 Generalized ordered logistic regression model with alternative gamma**

2 **parameterization, Tanzania DHS-MIS 2015 – 2016 (*n* = 13266)**

|  | Variable | POR [95% CI] | *P*-value |
|---|---|---|---|
| **Beta** | **Health insurance** (ref: No) | | |
| | Yes | 0.622 [0.531 - 0.731] | 0.000 |
| | **Residence** (ref: Urban) | | |
| | Rural | 0.858 [0.728 - 1.012] | 0.069 |
| | **Age** (continuous) | 1.010 [1.001 - 1.017] | 0.000 |
| | **Marital status** ref: Never married) | | |
| | Married/living together | 0.901 [0.801 - 1.014] | 0.085 |
| | Divorced/separated/widowed | 1.418 [1.175 - 1.712] | 0.000 |
| | **Education** (ref: None) | | |
| | Primary | 0.883 [0.788 - 0.990] | 0.033 |
| | Secondary | 0.683 [0.582 - 0.800] | 0.000 |
| | Highest | 0.516 [0.360 - 0.741] | 0.000 |
| | **Wealth status** (ref: Poorest) | | |
| | Poorer | 0.854 [0.726 - 1.006] | 0.059 |
| | Middle | 0.725 [0.626 - 0.840] | 0.000 |
| | Richer | 0.496 [0.417 - 0.590] | 0.000 |
| | Richest | 0.291 [0.233 - 0.364] | 0.000 |
| | **Employed last 12 months** (ref: Not employed | | |
| | Employed for cash | 0.975 [0.869 - 1.095] | 0.668 |
| | Employed but paid in kind | 1.220 [1.067 - 1.395] | 0.004 |
| Gamma_2 | Age | 0.993 [0.989 - 0.998] | 0.000 |
| | Wealth status  (Richest) | 1.279 [1.140 - 1.435] | 0.000 |
| | Marital status  (Divorced/separated/widowed) | 0.814 [0.701 - 0.945] | 0.007 |
| Gamma_3 | Age | 0.993 [0.986 - 0.999] | 0.018 |
| | Wealth status  (Richest) | 1.515 [1.265 - 1.814] | 0.000 |
| | Marital status  (Divorced/separated/widowed) | 0.749 [0.625 - 0.899] | 0.002 |
| Gamma_4 | Age | 0.987 [0.978 - 0.996] | 0.005 |
| | Wealth status  (Richest) | 1.957 [1.508 - 2.540] | 0.000 |
| | Marital status  (Divorced/separated/widowed) | 0.566 [0.419 - 0.764] | 0.000 |

3 Note: Wald test of parallel lines assumption for the final model: $F_{(33, 517)} = 1.110$, *P* = 0.310.

4 A non-significant test statistic indicates that the final model does not violate the proportional

5 odds/parallel lines assumption.

6 *POR = Proportional odds ratio.

1 **DISCUSSION**

2     This study was performed to explore the factors associated with accumulation of multiple

3 problems in accessing health care among women in Tanzania. To our knowledge, this is the first

4 study to explore the factors associated with multiple problems in accessing health care.

5 Furthermore, the study used a nationally representative sample from Tanzania with the

6 application of generalized ordered logistic regression models, which provided the best models

7 for ordinal data to validate the factors associated with problems in accessing health care. In the

8 present study, about 65%, 40%, and 20% of women reported "one or more," "two or more," and

9 "three or more" major problems in accessing health care, respectively. In addition, not having

10 health insurance and low socioeconomic status as measured by wealth, education, and

11 employment status were associated with accumulation of multiple problems in accessing health

12 care.

13     The high proportion of women reporting problems in accessing health care in this study

14 was consistent with the findings of a previous study performed in Egypt.[33]  These findings

15 provide evidence that demand-side barriers, such as cost of care, permission from their spouse,

16 lack of someone to escort to a health care facility, and distance to the facility,[34,35] still prevent

17 many African women from accessing health care. Due to the cultural, social, and traditional

18 perceptions in Africa that maternal health is only the responsibility of women, existing and new

19 interventions should influence health service utilization to begin at the individual, household, and

20 community levels to eliminate such demand-side barriers.[21,36]

21     Having health insurance is an essential element for timely access to health care and better

22 health-related outcomes.[37,38] Despite the availability of the National Health Insurance Fund

14

1   (NHIF) in Tanzania since 2001 through Act no. 8 of 1999, more than 90% of women are still

2   uninsured.[27,39] Less than one-tenth of the women in the present study reported having any type of

3   health insurance. Moreover, the women who had health insurance were less likely to report

4   having multiple problems associated with access to health care. This may have been because

5   having health insurance makes someone not only more comfortable with receiving a wide range

6   of services but also ensures a wider choice regarding where and when to obtain health care

7   without being afraid of the costs as they are covered by insurance. Similar findings were reported

8   in a study conducted Ghana.[26] The similarity in the findings between these studies may have

9   been because both used secondary data collected by a DHS program that applied a similar

10  methodology. Furthermore, the participants in these two studies were from SSA, and therefore

11  may have similar socioeconomic determinants.

12      The present study indicated a strong association between being in the poorest class of the

13  wealth index and accumulation of multiple problems in accessing health care among women in

14  Tanzania. This finding may be explained by the fact that being in the poorest class requires

15  individuals to spend their income on basic needs, such as food, and health care costs may

16  therefore be less likely to be affordable.[40] Such women are therefore more likely to report having

17  many problems in accessing health care, as reported in other studies conducted in SSA.[41–43]

18      In contrast to our expectations, we found no significant association between

19  unemployment and problems in accessing health care. However, this may have been because

20  being employed is not enough to have full access to health care as there are other barriers

21  preventing women from accessing health care, such as gender inequality, poor infrastructure, and

22  lack of knowledge regarding maternal health services.[28,33,44] On the other hand, the results

23  presented here indicated that women who are employed and receive wages in the form of

15

1  payment-in-kind, such as food, clothes, and other goods instead of cash, were likely to

2  experience multiple problems in accessing health care.

3  The variables age, wealth status (richest), and marital status (divorced, separated, or

4  widowed) were found to vary for each category of the outcome variable. The findings indicated

5  that the accumulation of multiple problems in accessing health care was associated with older

6  age and being divorced, separated, or widowed, consistent with the results of previous studies in

7  other low-income countries.[45,46] Older age is more likely to be accompanied by decreased

8  working capability, and hence low income, being retired, and uninsured.[47] As the risk of

9  maternal complications increased with older age[48,49] and living without a spouse reduced  the

10  chance of having an escort to the health facility, efforts and support should be made to provide

11  such women with access to health care.

12  This study had some limitations, including the risk of misclassification bias, which may

13  have been introduced due to the lack of external validation of self-reported information that

14  could have affected categorization of the outcome variable. However, we reduced this effect by

15  categorizing the outcome variable into five groups and the use of a generalized ordered logistics

16  regression model that clearly validated the factors associated with problems in accessing health

17  care among women in low-income countries. In addition, causality assumptions could not be

18  made due to the cross-sectional nature of the study, and therefore the results should be

19  interpreted with caution.

20

1 **CONCLUSION**

2      The results of the present study provided evidence for additive effects of barriers to

3 health care in low-income countries, such as Tanzania. Based on these results, improving access

4 to health insurance and addressing social determinants of health represent the first steps toward

5 reducing problems associated with accessing health care for women in low-income countries.

6 **Contributors**

7      DB originated the design of the study, performed statistical analysis, interpretation and

8 drafted the manuscript. KN contributed to the design of the study and the interpretation advice of

9 data. KS contributed to interpretation advice of data and drafted the manuscript. Both DB, KN &

10 KS critically revised the draft manuscript. All authors read and approved the final manuscript.

17 **Competing interest**

18      None to declare.

19 **Provenance and peer review**

20      Not commissioned; externally peer reviewed.

21 **A data sharing statement**

17

1    The datasets used for the current analysis was generated from the original survey of

2    Tanzania DHS-MIS datasets available from within the DHS program repository:

3    http://dhsprogram.com/data/available-datasets.cfm

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic | Item # | Recommendation | Reported on page # |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | Page 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | Page 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | Page 5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | Page 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | Page 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | Page 8-9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | Page 8 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | Page 9-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | Page 9-10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | Page 3, 8 |
| Study size | 10 | Explain how the study size was arrived at | Page 8 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Page 10 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | Page 10-12 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | Page 10-12 |
| | | (*c*) Explain how missing data were addressed | N/A |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Page 10 |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | Page 13 |
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | Page 14 and Table 1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | Page 14 and Table 1 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Table 2,3,4 |
| | | (*b*) Report category boundaries when continuous variables were categorized | Table 1 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | Table 4 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | Page 18-9, Table 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | Page 24 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | Page 24 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Page 24 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | N/A |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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.

# Improving access to health care for women in Tanzania by addressing socioeconomic determinants and health insurance

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Manuscripts

1 **Improving access to health care for women in Tanzania by addressing socioeconomic**

2 **determinants and health insurance**

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1

1    **ABSTRACT**

2    **Objective:** This study was performed to explore the factors associated with accumulation of

3    multiple problems in accessing health care among women in Tanzania as an example of a low-

4    income country.

5    **Design:** Population-based cross-sectional survey

6    **Setting:** Nationwide representative data for women of reproductive age obtained from the 2015

7    – 2016 Tanzania Demographic Health Survey were analyzed.

8    **Primary outcome measures:** A composite variable, "problems in accessing health care," with

9    five $(0 – 4)$ categories was created based on the number of problems reported: obtaining

10   permission to go to the doctor, obtaining money to pay for advice or treatment, distance to a

11   health facility, and not wanting to go alone. Respondents who reported fewer or more problems

12   placed in lower and higher categories, respectively.

13   **Results:** A total of 13266 women aged $15 – 49$ years, with a median age (IQR) of $27 (20 – 36)$

14   years were interviewed and included in the analysis. About two-third s (65.53%) of the

15   respondents reported at least one of the four major problems in accessing health care.

16   Furthermore, after controlling for other variables included in the final model, women without

17   any type of health insurance, those belonging to the poorest class according to the wealth index,

18   those who had not attended any type of formal education, those who were not employed for cash,

19   each year of increasing age, and those who were divorced, separated, or widowed were

20   associated with greater problems in accessing health care.

21

2

1  **Conclusion:** This study indicated the additive effects of barriers to health care in low-

2  income countries such as Tanzania. Based on these results, improving uptake of health insurance

3  and addressing social determinants of health are the first steps toward reducing women's

4  problems associated with accessing health care.

5  **Strengths and limitations of this study**

6  ➢ This is the first study to show additive effects of problems in accessing health care and

7  associated factors among women in Tanzania.

8  ➢ The study used a nationally representative sample with high response rate and robust

9  sampling procedure.

10 ➢ As a cross-sectional study design was used, causality assumptions could not be made.

11 Therefore, the results should be interpreted with caution.

1  **INTRODUCTION**

2      Despite the substantial decline in global maternal mortality ratio (MMR), low-income

3  countries have not seen the same decline in MMR as those with higher incomes.[1,2] This situation

4  is described as an "area of shameful failures of development."[3,4]  Current statistics show that the

5  MMR has increased significantly by more than 20% over the past 5 years in Tanzania, despite

6  the governmental efforts to strengthen the health system by increasing the coverage of health

7  care facilities.[5–7] Each ward now has at least one dispensary and/or health center, each district

8  has at least one hospital, while each region has at least one referral hospital.  Regardless of

9  differences in the levels of these facilities in terms of function, expertise, availability of services,

10  and population coverage, all are expected to provide basic maternal health services together with

11  basic emergency obstetric care.[7] This resulted in an increase in coverage of maternal health

12  services, such as antenatal care by skilled providers (96% – 98%), delivery at a health care

13  facility (50% – 63%), and births assisted by skilled providers (51% – 64%) between 2010 and

14  2016.[5,6] Persistent high MMR (556 maternal deaths per 100000 live births) in Tanzania raises

15  concerns about whether the country can achieve the Sustainable Development Goals (SDGs)

16  target of less than 140 maternal deaths per 100000 live births by 2030.[8,9] The majority of

17  avoidable and unnecessary maternal deaths experienced in this region likely result from poor

18  utilization of skilled maternal health services.[10]

19      Many social, cultural, and geographical factors as well as education level and poverty

20  have been reported to play roles in the poor utilization of health services.[11–13] Access to health

21  care has been highlighted as the major barrier toward the utilization of maternal health services

22  in low-income countries, especially in sub-Saharan Africa (SSA).[10,14,15] Access to health care can

23  be broadly defined based on availability, affordability, accessibility and acceptability,[16] but is

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1    simply referred to as the timely use of health services to achieve the desired health outcomes.

2    Despite agreement that access to health care must be universal and guaranteed for all on an

3    equitable basis,[17] women continue to face significant inequities in accessing and utilizing health

4    care particularly in low-income countries.[18]

5    In relation to the problems experienced by women in accessing health care, the following

6    four major problems have been addressed in previous studies: obtaining permission,[19,20]

7    obtaining money,[21] distance to the health facility,[22] and not wanting to go alone (lack of spouse

8    or family member escort).[23,24] Although it is unclear whether women with multiple problems

9    encounter greater difficulties in accessing health care, most previous studies assessed and

10   discussed each of these four problems independently. The limited evidence regarding whether

11   women facing multiple problems have less access to health care suggested the need to create a

12   composite variable that includes all four problems to identify groups of women at a greater

13   disadvantage. A similar approach has been used to assess the severity of problems in accessing

14   health care among individuals with disability in four African countries.[25] Moreover, recent

15   studies indicated that age, education, residence, possession of health insurance, socioeconomic

16   status, and occupation are strongly linked to access to health care.[26–30] The present study was

17   performed to explore the factors associated with accumulation of multiple problems in accessing

18   health care among women in Tanzania.

19   **METHODS**

20   **Data sources**

21   The present study used data from the 2015 – 2016 Tanzania Demographic Health Survey

22   and Malaria Indicator Survey (TDHS-MIS) conducted by the National Bureau of Statistics

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1  (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar, in collaboration with

2  the Ministry of Health, Community Development, Gender, Elderly, and Children (MoHCDGEC)

3  of the Tanzania Mainland and the Ministry of Health (MoH), Zanzibar. The technical support for

4  the surveys was provided by ICF International under DHS program.

5  **Study design**

6  This study analyzed a nationwide population-based cross-sectional survey using

7  information obtained by interviewing women (15 – 49 years old) who were either residents or

8  visitors in the household on the night before the survey.

9  **Sample size and sampling technique**

10  The 2015 – 2016 TDHS-MIS used a two-stage cluster sampling technique to obtain a

11  sample designed to provide nationally representative results according to all 30 regions of

12  Tanzania. In the first stage, sample points (a total of 608 clusters) consisting of enumeration

13  areas delineated for the 2012 Tanzania Population and Housing Census were selected. In the

14  second stage, households were selected systematically. A complete listing of households was

15  established for all 608 selected clusters prior to the fieldwork. From this list, 22 households were

16  then systematically selected from each cluster, yielding a representative probability sample of

17  13376 households. All eligible women in the selected households and men in subsample of one –

18  third of selected households between the ages of 15 and 49 years who were either residents or

19  visitors in the household on the night before the survey were then interviewed. Finally, a total of

20  13266 women and 3514 men were interviewed.[6]

21  **Data collection and processing**

22  The 2015 – 2016 TDHS-MIS used four main types of questionnaires during data

23  collection. However, only data collected with the Women's Questionnaire were used in the

6

1    present study. After pre-testing of the questionnaires, the finalized and corrected version was

2    used in the main survey from August 22, 2015, through February 14, 2016. Data collection was

3    performed by 64 female nurses who were trained and qualified to be interviewers through a

4    series of practical tests and examinations. Following the training, 16 teams were formed (three

5    for Zanzibar and 13 for Tanzania Mainland). Data entry was performed concurrently with data

6    collection in the field. After the paper questionnaires were completed, edited, and checked by

7    both the field editor and the supervisor, the data were entered into a tablet equipped with a data

8    entry program. A 100% double entry data entry process was used to minimize keying errors, and

9    editing was completed on March 21, 2016, while data cleaning and finalization were completed

10    on April 22, 2016.

11    **Measurement of variables**

12    **Outcome variable:** In this survey women were asked whether each of the following four

13    factors was a problem in seeking medical advice or treatment when they were ill: obtaining

14    permission to go to the doctor/health facility; obtaining money to pay for advice, consultation or

15    treatment; distance to the health facility; and not wanting to go alone. A new composite variable

16    called "problems in accessing health care" was then created based on the number of problems

17    reported, with respondents reporting fewer or more problems placed in lower and higher

18    categories, respectively. The categories were assigned as 1, 2, 3, 4, and 5 for women who

19    reported "no," "one," "two," "three," and "four" problems in accessing health care, respectively.

20    These categories of a composite (outcome) variable were treated as ordinal numbers, with the

21    assumption that conceptual differences between categories were identical.

22    **Independent variables:** Several independent variables that have been linked both

23    empirically and theoretically with the accessibility of health care among women were included in

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1 the present study. The respondents were divided into groups according to age as follows: 15 – 19,

2 20 – 34, and 35 – 49 years. Women were grouped according to marital status as "never married,"

3 "married/living together," and "divorced, separated, or widowed." Education level was classified

4 as "none," "primary," "secondary," and "higher" (including college and all university levels).

5 Employment in the last 12 months was grouped into "not employed," "employed for cash," and

6 "employed but paid-in-kind." The area of residence was grouped into "urban" and "rural."

7 Possession of health insurance was grouped as "no" for women who did not have any type of

8 health insurance and "yes" to those who had any type of health insurance. The wealth index was

9 computed based on household assets and housing characteristics. During computation, the

10 households were given scores based on the number and kinds of consumer goods they owned,

11 ranging from a television to a bicycle or car, plus housing characteristics, such as the source of

12 drinking water, toilet facilities, and flooring materials. These scores were derived using principal

13 component analysis. National wealth quintiles were compiled by assigning the household score

14 to each usual (de jure) household member, ranking each person in the household by their score,

15 and then dividing the distribution into five equal categories, each with 20% of the population, as

16 "poorest," "poorer," "middle," "richer," and "richest."[6] The selection of these variables was

17 based on previous studies.[26–30]

**Statistical approaches**

18

19 In descriptive analyses, categorical variables were summarized using proportions and

20 then presented in tables, while quantitative variables were summarized using the median and

21 interquartile range (IQR).

22 As the outcome variable "problems in accessing health care" was ordinal in nature (a

23 score based on the number of different reported problems), in which the order of values

8

1  corresponded to a hierarchy in meaning as in this study, the application of ordered logistic

2  regression was recommended.[31] Stata 14 (StataCorp, College Station, TX) was used for analysis

3  in the present study. For all analyses, the Stata survey set commands were used to adjust for the

4  variability of clustering and all the estimates were weighted to correct for non-responses and

5  disproportionate sampling.

6  When assessing the associations between selected independent variables and the outcome

7  variable, four models were tested for fit: a proportional ordered logistic model, a generalized

8  ordered logistic regression model, and a generalized ordered logistic regression model with and

9  without alternative parameterization. The generalized ordered logistic regression model with

10  alternative parameterization was chosen as the best fit. This model allows some variables to be

11  modeled with the proportional odds assumption while the parallel line constraint is relaxed for

12  variables in which the assumption is not met. The model is less restrictive as it allows the

13  coefficient of the variables to vary for the different categories that are compared.[32] The model

14  provides gamma coefficients that show the extent to which the parallel regression assumption is

15  violated by the variable.

16  **Ethics statement**

17  This study was based on an analysis of existing public domain survey data sets that are

18  freely available online with all identifier information detached. The original TDHS-MIS

19  protocols were reviewed by the Institution Review Board (IRB) of ICF Macro at Calverton in the

20  USA and by the National Institute of Medical Research (NIMR) IRB in Tanzania. The ICF IRB

21  ensured that the survey complied with the US Department of Health and Human Services

22  regulations for the protection of human subjects (45 CFR 46), while NIMR-IRB ensured that the

23  surveys complied with the laws and norms of Tanzania. The participants were adequately

9

1 informed about all relevant aspects of the survey, including its objective and interview

2 procedures. All participants accepted participating in the study signed informed consent prior to

3 the interviews.

4 **Patient and Public Involvement Statement**

5 Patients and the public were not involved in the analysis of this study.

6 **RESULTS**

7 **Respondents' characteristics**

8 As shown in Table 1, a total of 13266 women between 15 and 49 years old were

9 interviewed and included in the analysis. The median age (IQR) of the respondents was 27 (20 –

10 36) years. About 62% of the respondents were living with their spouse at the time of the

11 interview. Less than 2% had attained the highest level of education (college or university).

12 Nearly two-thirds were employed but paid-in-kind and one-tenth reported having any type of

13 health insurance. Almost half of the respondents reported that obtaining money for health care

14 was the major problem in accessing health care. Furthermore, about two-thirds of the

15 respondents reported at least one of the four problems in accessing health care.

16 **Table 1 Percent distribution of women between the ages 15 – 49 years by selected**

17 **background characteristics, Tanzania DHS-MIS 2015 – 2016 (n = 13266)**

| Variable | *n* (%) (Weighted) |
|---|---|
| **Age** (Median (IQR)=27, (20-36)) | |
| 15-19 | 2904 (21.89) |
| 20-34 | 6360 (47.94) |
| 35-49 | 4002 (30.17) |
| **Marital status** | |
| Never married | 3353 (25.27) |
| Married/living together | 8210 (61.89) |
| Divorced/separated/widowed | 1703 (12.84) |

10

**Education**

| | |
|---|---|
| None | 1947 (14.67) |
| Primary | 8211 (61.90) |
| Secondary | 2925 (22.05) |
| Highest | 183 (1.38) |

**Employed last 12 months**

| | |
|---|---|
| Not employed | 3033 (22.86) |
| Employed for cash | 6197 (46.71) |
| Employed but paid-in-kind | 4036 (30.43) |

**Residence**

| | |
|---|---|
| Urban | 4811 (36.27) |
| Rural | 8455 (63.73) |

**Health insurance ownership**

| | |
|---|---|
| Yes | 12066 (90.95) |
| No | 1200 (9.05) |

**Health quintile**

| | |
|---|---|
| Lowest | 2246 (16.93) |
| Second | 2274 (17.14) |
| Middle | 2328 (17.55) |
| Fourth | 2822 (21.27) |
| Highest | 3596 (27.11) |

**Types of problems***

| | |
|---|---|
| Obtaining money | 6565 (49.49) |
| Distance to facility | 5615 (42.33) |
| Not want to go alone | 3962 (29.87) |
| Obtaining permission | 1900 (14.32) |

**Number of problems in accessing health care**

| | |
|---|---|
| None | 4574 (34.48) |
| One problem | 3291 (24.81) |
| Two problems | 2547 (19.20) |
| Three problems | 1759 (13.26) |
| Four problems | 1095 (8.25) |

1  Note: *$n$ and % do not add up to 13266 and 100%, respectively, because multiple responses were possible.

2  **Partial generalized ordered logistic regression model with alternative gamma**

3  **parameterization**

4       Table 2 shows the results of the partially constrained generalized ordered logistic

5  regression model with alternative (gamma) parameterization for the outcome variable of

6  problems in accessing health care. The results showed non-significant Wald test statistics,

7  indicating that the model did not violate the proportional odds/parallel regression assumptions.

11

1 However, constraints for parallel lines were not imposed for age, wealth status (richest), and

2 marital status (divorced, separated, or widowed). The remaining variables that met the parallel

3 assumption can be interpolated in the same manner as for the ordered logistic regression model

4 as follows. The odds of being in higher categories of problems in accessing health care versus

5 lower or equal to a reference category were 0.622 [0.531 - 0.731] times lower for women who

6 had health insurance than those who did not, given constant values for the other variables in the

7 model. Furthermore, the odds of being in higher categories of problems in accessing health care

8 versus less than or equal to a reference category were 1.220 [1.067 - 1.395] times higher for

9 women who were employed but paid-in-kind than those who were unemployed for the last 12

10 months before the survey keeping the other variables constant in the model.

11 The variables for which constraints for parallel lines were not imposed were interpreted

12 as follows: the coefficients for age and marital status (divorced, separated, or widowed) were

13 consistently positive, while those for wealth status (richest) were negative but decreased across

14 the cut-points. Therefore, for each year of increase in age and being divorced, separated, or

15 widowed, women were more likely to report having a larger number of problems in accessing

16 health care. The greatest differences were seen with increasing age and for those who were

17 divorced, separated, or widowed, women were less likely to report having few problems in

18 accessing health care. In addition, the women in the richest economic group tended to be less

19 likely to report having many problems in accessing health care than those in the poorest group,

20 with the greatest differences because the richest women were less likely to report having many

21 problems in accessing health care.

22

1  **Table 2 Generalized ordered logistic regression model with alternative gamma**

2  **parameterization, Tanzania DHS-MIS 2015 – 2016 (*n* = 13266)**

| | Variable | POR [95% CI] | *P*-value |
|---|---|---|---|
| **Beta** | **Health insurance** (ref: No) | | |
| | Yes | 0.622 [0.531 - 0.731] | 0.000 |
| | **Residence** (ref: Urban) | | |
| | Rural | 0.858 [0.728 - 1.012] | 0.069 |
| | **Age** (continuous) | 1.010 [1.001 - 1.017] | 0.000 |
| | **Marital status** ref: Never married) | | |
| | Married/living together | 0.901 [0.801 - 1.014] | 0.085 |
| | Divorced/separated/widowed | 1.418 [1.175 - 1.712] | 0.000 |
| | **Education** (ref: None) | | |
| | Primary | 0.883 [0.788 - 0.990] | 0.033 |
| | Secondary | 0.683 [0.582 - 0.800] | 0.000 |
| | Highest | 0.516 [0.360 - 0.741] | 0.000 |
| | **Wealth status** (ref: Poorest) | | |
| | Poorer | 0.854 [0.726 - 1.006] | 0.059 |
| | Middle | 0.725 [0.626 - 0.840] | 0.000 |
| | Richer | 0.496 [0.417 - 0.590] | 0.000 |
| | Richest | 0.291 [0.233 - 0.364] | 0.000 |
| | **Employed last 12 months** (ref: Not employed | | |
| | Employed for cash | 0.975 [0.869 - 1.095] | 0.668 |
| | Employed but paid in kind | 1.220 [1.067 - 1.395] | 0.004 |
| Gamma_2 | Age | 0.993 [0.989 - 0.998] | 0.000 |
| | Wealth status  (Richest) | 1.279 [1.140 - 1.435] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.814 [0.701 - 0.945] | 0.007 |
| Gamma_3 | Age | 0.993 [0.986 - 0.999] | 0.018 |
| | Wealth status  (Richest) | 1.515 [1.265 - 1.814] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.749 [0.625 - 0.899] | 0.002 |
| Gamma_4 | Age | 0.987 [0.978 - 0.996] | 0.005 |
| | Wealth status  (Richest) | 1.957 [1.508 - 2.540] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.566 [0.419 - 0.764] | 0.000 |

13

1 Note: Wald test of parallel lines assumption for the final model: $F_{(33, 517)} = 1.110$, $P = 0.310$.

2 A non-significant test statistic indicates that the final model does not violate the proportional

3 odds/parallel lines assumption.

4 *POR = Proportional odds ratio.

5 **DISCUSSION**

6      This study was performed to explore the factors associated with accumulation of multiple

7 problems in accessing health care among women in Tanzania. To our knowledge, this is the first

8 study to explore the factors associated with multiple problems in accessing health care.

9 Furthermore, the study used a nationally representative sample from Tanzania with the

10 application of generalized ordered logistic regression models, which provided the best models

11 for ordinal data to validate the factors associated with problems in accessing health care. In the

12 present study, about 65%, 40%, and 20% of women reported "one or more," "two or more," and

13 "three or more" major problems in accessing health care, respectively. In addition, not having

14 health insurance and low socioeconomic status as measured by wealth, education, and

15 employment status were associated with accumulation of multiple problems in accessing health

16 care.

17      The high proportion of women reporting problems in accessing health care in this study

18 was consistent with the findings of a previous study performed in Egypt.[33]   These findings

19 provide evidence that demand-side barriers, such as cost of care, permission from their spouse,

20 lack of someone to escort to a health care facility, and distance to the facility,[34,35] still prevent

21 many African women from accessing health care. Due to the cultural, social, and traditional

22 perceptions in Africa that maternal health is only the responsibility of women, existing and new

14

1  interventions should influence health service utilization to begin at the individual, household, and

2  community levels to eliminate such demand-side barriers.[21,36]

3  Having health insurance is an essential element for timely access to health care and better

4  health-related outcomes.[37,38] Despite the availability of the National Health Insurance Fund

5  (NHIF) in Tanzania since 2001 through Act no. 8 of 1999, more than 90% of women are still

6  uninsured.[27,39] Less than one-tenth of the women in the present study reported having any type of

7  health insurance. Moreover, the women who had health insurance were less likely to report

8  having multiple problems associated with access to health care. This may have been because

9  having health insurance makes someone not only more comfortable with receiving a wide range

10  of services but also ensures a wider choice regarding where and when to obtain health care

11  without being afraid of the costs as they are covered by insurance. Similar findings were reported

12  in a study conducted Ghana.[26] The similarity in the findings between these studies may have

13  been because both used secondary data collected by a DHS program that applied a similar

14  methodology. Furthermore, the participants in these two studies were from SSA, and therefore

15  may have similar socioeconomic determinants.

16  The present study indicated a strong association between being in the poorest class of the

17  wealth index and accumulation of multiple problems in accessing health care among women in

18  Tanzania. This finding may be explained by the fact that being in the poorest class requires

19  individuals to spend their income on basic needs, such as food, and health care costs may

20  therefore be less likely to be affordable.[40] Such women are therefore more likely to report having

21  many problems in accessing health care, as reported in other studies conducted in SSA.[41–43]

22  In contrast to our expectations, we found no significant association between

23  unemployment and problems in accessing health care. However, this may have been because

15

1  being employed is not enough to have full access to health care as there are other barriers

2  preventing women from accessing health care, such as gender inequality, poor infrastructure, and

3  lack of knowledge regarding maternal health services.[28,33,44] On the other hand, the results

4  presented here indicated that women who are employed and receive wages in the form of

5  payment-in-kind, such as food, clothes, and other goods instead of cash, were likely to

6  experience multiple problems in accessing health care.

7  The variables age, wealth status (richest), and marital status (divorced, separated, or

8  widowed) were found to vary for each category of the outcome variable. The findings indicated

9  that the accumulation of multiple problems in accessing health care was associated with older

10  age and being divorced, separated, or widowed, consistent with the results of previous studies in

11  other low-income countries.[45,46] Older age is more likely to be accompanied by decreased

12  working capability, and hence low income, being retired, and uninsured.[47] As the risk of

13  maternal complications increased with older age[48,49] and living without a spouse reduced the

14  chance of having an escort to the health facility, efforts and support should be made to provide

15  such women with access to health care.

16  This study had some limitations, including the risk of misclassification bias, which may

17  have been introduced due to the lack of external validation of self-reported information that

18  could have affected categorization of the outcome variable. However, we reduced this effect by

19  categorizing the outcome variable into five groups and the use of a generalized ordered logistics

20  regression model that clearly validated the factors associated with problems in accessing health

21  care among women in low-income countries. In addition, causality assumptions could not be

22  made due to the cross-sectional nature of the study, and therefore the results should be

23  interpreted with caution.

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**CONCLUSION**

The results of the present study provided evidence for additive effects of barriers to health care in low-income countries, such as Tanzania. Based on these results, improving access to health insurance and addressing social determinants of health represent the first steps toward reducing problems associated with accessing health care for women in low-income countries.

**Contributors**

DB originated the design of the study, performed statistical analysis, interpretation and drafted the manuscript. KN contributed to the design of the study and the interpretation advice of data. KS contributed to interpretation advice of data and drafted the manuscript. Both DB, KN & KS critically revised the draft manuscript. All authors read and approved the final manuscript.

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**Competing interest**

None to declare.

**Provenance and peer review**

Not commissioned; externally peer reviewed.

**A data sharing statement**

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1        The datasets used for the current analysis was generated from the original survey of

2        Tanzania DHS-MIS datasets available from within the DHS program repository:

3        http://dhsprogram.com/data/available-datasets.cfm

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic | Item # | Recommendation | Reported on page # |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | Page 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | Page 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | Page 5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | Page 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | Page 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | Page 8-9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | Page 8 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | Page 9-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | Page 9-10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | Page 3, 8 |
| Study size | 10 | Explain how the study size was arrived at | Page 8 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Page 10 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | Page 10-12 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | Page 10-12 |
| | | (*c*) Explain how missing data were addressed | N/A |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Page 10 |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | Page 13 |
|---|---|---|---|
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | Page 14 and Table 1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | Page 14 and Table 1 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Table 2,3,4 |
| | | (*b*) Report category boundaries when continuous variables were categorized | Table 1 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | Table 4 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | Page 18-9, Table 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | Page 24 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | Page 24 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Page 24 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | N/A |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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.

# BMJ Open

## Improving access to health care for women in Tanzania by addressing socioeconomic determinants and health insurance: a population-based cross-sectional survey

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1 **Improving access to health care for women in Tanzania by addressing socioeconomic**

2 **determinants and health insurance: a population-based cross-sectional survey**

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**ABSTRACT**

**Objective:** This study was performed to explore the factors associated with accumulation of multiple problems in accessing health care among women in Tanzania as an example of a low-income country.

**Design:** Population-based cross-sectional survey

**Setting:** Nationwide representative data for women of reproductive age obtained from the 2015 – 2016 Tanzania Demographic Health Survey were analyzed.

**Primary outcome measures:** A composite variable, "problems in accessing health care," with five (0 – 4) categories was created based on the number of problems reported: obtaining permission to go to the doctor, obtaining money to pay for advice or treatment, distance to a health facility, and not wanting to go alone. Respondents who reported fewer or more problems placed in lower and higher categories, respectively.

**Results:** A total of 13266 women aged 15 – 49 years, with a median age (IQR) of 27 (20 – 36) years were interviewed and included in the analysis. About two-third s (65.53%) of the respondents reported at least one of the four major problems in accessing health care. Furthermore, after controlling for other variables included in the final model, women without any type of health insurance, those belonging to the poorest class according to the wealth index, those who had not attended any type of formal education, those who were not employed for cash, each year of increasing age, and those who were divorced, separated, or widowed were associated with greater problems in accessing health care.

2

1    **Conclusion:** This study indicated the additive effects of barriers to health care in low-

2    income countries such as Tanzania. Based on these results, improving uptake of health insurance

3    and addressing social determinants of health are the first steps toward reducing women's

4    problems associated with accessing health care.

5    **Strengths and limitations of this study**

6    ➢ This is the first study to show additive effects of problems in accessing health care and

7        associated factors among women in Tanzania.

8    ➢ The study used a nationally representative sample with high response rate and robust

9        sampling procedure.

10   ➢ As a cross-sectional study design was used, causality assumptions could not be made.

11       Therefore, the results should be interpreted with caution.

3

1 **INTRODUCTION**

2   Despite the substantial decline in global maternal mortality ratio (MMR), low-income

3 countries have not seen the same decline in MMR as those with higher incomes.[1,2] This situation

4 is described as an "area of shameful failures of development."[3,4]  Current statistics show that the

5 MMR has increased significantly by more than 20% over the past 5 years in Tanzania, despite

6 the governmental efforts to strengthen the health system by increasing the coverage of health

7 care facilities.[5–7] Each ward now has at least one dispensary and/or health center, each district

8 has at least one hospital, while each region has at least one referral hospital.  Regardless of

9 differences in the levels of these facilities in terms of function, expertise, availability of services,

10 and population coverage, all are expected to provide basic maternal health services together with

11 basic emergency obstetric care.[7] This resulted in an increase in coverage of maternal health

12 services, such as antenatal care by skilled providers (96% – 98%), delivery at a health care

13 facility (50% – 63%), and births assisted by skilled providers (51% – 64%) between 2010 and

14 2016.[5,6] Persistent high MMR (556 maternal deaths per 100000 live births) in Tanzania raises

15 concerns about whether the country can achieve the Sustainable Development Goals (SDGs)

16 target of less than 140 maternal deaths per 100000 live births by 2030.[8,9] The majority of

17 avoidable and unnecessary maternal deaths experienced in this region likely result from poor

18 utilization of skilled maternal health services.[10]

19   Many social, cultural, and geographical factors as well as education level and poverty

20 have been reported to play roles in the poor utilization of health services.[11–13] Access to health

21 care has been highlighted as the major barrier toward the utilization of maternal health services

22 in low-income countries, especially in sub-Saharan Africa (SSA).[10,14,15] Access to health care can

23 be broadly defined based on availability, affordability, accessibility and acceptability,[16] but is

4

1    simply referred to as the timely use of health services to achieve the desired health outcomes.

2    Despite agreement that access to health care must be universal and guaranteed for all on an

3    equitable basis,[17] women continue to face significant inequities in accessing and utilizing health

4    care particularly in low-income countries.[18]

5    In relation to the problems experienced by women in accessing health care, the following

6    four major problems have been addressed in previous studies: obtaining permission,[19,20]

7    obtaining money,[21] distance to the health facility,[22] and not wanting to go alone (lack of spouse

8    or family member escort).[23,24] Although it is unclear whether women with multiple problems

9    encounter greater difficulties in accessing health care, most previous studies assessed and

10   discussed each of these four problems independently. The limited evidence regarding whether

11   women facing multiple problems have less access to health care suggested the need to create a

12   composite variable that includes all four problems to identify groups of women at a greater

13   disadvantage. A similar approach has been used to assess the severity of problems in accessing

14   health care among individuals with disability in four African countries.[25] Moreover, recent

15   studies indicated that age, education, residence, possession of health insurance, socioeconomic

16   status, and occupation are strongly linked to access to health care.[26–30] The present study was

17   performed to explore the factors associated with accumulation of multiple problems in accessing

18   health care among women in Tanzania.

19   **METHODS**

20   **Data sources**

21   The present study used data from the 2015 – 2016 Tanzania Demographic Health Survey

22   and Malaria Indicator Survey (TDHS-MIS) conducted by the National Bureau of Statistics

5

1   (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar, in collaboration with

2   the Ministry of Health, Community Development, Gender, Elderly, and Children (MoHCDGEC)

3   of the Tanzania Mainland and the Ministry of Health (MoH), Zanzibar. The technical support for

4   the surveys was provided by ICF International under DHS program.

5   **Study design**

6   This study analyzed a nationwide population-based cross-sectional survey using

7   information obtained by interviewing women (15 – 49 years old) who were either residents or

8   visitors in the household on the night before the survey.

9   **Sample size and sampling technique**

10  The 2015 – 2016 TDHS-MIS used a two-stage cluster sampling technique to obtain a

11  sample designed to provide nationally representative results according to all 30 regions of

12  Tanzania. In the first stage, sample points (a total of 608 clusters) consisting of enumeration

13  areas delineated for the 2012 Tanzania Population and Housing Census were selected. In the

14  second stage, households were selected systematically. A complete listing of households was

15  established for all 608 selected clusters prior to the fieldwork. From this list, 22 households were

16  then systematically selected from each cluster, yielding a representative probability sample of

17  13376 households. All eligible women in the selected households and men in subsample of one –

18  third of selected households between the ages of 15 and 49 years who were either residents or

19  visitors in the household on the night before the survey were then interviewed. Finally, a total of

20  13266 women and 3514 men were interviewed.[6]

21  **Data collection and processing**

22  The 2015 – 2016 TDHS-MIS used four main types of questionnaires during data

23  collection. However, only data collected with the Women's Questionnaire were used in the

6

1  present study. After pre-testing of the questionnaires, the finalized and corrected version was

2  used in the main survey from August 22, 2015, through February 14, 2016. Data collection was

3  performed by 64 female nurses who were trained and qualified to be interviewers through a

4  series of practical tests and examinations. Following the training, 16 teams were formed (three

5  for Zanzibar and 13 for Tanzania Mainland). Data entry was performed concurrently with data

6  collection in the field. After the paper questionnaires were completed, edited, and checked by

7  both the field editor and the supervisor, the data were entered into a tablet equipped with a data

8  entry program. A 100% double entry data entry process was used to minimize keying errors, and

9  editing was completed on March 21, 2016, while data cleaning and finalization were completed

10  on April 22, 2016.

11  **Measurement of variables**

12  **Outcome variable:** In this survey women were asked whether each of the following four

13  factors was a problem in seeking medical advice or treatment when they were ill: obtaining

14  permission to go to the doctor/health facility; obtaining money to pay for advice, consultation or

15  treatment; distance to the health facility; and not wanting to go alone. A new composite variable

16  called "problems in accessing health care" was then created based on the number of problems

17  reported, with respondents reporting fewer or more problems placed in lower and higher

18  categories, respectively. The categories were assigned as 1, 2, 3, 4, and 5 for women who

19  reported "no," "one," "two," "three," and "four" problems in accessing health care, respectively.

20  These categories of a composite (outcome) variable were treated as ordinal numbers, with the

21  assumption that conceptual differences between categories were identical.

22  **Independent variables:** Several independent variables that have been linked both

23  empirically and theoretically with the accessibility of health care among women were included in

7

1    the present study. The respondents were divided into groups according to age as follows: 15 – 19,

2    20 – 34, and 35 – 49 years. Women were grouped according to marital status as "never married,"

3    "married/living together," and "divorced, separated, or widowed." Education level was classified

4    as "none," "primary," "secondary," and "higher" (including college and all university levels).

5    Employment in the last 12 months was grouped into "not employed," "employed for cash," and

6    "employed but paid-in-kind." The area of residence was grouped into "urban" and "rural."

7    Possession of health insurance was grouped as "no" for women who did not have any type of

8    health insurance and "yes" to those who had any type of health insurance. The wealth index was

9    computed based on household assets and housing characteristics. During computation, the

10    households were given scores based on the number and kinds of consumer goods they owned,

11    ranging from a television to a bicycle or car, plus housing characteristics, such as the source of

12    drinking water, toilet facilities, and flooring materials. These scores were derived using principal

13    component analysis. National wealth quintiles were compiled by assigning the household score

14    to each usual (de jure) household member, ranking each person in the household by their score,

15    and then dividing the distribution into five equal categories, each with 20% of the population, as

16    "poorest," "poorer," "middle," "richer," and "richest."[6] The selection of these variables was

17    based on previous studies.[26–30]

18    **Statistical approaches**

19    In descriptive analyses, categorical variables were summarized using proportions and

20    then presented in tables, while quantitative variables were summarized using the median and

21    interquartile range (IQR).

22    As the outcome variable "problems in accessing health care" was ordinal in nature (a

23    score based on the number of different reported problems), in which the order of values

1  corresponded to a hierarchy in meaning as in this study, the application of ordered logistic

2  regression was recommended.[31] Stata 14 (StataCorp, College Station, TX) was used for analysis

3  in the present study. For all analyses, the Stata survey set commands were used to adjust for the

4  variability of clustering and all the estimates were weighted to correct for non-responses and

5  disproportionate sampling.

6  When assessing the associations between selected independent variables and the outcome

7  variable, four models were tested for fit: a proportional ordered logistic model, a generalized

8  ordered logistic regression model, and a generalized ordered logistic regression model with and

9  without alternative parameterization. The generalized ordered logistic regression model with

10  alternative parameterization was chosen as the best fit. This model allows some variables to be

11  modeled with the proportional odds assumption while the parallel line constraint is relaxed for

12  variables in which the assumption is not met. The model is less restrictive as it allows the

13  coefficient of the variables to vary for the different categories that are compared.[32] The model

14  provides gamma coefficients that show the extent to which the parallel regression assumption is

15  violated by the variable.

16  **Ethics statement**

17  This study was based on an analysis of existing public domain survey data sets that are

18  freely available online with all identifier information detached. The original TDHS-MIS

19  protocols were reviewed by the Institution Review Board (IRB) of ICF Macro at Calverton in the

20  USA and by the National Institute of Medical Research (NIMR) IRB in Tanzania. The ICF IRB

21  ensured that the survey complied with the US Department of Health and Human Services

22  regulations for the protection of human subjects (45 CFR 46), while NIMR-IRB ensured that the

23  surveys complied with the laws and norms of Tanzania. The participants were adequately

9

1 informed about all relevant aspects of the survey, including its objective and interview

2 procedures. All participants accepted participating in the study signed informed consent prior to

3 the interviews.

4 **Patient and Public Involvement Statement**

5 Patients and the public were not involved in the analysis of this study.

6 **RESULTS**

7 **Respondents' characteristics**

8 As shown in Table 1, a total of 13266 women between 15 and 49 years old were

9 interviewed and included in the analysis. The median age (IQR) of the respondents was 27 (20 –

10 36) years. About 62% of the respondents were living with their spouse at the time of the

11 interview. Less than 2% had attained the highest level of education (college or university).

12 Nearly two-thirds were employed but paid-in-kind and one-tenth reported having any type of

13 health insurance. Almost half of the respondents reported that obtaining money for health care

14 was the major problem in accessing health care. Furthermore, about two-thirds of the

15 respondents reported at least one of the four problems in accessing health care.

16 **Table 1 Percent distribution of women between the ages 15 – 49 years by selected**

17 **background characteristics, Tanzania DHS-MIS 2015 – 2016 (n = 13266)**

| Variable | *n* (%) (Weighted) |
|---|---|
| **Age** (Median (IQR)=27, (20-36) | |
| 15-19 | 2904 (21.89) |
| 20-34 | 6360 (47.94) |
| 35-49 | 4002 (30.17) |
| **Marital status** | |
| Never married | 3353 (25.27) |
| Married/living together | 8210 (61.89) |
| Divorced/separated/widowed | 1703 (12.84) |

**Education**
| | |
|---|---|
| None | 1947 (14.67) |
| Primary | 8211 (61.90) |
| Secondary | 2925 (22.05) |
| Highest | 183 (1.38) |

**Employed last 12 months**
| | |
|---|---|
| Not employed | 3033 (22.86) |
| Employed for cash | 6197 (46.71) |
| Employed but paid-in-kind | 4036 (30.43) |

**Residence**
| | |
|---|---|
| Urban | 4811 (36.27) |
| Rural | 8455 (63.73) |

**Health insurance ownership**
| | |
|---|---|
| Yes | 12066 (90.95) |
| No | 1200 (9.05) |

**Health quintile**
| | |
|---|---|
| Lowest | 2246 (16.93) |
| Second | 2274 (17.14) |
| Middle | 2328 (17.55) |
| Fourth | 2822 (21.27) |
| Highest | 3596 (27.11) |

**Types of problems\***
| | |
|---|---|
| Obtaining money | 6565 (49.49) |
| Distance to facility | 5615 (42.33) |
| Not want to go alone | 3962 (29.87) |
| Obtaining permission | 1900 (14.32) |

**Number of problems in accessing health care**
| | |
|---|---|
| None | 4574 (34.48) |
| One problem | 3291 (24.81) |
| Two problems | 2547 (19.20) |
| Three problems | 1759 (13.26) |
| Four problems | 1095 (8.25) |

Note: \**n* and % do not add up to 13266 and 100%, respectively, because multiple responses were possible.

**Partial generalized ordered logistic regression model with alternative gamma parameterization**

Table 2 shows the results of the partially constrained generalized ordered logistic regression model with alternative (gamma) parameterization for the outcome variable of problems in accessing health care. The results showed non-significant Wald test statistics, indicating that the model did not violate the proportional odds/parallel regression assumptions.

11

1    However, constraints for parallel lines were not imposed for age, wealth status (richest), and

2    marital status (divorced, separated, or widowed). The remaining variables that met the parallel

3    assumption can be interpolated in the same manner as for the ordered logistic regression model

4    as follows. The odds of being in higher categories of problems in accessing health care versus

5    lower or equal to a reference category were 0.622 [0.531 - 0.731] times lower for women who

6    had health insurance than those who did not, given constant values for the other variables in the

7    model. Furthermore, the odds of being in higher categories of problems in accessing health care

8    versus less than or equal to a reference category were 1.220 [1.067 - 1.395] times higher for

9    women who were employed but paid-in-kind than those who were unemployed for the last 12

10    months before the survey keeping the other variables constant in the model.

11    The variables for which constraints for parallel lines were not imposed were interpreted

12    as follows: the coefficients for age and marital status (divorced, separated, or widowed) were

13    consistently positive, while those for wealth status (richest) were negative but decreased across

14    the cut-points. Therefore, for each year of increase in age and being divorced, separated, or

15    widowed, women were more likely to report having a larger number of problems in accessing

16    health care. The greatest differences were seen with increasing age and for those who were

17    divorced, separated, or widowed, women were less likely to report having few problems in

18    accessing health care. In addition, the women in the richest economic group tended to be less

19    likely to report having many problems in accessing health care than those in the poorest group,

20    with the greatest differences because the richest women were less likely to report having many

21    problems in accessing health care.

22

12

1 **Table 2 Generalized ordered logistic regression model with alternative gamma**

2 **parameterization, Tanzania DHS-MIS 2015 – 2016 (*n* = 13266)**

|  | Variable | POR [95% CI] | *P*-value |
|---|---|---|---|
| **Beta** | **Health insurance** (ref: No) | | |
| | Yes | 0.622 [0.531 - 0.731] | 0.000 |
| | **Residence** (ref: Urban) | | |
| | Rural | 0.858 [0.728 - 1.012] | 0.069 |
| | **Age** (continuous) | 1.010 [1.001 - 1.017] | 0.000 |
| | **Marital status** ref: Never married) | | |
| | Married/living together | 0.901 [0.801 - 1.014] | 0.085 |
| | Divorced/separated/widowed | 1.418 [1.175 - 1.712] | 0.000 |
| | **Education** (ref: None) | | |
| | Primary | 0.883 [0.788 - 0.990] | 0.033 |
| | Secondary | 0.683 [0.582 - 0.800] | 0.000 |
| | Highest | 0.516 [0.360 - 0.741] | 0.000 |
| | **Wealth status** (ref: Poorest) | | |
| | Poorer | 0.854 [0.726 - 1.006] | 0.059 |
| | Middle | 0.725 [0.626 - 0.840] | 0.000 |
| | Richer | 0.496 [0.417 - 0.590] | 0.000 |
| | Richest | 0.291 [0.233 - 0.364] | 0.000 |
| | **Employed last 12 months** (ref: Not employed | | |
| | Employed for cash | 0.975 [0.869 - 1.095] | 0.668 |
| | Employed but paid in kind | 1.220 [1.067 - 1.395] | 0.004 |
| Gamma_2 | Age | 0.993 [0.989 - 0.998] | 0.000 |
| | Wealth status  (Richest) | 1.279 [1.140 - 1.435] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.814 [0.701 - 0.945] | 0.007 |
| Gamma_3 | Age | 0.993 [0.986 - 0.999] | 0.018 |
| | Wealth status  (Richest) | 1.515 [1.265 - 1.814] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.749 [0.625 - 0.899] | 0.002 |
| Gamma_4 | Age | 0.987 [0.978 - 0.996] | 0.005 |
| | Wealth status  (Richest) | 1.957 [1.508 - 2.540] | 0.000 |
| | Marital status (Divorced/separated/widowed) | 0.566 [0.419 - 0.764] | 0.000 |

1   Note: Wald test of parallel lines assumption for the final model: $F_{(33, 517)} = 1.110$, $P = 0.310$.

2   A non-significant test statistic indicates that the final model does not violate the proportional

3   odds/parallel lines assumption.

4   *POR = Proportional odds ratio.

5   **DISCUSSION**

6       This study was performed to explore the factors associated with accumulation of multiple

7   problems in accessing health care among women in Tanzania. To our knowledge, this is the first

8   study to explore the factors associated with multiple problems in accessing health care.

9   Furthermore, the study used a nationally representative sample from Tanzania with the

10   application of generalized ordered logistic regression models, which provided the best models

11   for ordinal data to validate the factors associated with problems in accessing health care. In the

12   present study, about 65%, 40%, and 20% of women reported "one or more," "two or more," and

13   "three or more" major problems in accessing health care, respectively. In addition, not having

14   health insurance and low socioeconomic status as measured by wealth, education, and

15   employment status were associated with accumulation of multiple problems in accessing health

16   care.

17       The high proportion of women reporting problems in accessing health care in this study

18   was consistent with the findings of a previous study performed in Egypt.[33] These findings

19   provide evidence that demand-side barriers, such as cost of care, permission from their spouse,

20   lack of someone to escort to a health care facility, and distance to the facility,[34,35] still prevent

21   many African women from accessing health care. Due to the cultural, social, and traditional

22   perceptions in Africa that maternal health is only the responsibility of women, existing and new

1  interventions should influence health service utilization to begin at the individual, household, and

2  community levels to eliminate such demand-side barriers.[21,36]

3      Having health insurance is an essential element for timely access to health care and better

4  health-related outcomes.[37,38] Despite the availability of the National Health Insurance Fund

5  (NHIF) in Tanzania since 2001 through Act no. 8 of 1999, more than 90% of women are still

6  uninsured.[27,39] Less than one-tenth of the women in the present study reported having any type of

7  health insurance. Moreover, the women who had health insurance were less likely to report

8  having multiple problems associated with access to health care. This may have been because

9  having health insurance makes someone not only more comfortable with receiving a wide range

10  of services but also ensures a wider choice regarding where and when to obtain health care

11  without being afraid of the costs as they are covered by insurance. Similar findings were reported

12  in a study conducted Ghana.[26] The similarity in the findings between these studies may have

13  been because both used secondary data collected by a DHS program that applied a similar

14  methodology. Furthermore, the participants in these two studies were from SSA, and therefore

15  may have similar socioeconomic determinants.

16      The present study indicated a strong association between being in the poorest class of the

17  wealth index and accumulation of multiple problems in accessing health care among women in

18  Tanzania. This finding may be explained by the fact that being in the poorest class requires

19  individuals to spend their income on basic needs, such as food, and health care costs may

20  therefore be less likely to be affordable.[40] Such women are therefore more likely to report having

21  many problems in accessing health care, as reported in other studies conducted in SSA.[41–43]

22      In contrast to our expectations, we found no significant association between

23  unemployment and problems in accessing health care. However, this may have been because

15

1    being employed is not enough to have full access to health care as there are other barriers

2    preventing women from accessing health care, such as gender inequality, poor infrastructure, and

3    lack of knowledge regarding maternal health services.[28,33,44] On the other hand, the results

4    presented here indicated that women who are employed and receive wages in the form of

5    payment-in-kind, such as food, clothes, and other goods instead of cash, were likely to

6    experience multiple problems in accessing health care.

7    The variables age, wealth status (richest), and marital status (divorced, separated, or

8    widowed) were found to vary for each category of the outcome variable. The findings indicated

9    that the accumulation of multiple problems in accessing health care was associated with older

10    age and being divorced, separated, or widowed, consistent with the results of previous studies in

11    other low-income countries.[45,46] Older age is more likely to be accompanied by decreased

12    working capability, and hence low income, being retired, and uninsured.[47] As the risk of

13    maternal complications increased with older age[48,49] and living without a spouse reduced the

14    chance of having an escort to the health facility, efforts and support should be made to provide

15    such women with access to health care.

16    This study had some limitations, including the risk of misclassification bias, which may

17    have been introduced due to the lack of external validation of self-reported information that

18    could have affected categorization of the outcome variable. However, we reduced this effect by

19    categorizing the outcome variable into five groups and the use of a generalized ordered logistics

20    regression model that clearly validated the factors associated with problems in accessing health

21    care among women in low-income countries. In addition, causality assumptions could not be

22    made due to the cross-sectional nature of the study, and therefore the results should be

23    interpreted with caution.

1

1 **CONCLUSION**

2     The results of the present study provided evidence for additive effects of barriers to

3 health care in low-income countries, such as Tanzania. Based on these results, improving access

4 to health insurance and addressing social determinants of health represent the first steps toward

5 reducing problems associated with accessing health care for women in low-income countries.

6 **Contributors**

7     DB originated the design of the study, performed statistical analysis, interpretation and

8 drafted the manuscript. KN contributed to the design of the study and the interpretation advice of

9 data. KS contributed to interpretation advice of data and drafted the manuscript. Both DB, KN &

10 KS critically revised the draft manuscript. All authors read and approved the final manuscript.

17 **Competing interest**

18     None to declare.

19 **Provenance and peer review**

20     Not commissioned; externally peer reviewed.

21 **A data sharing statement**

1      The datasets used for the current analysis was generated from the original survey of

2     Tanzania DHS-MIS datasets available from within the DHS program repository:

3     http://dhsprogram.com/data/available-datasets.cfm

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic | Item # | Recommendation | Reported on page # |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | Page 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | Page 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | Page 5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | Page 7 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | Page 8 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | Page 8-9 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | Page 8 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | Page 9-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | Page 9-10 |
| Bias | 9 | Describe any efforts to address potential sources of bias | Page 3, 8 |
| Study size | 10 | Explain how the study size was arrived at | Page 8 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Page 10 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | Page 10-12 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | Page 10-12 |
| | | (*c*) Explain how missing data were addressed | N/A |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Page 10 |
| | | (*e*) Describe any sensitivity analyses | N/A |
| **Results** | | | |

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | Page 13 |
|---|---|---|---|
| | | (b) Give reasons for non-participation at each stage | N/A |
| | | (c) Consider use of a flow diagram | N/A |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | Page 14 and Table 1 |
| | | (b) Indicate number of participants with missing data for each variable of interest | N/A |
| Outcome data | 15* | Report numbers of outcome events or summary measures | Page 14 and Table 1 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Table 2,3,4 |
| | | (*b*) Report category boundaries when continuous variables were categorized | Table 1 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | N/A |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | Table 4 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | Page 18-9, Table 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | Page 24 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | Page 24 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Page 24 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | N/A |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**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.