International Journal of Maternal and Child Health and AIDS (2020), Volume 9, Issue 3, 274-286

IJMA

Available online at www.mchandaids.org

INTERNATIONAL JOURNAL of MATERNAL and CHILD HEALTH and AIDS
ISSN 2161-864X (Online)
ISSN 2161-8674 (Print)
DOI: 10.21106/ijma.372

ORIGINAL ARTICLE | HIV AND WOMEN EMPOWERMENT

Women's Empowerment and HIV Testing Uptake: A Meta-analysis of Demographic and Health Surveys from 33 Sub-Saharan African Countries

Sanni Yaya, PhD;[1,2]✉ **Gebretsadik Shibre,** MPH;[3] **Dina Idriss-Wheeler,** MHA;[4] **Olalekan A Uthman,** PhD[5]

[1]School of International Development and Global Studies, University of Ottawa, Ottawa, Canada; [2]The George Institute for Global Health, The University of Oxford, Oxford, United Kingdom; [3]Department of Reproductive, Family and Population Health, School of Public Health, Addis Ababa University, Addis Ababa, Ethiopia; [4]Interdisciplinary School of Health Sciences, University of Ottawa, Ottawa, Canada; [5]Warwick Centre for Applied Health Research and Delivery (WCAHRD), Division of Health Sciences, Warwick Medical School, University of Warwick, Coventry, United Kingdom

✉Corresponding author email: sanni.yaya@uottawa.ca

ABSTRACT

Background: There is a growing body of evidence suggesting that women's empowerment can help achieve better health behaviours and outcomes. However, few have looked at the impact of women's empowerment on HIV testing in Sub-Saharan Africa (SSA). This study investigated the association between women's empowerment and HIV testing among women in 33 countries across SSA.

Methods: Cross-sectional data from the most recent Demographic and Health Surveys (2005-2018) of 33 countries in SSA were used. Confounder adjusted logistic regression analysis was completed separately for each of the 33 DHS datasets to produce the adjusted Odds Ratio (OR) for the association between women empowerment and HIV testing. The regression analysis strictly accounted for the three design elements (weight, cluster and strata) to produce an estimate representative of the respective countries. Finally, an Individual Participant Data (IPD) meta-analysis approach was used to statistically pool the effect of women empowerment on HIV testing.

Results: There was a wide variation in the percentage of women who were empowered among the countries studied, with only a few countries such as South Africa, Angola and Ghana having a high prevalence of negative attitudes toward wife beating. HIV testing was higher in Angola, Lesotho, Uganda and South Africa. While participation in one or two of the three decisions had been marginally associated with lower odds of HIV testing across the SSA regions (0.89; 95%CI: 0.83, 0.97); the corresponding prediction interval crossed the null. Being involved in the three decisions (0.92; 95%CI: 0.84, 1.00) and disagreement to wife-beating (0.99; 95%CI: 0.94, 1.05) had no statistical relationship with HIV testing uptake.

Conclusion and Global Health Implications: The two indirect indicators of women empowerment could not predict HIV testing uptake. Further studies are recommended to establish the nature of the relationship between HIV testing and women's empowerment that is measured through standard tools.

Key words: • HIV/AIDS prevention • Women • Empowerment • Gender equality • Global health • Sub-Saharan Africa

1. Introduction

1.1. Background of the Study

Globally, an estimated 36.7 million people were living with HIV by the end of 2016, many of whom were women (51.6%).[1,2] According to the Joint United Nations Program on HIV/AIDS, one woman becomes infected with HIV every minute.[3] Differences in the number of new HIV infections between men and women are most pronounced in younger age groups; new infections were 44% higher in women aged 15-24 compared to men in the same age group.[2,4] HIV is the leading cause of death among women aged 30-49 and the third leading cause of death for women aged 15-29.[5]

Sub-Saharan Africa (SSA) accounts for 12% of the global population, yet 71% of the global burden of HIV infection is found within the region.[6] More specifically, 76% of the total people infected with HIV, 76% of the total new HIV infections, and 75% of the total HIV/AIDS related deaths recorded in 2015 occurred in SSA.[1,2] Young women bear a disproportionate burden of HIV infection. Of the 6.1 million people living with HIV in western and central Africa, 56% are women. In eastern and southern Africa, 19.4 million people are living with HIV and of those, 59% are women.[1,2,6] The number of new infections of HIV in SSA have decreased by 33% from an estimated 2.2 million in 2005 to an estimated 1.5 million in 2013.[7] Despite this declining trend, HIV infections continue to pose a problem in the region.

The disproportionate impact of HIV infection on women can be attributable to biological, social, cultural, economic, and structural factors.[8] Within the Sub-Saharan region, women tend to play no part is sexual decision making as their needs and desires are not considered significant.[9] Women in the region are expected to respect the choices of their husband, even if this means accepting of polygamous relationships and cheating on the part of the husband.[10] Women who refuse sexual advances from their partners who reject the use of protection during sex may be subject to violence.[9] Those who are unable to negotiate for safer sex practices are more likely to be infected by their partner.[11]

Late diagnosis of HIV and being unaware of one's HIV positive status has numerous negative impacts. Not knowing that one has HIV increases the likelihood that the virus will be transmitted to others.[12] Late diagnosis can also reduce an infected individual's lifespan through an increase in viral load and reduction of the body's CD4+ T-cell count.[13] Early diagnosis of HIV is essential in order for those infected with HIV to receive proper treatment and care, as well as limit the transmission of the infection to others.[14] Despite the host of negative outcomes that can be reduced with HIV testing, 80% of people from low- and middle-income countries have not been tested.[15]

For many women in Sub-Saharan Africa, fear of their partner's reaction is a major barrier to their uptake of HIV testing as some partners discourage testing and even require that women need their permission in order to get tested.[16] Literature has suggested that HIV prevention policies in SSA must consider women's lack of negotiating power and gender inequality as one of the root causes contributing to the spread of HIV in the region.[17] Several studies have identified the importance of women's empowerment to increase HIV testing and prevention.[18,19] The Sonagachi Project was a sustainable community intervention project in India that aimed to increase female sex workers' social power through increase economic opportunities, creation of a female sex worker's association and increased psychological empowerment and leadership.[20] This 12-year project saw an associated decrease in HIV/AIDS risk among female sex workers.[20]

1.2. Objective

There is a growing body of evidence suggesting that women's empowerment can help achieve better health outcomes. Achieving gender equality and empowering all women and girls are now recognized as powerful tools to enable accessibility to reproductive and sexual health care services for improved mother-and-child outcomes.[21] So far, few studies have attempted to show the influence of women's empowerment on HIV testing in Sub-Saharan Africa.[18,22,23] However, our study significantly extended and improved

the existing body of evidence on the women's empowerment-HIV testing relationship. First, the two indicators of women's empowerment in this paper are created in accordance with the DHS guideline, making our findings largely comparable to other similar papers whose methodology is aligned well with the DHS statistics guideline. Second, the use of methodologically rigorous and statistically sound analysis approaches are crucial to produce findings that are of policy relevance. In this regard, the use of IPD meta-analysis allowed us to statistically estimate the nature of the relationship women's empowerment had with HIV testing in the context of SSA after first establishing the effect of women's empowerment on HIV testing in each country. Unlike most prior studies on this area, our selection of confounding variables has been sufficiently informed by epidemiological principles; that is, all variables in the model other than the two indicators of women empowerment are confounders that have a demonstrated association with both women's empowerment and HIV testing. This is important to get unbiased findings. Finally, given that there are only few studies on this increasingly important topic already, our findings are important to understand the role that women empowerment does play on the uptake of HIV testing for SSA women. To our knowledge, there is no meta-analysis study on this topic in the SSA region, yet findings that come from large sample sizes are important to accurately shed light on how women's empowerment affects HIV testing in the region.

2. Methods

2.1. Data Sources and Study Design

In the SSA, we were able to access 39 DHS datasets. For our study, the DHS datasets from 33 SSA countries were used: Angola (2015), Benin (2018), Burkina Faso (2010), Burundi (2017), Chad (2015), Comoros (2012), Congo (2012), DR Congo (2014), Cameroon (2010), Côte d'Ivoire (2012), Ethiopia (2016), Gabon (2012), Gambia (2013), Ghana (2014), Guinea (2018), Kenya (2014), Liberia (2013), Lesotho (2014), Madagascar (2008), Mali (2018), Mozambique (2011), Namibia (2013), Niger (2012), Rwanda (2015), Sao Tome et Principe (2009), Senegal (2017), Sierra Leone (2013), South Africa (2016), Swaziland (2005), Togo (2013), Uganda (2016), Zambia (2016), Zimbabwe (2015). The most recent datasets were selected for each country. Excluded datasets included Nigeria, Sudan, Malawi, Tanzania, and Central African Republic because these datasets did not contain either the response variable or predictor variables or both.

DHS is a nationally representative household survey conducted at regular time intervals to provide countries with updated information on different health topics such as maternal and child health, reproductive health, fertility, nutrition, mortality, and HIV/AIDS.[24] The United States Agency for International development (USAID) and each country's statistical agency conduct the survey with technical support from Inner City Fund (ICF) International. Methodology and methods for DHS are described in detail in the final DHS report of each country. Concisely, it follows a two-stage stratified cluster sampling design. Big geographic areas, the enumeration area (EA), are selected in the first stage through the Probability Proportional to Size (PPS) approach,[24] where a relatively larger EA is more likely to be selected than a smaller EA. In the second stage, a pre-calculated (28 to 30) number of households are selected from each EA. In the selected household, eligible participants (women aged 15 to 49 years and men 15 to 59 years) were interviewed about a wide range of topics using questionnaires that are comparable across countries. In Namibia DHS, data was collected for women aged between 15 to 64 years, and analyses was restricted to women age 15 to 49 years so that our analysis became similar in all DHS data included in this paper. For all 33 countries, the Individual Recode file (or women's recode file) was used to complete our analysis. To capture some useful information on health topics that would be of relevance in a particular country only, country specific questions were also included in the model questionnaire.

2.2. Study Variables

The independent variable for the study is women empowerment. Following the DHS data analysis guidelines,[25] women empowerment was measured using two indicators: decision making on three

specific topics and disagreement with five reasons justifying wife-beating. For the first indicator, surveyed women were asked to report on participation in decision making regarding own health care (person who usually makes decisions on health care for yourself?), large household purchases (person who usually makes decisions on making major household purchases?), and visits to family or relatives (person who usually makes decisions on visits to your family or relatives?). Each of these decisions was changed into a binary variable with a value of 1 and 0, where 1 indicated the woman participated in decision making on that particular decision alone, or jointly with her husband. Finally, a three-category variable was formed out of the three binary variables with values 0 (no empowerment), 1-2 (moderate empowerment) and 3 (high empowerment). Prior evidence followed the same method of creating this variable.[26]

Women were asked if they agree that a husband is justified in beating his wife for the following reasons: a) burning food b) arguing with him c) going out without telling him d) neglecting the children and e) refusing to have sexual intercourse with him. If the woman disagreed to all of these reasons, they were assumed to be empowered. Therefore, an overall binary variable was created with a value of 1 and 0, where 1 indicated disagreement to all of the reasons, and 0 indicated she disagreed with only 4 or fewer reasons. These two indirect indicators of women's empowerment were treated as separate exposure variables of HIV testing, and were associated with HIV testing separately.

HIV testing in the past 12 months was our response or outcome variable. In our analysis, potential confounding factors in the model were accounted for to determine the relationship between women empowerment and HIV testing. The following variables were included as confounders: age in years (15-19, 20-29, 30-39, 40-49); education (none, primary, secondary, higher); wealth (poorest, poorer, middle, richer and richest); employment for cash (employment for cash vs. not); regular media exposure (exposed to one or more of the following media at least once a week: reading newspaper or magazine, listening radio, and watching TV vs. not); and residence (rural vs. urban). Our analysis was restricted to women who were currently married at the time of survey administration.

2.3. Statistical Analysis

First, confounder adjusted logistic regression analysis was completed separately for each of the 33 DHS datasets to produce an adjusted odds ratio (OR) for the women empowerment-HIV testing association. The regression analysis strictly accounted for the three design elements (weight, cluster and strata) to produce an estimate that was representative of the respective countries. Second, meta-analysis to statistically summarize the effect of women empowerment on HIV testing was carried out through the Individual Participant Data (IPD) approach.[27] The IPD meta-analysis has increasingly become an important alternative to the traditional Aggregate Data (AD) meta-analysis. This method of analysis offers researchers an important amount of control over the quality of the data to be analysed thereby boosting quality of evidence produced from the study. Meta-analysis using the IPD approach is unlikely to be affected by publication bias which is one of the most common limitations of AD meta-analysis.[27]

The country specific OR was pooled using a random effect model to enable generalization of findings to a setting the countries in the analysis represent. The random effect model was chosen over the fixed effect alternative because of dissimilarities between the 33 countries where many factors could affect the findings (i.e. culture). Furthermore, the random effect model allows researchers to assume that the true effect sizes (ORs in this study) vary randomly cross studies in the analysis. The inverse-variance approach was used to estimate weights for each study that were later used to produce the summary effect size. Unlike in the fixed effect model, the random effect model takes the between–study variability into account in the estimation of weights for each individual study. The between–study variability was estimated through the non-iterative, non-parametric methods of moments (MoM) estimator of DerSimonian and Laird.[28] The effect of the country-level factors on the pooled effect estimates using sub-group analysis were investigated. The following country-level factors were considered:

survey year, sample size, region and country's income category. Analysis was completed in STATA v 14. The *metan stata module* was used for the meta-analysis. The report of findings was organized based on the Preferred Reporting of Items for Systematic Review and Meta-analysis for Individual Participant Data (PRISMA-IPD) guidelines and PRISMA flow chart.[29]

2.4. Ethical Approval

Ethical permissions were not required for this study since DHS datasets are publicly available. Ethical procedures were the responsibility of the institutions that commissioned, funded, or managed the surveys. All DHS surveys are approved by ICF international as well as an Institutional Review Board (IRB) in the respective country to ensure that protocols are in compliance with the U.S. Department of Health and Human Services regulations for the protection of human subjects. The dataset were extracted from MEASURE DHS website at http://dhsprogram.com/data/available-datasets.cfm.

3. Results

3.1. Women's Empowerment and HIV Testing Distribution by Countries

Table 1 presents percentage of women who are empowered in the SSA countries according to the two measures of women's empowerment, and the proportion of women who tested for HIV. There was large variation in the number of women who were empowered across the countries studied. Among the studied countries, South Africa, Madagascar, Liberia, Lesotho, Angola, Namibia, Rwanda, Zimbabwe and Ethiopia had relatively higher percentage of women empowered in terms of participating in the three decision topics. The percentage of women who disagreed to all of the five wife-beating questions varied considerably from 0% in Chad to more than 94% in South Africa. We also showed huge between country disparity in terms of HIV testing, where the highest prevalence was in South Africa with nearly 76% and the lowest was in Senegal with nearly 32%. See table 1 for details.

3.2. Association of Women Empowerment and HIV Testing Uptake

The association between the two indicators of women's empowerment and HIV testing uptake in each country, together with the pooled effect of women's empowerment on HIV testing in SSA is presented in Figures 1-3 and Table 2. The association of women's participation in decision making and their disagreement to wife-beating with HIV testing uptake was observed in 14 of the studied countries. Women empowerment was associated with higher odds of HIV testing in only five countries: Lesotho, South Africa, Niger, Namibia, and Sao Tome et Principe. In the remaining nine countries, there was a negative relationship between empowerment and HIV testing, where empowerment was associated with lower odds of testing for HIV. Most of the statistically significant associations were between decision making and HIV testing; attitude towards wife beating was associated with HIV testing in only six countries (See Figures 1-3).

In the meta-analysis, compared to women who responded *no* to all of the three questions pertaining to the three different decisions, women who stated that they participated in making one or two decisions had marginally lower odds of HIV testing (0.89; 95%CI: 0.83, 0.97), though the prediction interval crossed the null (Figure 1). However, there was no statistically significant association between HIV testing and participation in all of the three decisions (0.92; 95%CI:0.84, 1.00; Figure 2) and attitude towards wife beating (0.99; 95%CI:0.94, 1.05; Figure 3).

Figure 1 shows the random-effects meta-analysis of the effect of having participated in one or two decisions related to women's own health, visiting family or relatives and large household purchases on HIV testing. Country specific estimates are presented on the left side, and the overall OR is presented at the bottom of the graph. The prediction interval for a future study is displayed for overall.

Figure 2 displays the effect of having participated in three decisions related to women's own health, visiting family or relatives and large household purchases on HIV testing. Country specific estimates are presented on the left side, and the overall OR is presented at the bottom of the graph. The prediction interval for a future study is displayed for overall.

Figure 3 highlights the effect of wife beating attitude on HIV testing. Country specific estimates

Table 1: Summary of percentage of women empowerment and HIV testing uptake, by country

Country	Decision making (1 or 2) %	Decision making (3) %	Wife beating attitude %	HIV testing %
Angola	28.1	65.4	71.4	71.6
Burkina Faso	40.0	31.8	60.3	58.0
Benin	36.5	36.3	65.4	46.9
Burundi	26.7	60.3	38.8	49.2
DR Congo	40.0	33.6	23.0	47.6
Côte d'Ivoire	34.1	23.7	48.5	47.6
Cameroon	46.7	23.8	51.0	43.6
Gabon	43.7	44.4	47.0	56.7
Ghana	31.7	61.6	70.0	39.4
Gambia	44.4	39.3	37.0	41.6
Guinea	32.5	30.4	28.0	60.0
Kenya	34.5	56.0	55.5	71.3
Comoros	30.5	34.9	57.0	43.5
Liberia	25.0	66.2	56.0	47.9
Lesotho	31.6	65.4	66.8	74.9
Madagascar	23.5	74.3	66.3	34.0
Mali	26.7	10.4	17.7	54.0
Mozambique	36.2	49.4	74.4	68.3
Niger	31.9	12.3	37.5	41.1
Namibia	19.2	75.3	67.9	68.0
Rwanda	27.8	65.7	60.0	52.7
Sierra Leone	23.5	45.8	29.6	39.8
Senegal	29.7	14.0	48.9	31.7
Swaziland	45.4	37.6	76.9	59.7
Chad	44.0	17.6	0.0	59.3
Togo	44.8	29.4	68.0	39.6
Uganda	35.6	51.0	50.7	73.2
Zimbabwe	24.6	72.0	61.7	70.7
Congo	52.0	28.5	38.0	45.3
Sao Tome et Principe	37.3	47.3	76.7	50.0
Ethiopia	19.0	70.6	33.0	57.5
Zambia	34.3	53.9	50.3	68.8
South Africa	9.9	87.5	94.4	75.7

Decision making 1 or 2 refers to women who participated in one or two of the three decision topics, namely large household purchase, visit to family or relative and own health care alone or with her partner. Decision making 3 indicates women who participated alone or jointly with her partner on all of the three-decision topic mentioned above. Wife-beating attitude refers to the proportion of women who disagreed to all of the five" is wife-beating justified if " questions: (a) burning food, (b) arguing with him, (c) going out without telling him, (d) neglecting the children, and (e) refusing to have sexual intercourse with him.

are presented on the left side and the overall OR are presented at the bottom of the graph. The prediction interval for a future study is displayed for overall.

We further carried out sub-group meta-analysis to see whether the overall pooled estimate changes by different groups (Table 2). We completed the sub-group analysis for survey year, sample size, geographical region and country's income. While geographical region and country's income data are standard and known classifications, the survey year

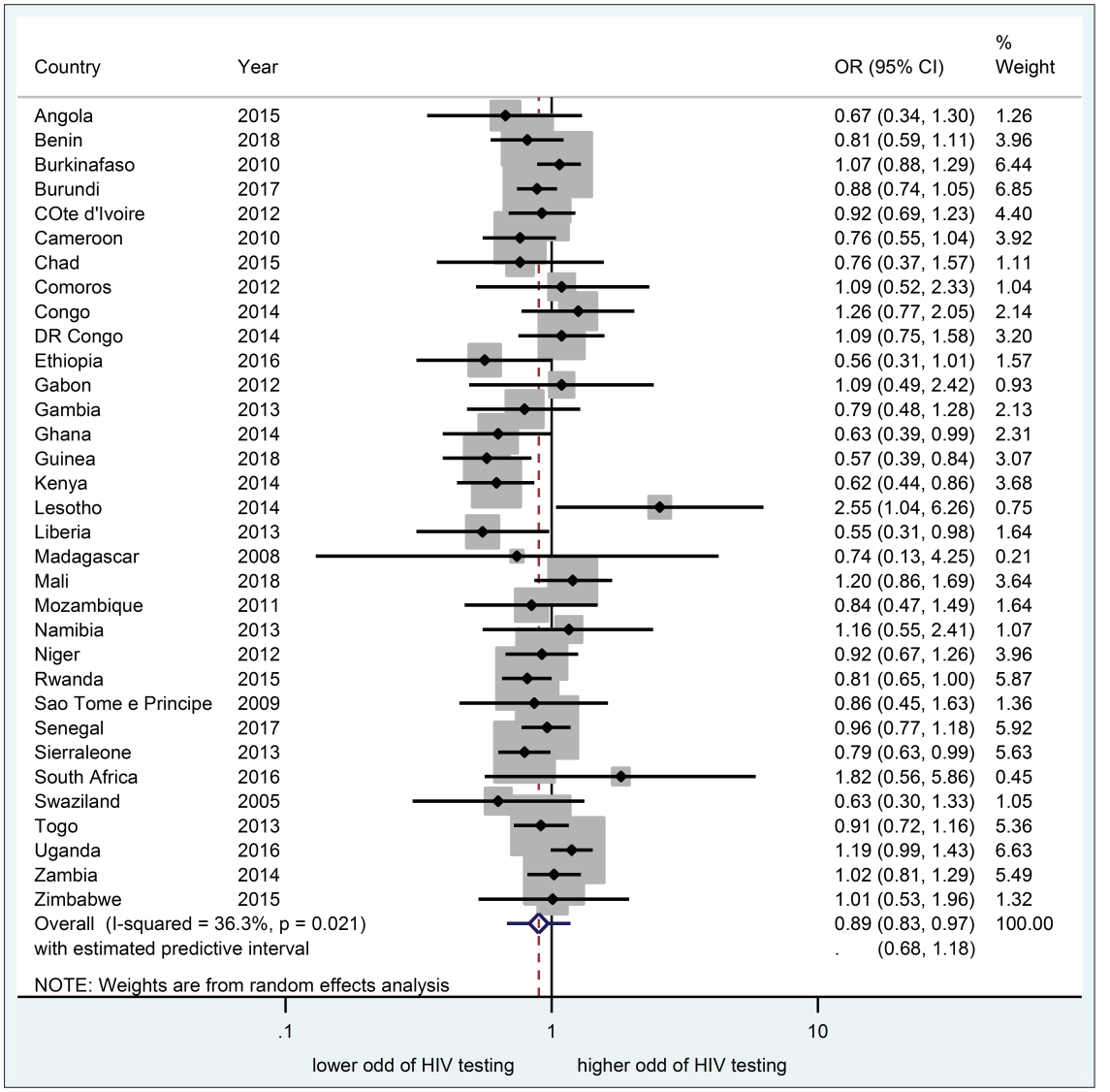

Figure 1: Forest plot showing the effect of having participated in one or two decisions related to women's own health, visiting family or relatives and large household purchases on HIV testing

is the time of administration of the respective DHS and sample size was arbitrarily classified. A similar approach has been used in prior work.[30] In the series of subgroup analyses, we found no evidence of differentials in the pooled association group.

4. Discussion

This study investigated the influence of women empowerment on the uptake of HIV testing in the context of the sub-Saharan Africa (SSA) region. The absence of high-quality evidence on the topic was the motivation behind understanding whether women's empowerment consistently predicts higher odds of testing for HIV in SSA, by considering the substantial diversity of the region in terms of ethnicity, culture and religion.

In 58% of the countries included in the analysis, women empowerment had no statistically significant

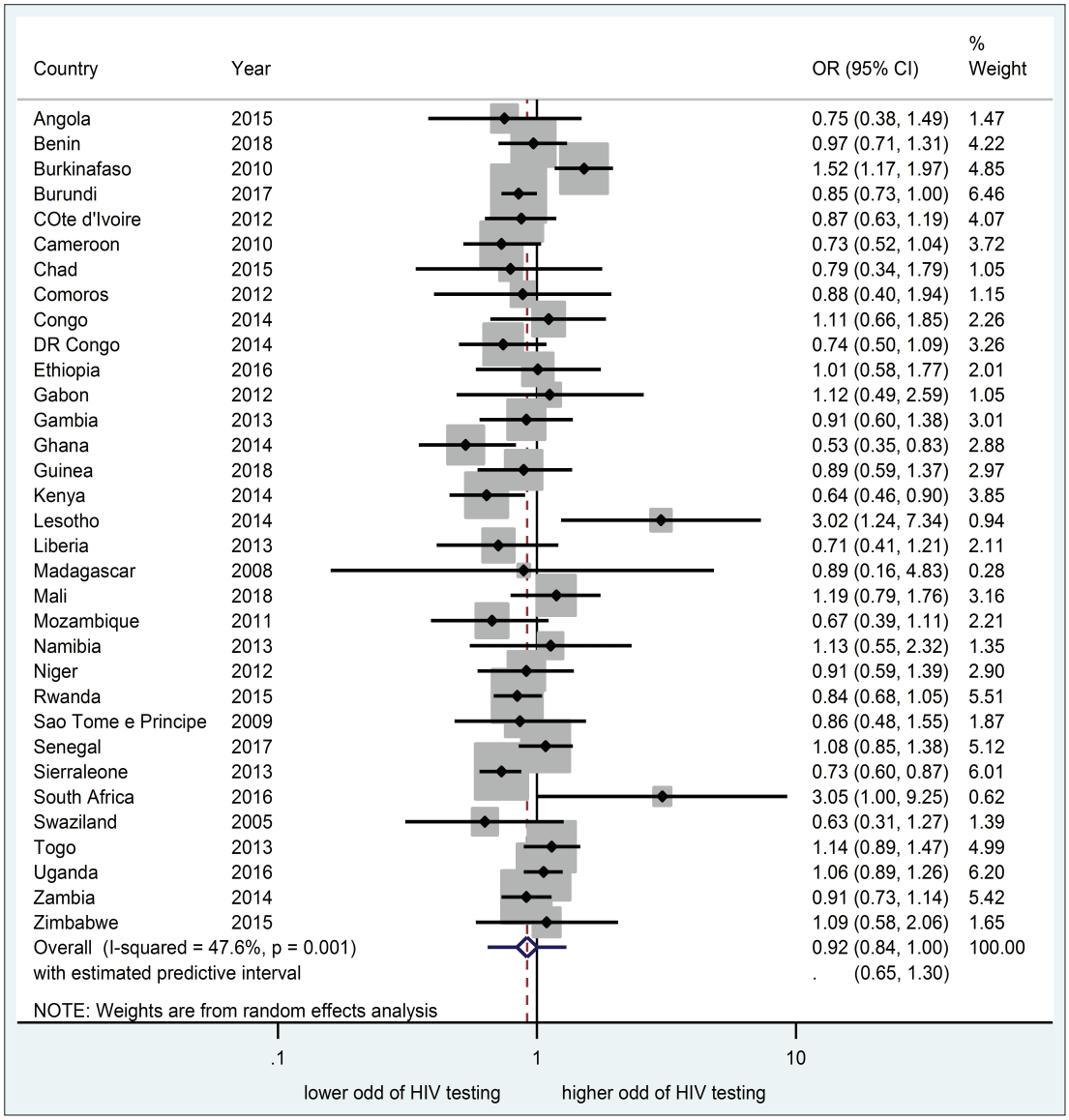

Figure 2: Forest plot showig the effect of having participated in three decisions related to women's own health, visiting family or relatives and large household purchases on HIV testing

relationship with HIV testing. In the remaining countries, there was an association between uptake of HIV test and indicators of women empowerment, with most associations being negative. Available studies link women's empowerment with uptake of HIV testing[18,22,23]. In those studies, empowerment of women has been measured through commonly used variables like wealth and education, preventing us from making direct comparisons with our findings. However, little is known about the nature of the relationship between women's empowerment as measured by participation in decision making and attitude towards wife-beating and HIV testing. Although the primary aim of this study was to show the influence of women's empowerment on HIV testing in the SSA region as whole, our country

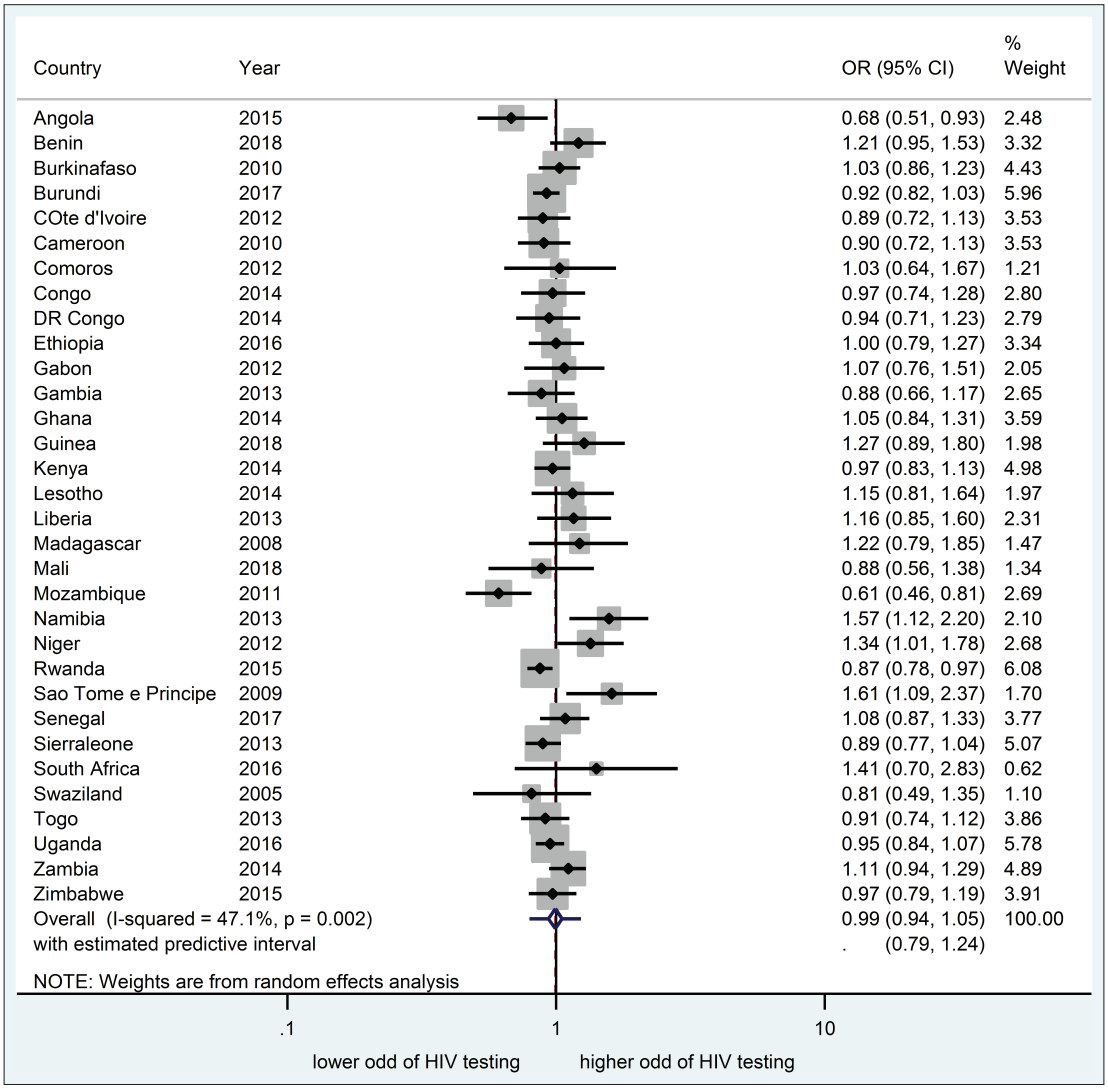

Figure 3: Forest plot showing the effect of wife beating attitude on HIV testing

specific analysis showed that in some SSA countries, women's empowerment is associated with lower odds of HIV testing, which is at odds with available similar prior studies.[18,31] Similar to our findings however, attitude towards wife-beating had shown no effect on HIV testing when controlling for the effect of other empowerment variables[18]. That being said, whether the observed association is by chance, spurious or real deserves future context specific studies in the SSA region.

The overall pooled estimate showed that being involved in one or two of the three areas of the decision-making indicator of women empowerment had odds of HIV testing that were slightly lower than one. However, the corresponding prediction interval included one, indicating HIV testing was not different between women who participate in one or two decisions and women who do not participate in any decisions. Furthermore, participation in all of the three decisions and disagreement with all of the five

Table 2: Results of subgroup analyses

	One or two decisions				Three decisions				Attitude towards wife beating			
	Overall OR (95% CI)	PI (95% CI)	k	I^2	Overall OR (9% CI)	PI OR (95% CI)	k	I^2	Overall OR (95% CI)	PI OR (95% CI)	k	I^2
Survey year												
2015-2018	0.89 (0.77, 1.03)	0.60, 1.33	12	53.1*	0.96 (0.87,1.05)	0.82, 1.12	12	9.6	0.96 (0.89, 1.04)	0.78, 1.18	11	41.3
2012-2014	0.89 (0.79, 1.01)	0.65, 1.24	15	34.6	0.86 (0.75, 0.99)	0.57, 1.30	15	47*	1.02 (0.95, 1.10)	0.85, 1.22	15	28.7
2005 - 2011	0.94 (0.81,1.09)	0.76, 1.16	6	0	0.87 (0.59,1.28)	0.27, 2.85	6	70.9*	0.97(0.76, 1.23)	0.45, 2.10	6	74*
Income category												
Low income	0.89 (0.81,0.99)	0.66,1.21	18	42.7*	0.94 (0.84, 1.05)	0.67, 1.31	18	48.2*	0.96 (0.90, 1.03)	0.78, 1.19	17	45.9*
Lower-middle	0.88 (0.75,1.02)	0.59, 1.30	12	40.3	0.85 (0.71, 1.01)	0.52, 1.38	13	49.6*	1.00 (0.91, 1.09)	0.78, 1.27	12	38.3
Upper-middle	1.23 (0.75,2.01)	0.05, 29.83	3		1.4 (0.80, 2.43)	0.01, 131.5	3	19.6	1.31 (1.01, 1.71)	0.15, 11.4	3	19.4
Sample size												
1754-6453	0.90 (0.76, 1.07)	0.64, 1.27	`12	19	0.96 (0.76, 1.22)	0.49, 1.90	12	52.6*	1.07 (0.96, 1.19)	0.81, 1.41	12	
6750-9824	0.86 (0.77,0.97)	0.65, 1.15	`12	32.4	0.87 (0.80, 0.95)	0.79, 0.97	12	0	0.93 (0.84, 1.03)	0.68, 1.29	13	62.2*
10754-11903	0.94 (0.78,1.13)	0.53, 1.67	5	56.8	0.94 (0.78, 1.14)	0.52, 1.71	5	60.9*	1.01 (0.90, 1.13)	0.74, 1.37	5	39.9
12448-19036	0.89 (0.66,1.20)	0.26,2.99	4	65*	0.89 (0.54, 1.46)	0.1, 8.22	4	84.5*	0.99 (0.89, 1.10)	0.49, 1.98	3	0
Region												
South-central Africa	0.67 (0.34,1.30)	NA	1	NA	0.75 (0.38, 1.49)	NA	1	NA	0.68 (0.50, 0.92)	NA	1	NA
West Africa	0.86 (0.77,0.96)	0.65, 1.15	12	39	0.93 (0.79, 1.08)	0.55, 1.56	13	66*	1.01 (0.94, 1.09)	0.85, 1.20	13	25.1
East Africa	0.85 (0.69, 1.05)	0.47, 1.53	7	65.4*	0.88 (0.77, 1.00)	0.66, 1.17	7	28.5	0.93 (0.88, 0.99)	0.86. 1.00	7	0
Equatorial Africa	1.09 (0.78, 1.53)	NA	3	0	0.80 (0.56, 1.13)	NA	3	0	0.98 (0.83, 1.16)	0.33, 2.93	3	0
Southern Africa	1.09 (0.82, 1.45)	0.58, 2.06	6	23.6	0.19 (0.79, 1.79)	0.37, 3.87	6	59.4*	0.12 (0.96, 1.30)	0.77, 1.61	6	34.8
South east Africa	0.84 (0.47, 1.50)	NA	1	NA	0.67 (0.40, 1.13)	NA	1	NA	0.61 (0.46, 0.81)	NA	1	NA
Central Africa	0.81 (0.50, 1.32)	NA	2	0	0.84 (0.52, 1.35)	NA	2	NA	0.61(1.09, 2.37)	NA	1	NA

NA=Not Available; PI=Predictive interval which is inestimable for < 3 studies; I^2 is * indicates significance at p-value < 0.05; k= number of studies. One or two decisions refers to women who participated in one or two of the three decision topics, namely large household purchase, visit to family or relative and own health care alone or with her partner. Three decisions indicates women who participated alone or jointly with her partner on all of the three decision topic mentioned above. Wife-beating attitude refers to the proportion of women who disagreed to all of the five " is wife-beating justified if " questions: (a) burning food, (b) arguing with him, (c) going out without telling him, (d) neglecting the children, and (e) refusing to have sexual intercourse with him

questions regarding reasons justifying wife beating had no statistical association. The prediction intervals, which included one, supported this conclusion, indicating that ORs of any future studies will fall in the intervals that crossed the null value. Our subgroup analyses similarly confirmed the absence of any association between women's empowerment and HIV testing uptake. This showed that though the women's empowerment-HIV testing relationship was tested in smaller groups, we still observed the same conclusion that no statistical association was observed between them. Apart from few country specific prior studies mentioned above, lack of meta-analysis studies on the women's empowerment and HIV testing relationship in the SSA region prevents us from discussing our findings within the context of available literature. Additional studies are recommended to further examine whether participation of women in different health and household related decisions alone or jointly with their partner, and disapproval with all the five questions justifying wife beating, are related with the odds of HIV test uptake. Especially important are studies which are meant to develop standard tools to measure women's empowerment accurately in community-based surveys. While decision making power on certain matters and attitudinal change towards wife beating are elements that could reflect women's empowerment, the concept of women empowerment may also include issues of socioeconomic status (i.e. employment, education). A tool that can effectively measure women empowerment is one that is comprehensive and includes all relevant elements. In the absence of such a standard measurement tool, it is difficult to properly evaluate the extent of contribution women empowerment has on HIV test uptake. Prior studies revealed that these two indicators of women empowerment are positively related with HIV testing.[26] However, comparison of findings from this study is greatly hampered by the absence of similar pooled studies on the women empowerment-HIV testing relationship.

4.1. Limitations

The study has a few strengths. The adoption of the IPD meta-analysis approach in this study elevated the quality of evidence as it allowed similar analysis strategies in each of the individual countries, which substantially reduced between-study variations in the effect size measured. The approach also allowed sufficient control over the data, something that the traditional meta-analysis technique does not.

5. Conclusion and Global Health Implications

The study showed that women empowerment, as proxied by the two indicators, could not be a predictor of HIV testing uptake in the Sub-Saharan African region. Before concluding on the lack of predictive power of women empowerment on the uptake of testing for HIV in the region, further studies are required to produce concrete evidence on the issue. The meta-analysis revealed that future studies on the women empowerment-HIV testing association could produce results that may not be statistically significant. Qualitative studies are recommended to better understand this important issue.

Compliance with Ethical Standards

Conflicts of Interest: *There are no conflicts of interest to disclose regarding this study.* ***Financial Disclosure:*** *None.* ***Funding/Support:*** *None.* ***Ethics Approval:*** *Ethics approval was not required since the data is available to the public domain.* ***Acknowledgements:*** *We acknowledge the MEASURE DHS for making the dataset available to the public domain for free.*

Key Messages

- There was a wide variation in the percentage of women who were empowered among the countries studied, with only a few countries like South Africa, Angola and Ghana having high prevalence of negative attitudes toward wife-beating.
- Women's participation in decision making and ability to oppose husband's wife-beating behaviours were not necessarily associated with higher odds of HIV testing uptake.
- Future studies are needed to establish the nature of the relationship between HIV testing and women's empowerment that can be measured through standard tools.

References

1. Joint United Nations Programme on HIV/AIDS (UNAIDS). In. Geneva: UNAIDS Data; 2017. https://www.unaids.org/sites/default/files/media_asset/20170720_Data_book_2017_en.pdf. Accessed March 14, 2020.
2. Joint United Nations Programme on HIV/AIDS (UNAIDS). Ending AIDS progress towards the 90–90–90 targets. In. Geneva: Global aids update; 2017:12-16. https://www.unaids.org/en/resources/documents/2017/20170720_Global_AIDS_update_2017. Accessed March 14, 2020.
3. AIDS info. 2016. http://aidsinfo.unaids.org/. Accessed March 14, 2020.
4. Wang H, Wolock TM, Carter A, et al. Estimates of global, regional, and national incidence, prevalence, and mortality of HIV, 1980–2015: the Global Burden of Disease Study 2015. *TheLlancet HIV.* 2016;3(8):e361-e387.
5. Joint United Nations Programme on HIV/AIDS (UNAIDS). When women lead change happens: Women advancing the end of AIDS. 2017. http://www.unaids.org/sites/default/files/media_asset/when-womenlead-change-happens_en.pdf. Accessed March 15, 2020.
6. Joint United Nations Programme on HIV/AIDS (UNAIDS). Communities at the centre - Global report 2019. https://www.unaids.org/sites/default/files/media_asset/2019-global-AIDS-update_en.pdf. Accessed March 14, 2020.
7. Kharsany AB, Karim QA. HIV Infection and AIDS in Sub-Saharan Africa: Current Status, Challenges and Opportunities. The Open AIDS Journal. 2016; 10: 34–48. In: Epub 2016/06/28. https://doi. org/10.2174/1874613601610010034 PMID: 27347270.
8. Ramjee G, Daniels B. Women and HIV in sub-Saharan Africa. *AIDS Research and Therapy.* 2013;10(1):30.
9. Duffy L. Culture and context of HIV prevention in rural Zimbabwe: the influence of gender inequality. *Journal of Transcultural Nursing.* 2005;16(1):23-31.
10. Joint United Nations Programme on HIV/AIDS (UNAIDS). Women out loud: How women living with HIV will help the world ends AIDS. Geneva, Switzerland: Joint United Nations Program on HIV/AIDS (UNAIDS); 2012. https://www.unaids.org/en/resources/documents/2012/20121211_Women_Out_Loud. Accessed March 14, 2020.
11. Jesmin SS, Cready CM. Can a woman refuse sex if her husband has a sexually transmitted infection? Attitudes toward safer-sex negotiation among married women in Bangladesh. *Culture, Health & Sexuality.* 2014;16(6):666-682.
12. Park BJ, Wannemuehler K a, Marston BJ, Govender N, Pappas PG, TM C. Estimation of the current global burden of cryptococcal meningitis among persons living with HIV/AIDS. *AIDS.* 2009;23:525-530.
13. Smurzynski M, Wu K, Benson CA, Bosch RJ, Collier AC, Koletar SL. Relationship between CD4+ T-cell counts/HIV-1 RNA plasma viral load and AIDS defining events among persons followed in the ACTG Longitudinal Linked Randomized Trials (ALLRT) study. *Journal of Acquired Immune Deficiency Syndrome.* 2010;55(1):117.
14. Granich RM, Gilks CF, Dye C, De Cock KM, Williams BG. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *The Lancet.* 2009;373(9657):48-57.
15. World Health Organization (WHO). HIV testing and counseling. 2008. http://www.who.int/hiv/topics/vct/en. Accessed March 20, 2020.
16. Maman S, Mbwambo J, Hogan NM, Kilonzo GP, Sweat M. Women's barriers to HIV-1 testing and disclosure: challenges for HIV-1 voluntary counselling and testing. *AIDS Care.* 2001;13(5):595-603.
17. Joint United Nations Programme on HIV/AIDS (UNAIDS). Gender and HIV. 2000. http://www.unaids.org/fact—sheets/files/GenderFS— en.pdf. Accessed March 20, 2020.
18. Bashemera DR, Nhembo MJ, Benedict G. *The role of women's empowerment in influencing HIV testing.* ICF International; 2013.
19. Romero L, Wallerstein N, Lucero J, Fredine HG, Keefe J, O'Connell J. Woman to woman: coming together for positive change—using empowerment and popular education to prevent HIV in women. *AIDS Education and Prevention.* 2006;18(5):390-405.
20. Jana S, Basu I, Rotheram-Borus MJ, Newman PA. The Sonagachi Project: a sustainable community intervention program. *AIDS Education and Prevention.* 2004;16(5):405-414.
21. Thapa DK, Niehof A. Women's autonomy and husbands' involvement in maternal health care in

Nepal. *Social Science & Medicine*. 2013;93:1-10.

22. Sambah F, Baatiema L, Appiah F, et al. Educational attainment and HIV testing and counselling service utilisation during antenatal care in Ghana: Analysis of Demographic and Health Surveys. *Plos ONE*. 2020;15(1):e0227576.
23. Ngandu NK, Van Malderen C, Goga A, Speybroeck N. Wealth-related inequality in early uptake of HIV testing among pregnant women: an analysis of data from a national cross-sectional survey, South Africa. *BMJ Ppen*. 2017;7(7):e013362.
24. Makela S, Si Y, Gelman A. Bayesian inference under cluster sampling with probability proportional to size. *Stat Med*. 2018;37(26):3849-3868.
25. Croft TN, Marshall AMJ, Allen CK, Arnold F, Assaf S, Balian S. Guide to DHS statistics. *Rockville: ICF*. 2018.
26. Thapa R, Yang Y, Kang JH, Nho J-H. Empowerment as a predictor of HIV testing among married women in Nepal. *Journal of the Association of Nurses in AIDS Care*. 2019;30(5):563-574.
27. Burke DL, Ensor J, Riley RD. Meta-analysis using individual participant data: one-stage and two-stage approaches, and why they may differ. *Statistics in Medicine*. 2017;36(5):855-875.
28. DerSimonian R, Laird N. Meta-analysis in clinical trials. *Controlled Clinical Trials*. 1986;7(3):177-188.
29. Stewart LA, Clarke M, Rovers M, et al. Preferred reporting items for a systematic review and meta-analysis of individual participant data: the PRISMA-IPD statement. *JAMA*. 2015;313(16):1657-1665.
30. Uthman OA, Lawoko S, Moradi T. Sex disparities in attitudes towards intimate partner violence against women in sub-Saharan Africa: a socio-ecological analysis. *BMC Public Health*. 2010;10(1):223.
31. Iwelunmor J, Blackstone S, Jennings L, Converse D, Ehiri J, Curley J. Determinants of HIV testing and receipt of test results among adolescent girls in Nigeria: The role of assets and decision-making. *International Journal of Adolescent Medicine and Health*. 2018.