

## Research Articles

# Lack of agency and sexual behaviors among married women: a study of population-based HIV impact assessment (PHIA) surveys in Malawi, Tanzania and Zambia

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### Background

Educational campaigns to prevent HIV/AIDS have shown mixed success in Africa. We hypothesized that women's lack of agency in decision-making and taking discernible actions reduces the beneficial impact of HIV-related knowledge.

### Methods

We used data from Population-based HIV Impact Assessment (PHIA) surveys in Malawi, Tanzania and Zambia. A subsample of surveys that were completed by married adult women were selected for the HIV knowledge module which included responses for household decision-making questions. We created a binary variable for agency (ability to participate in decision-making about household matters, health, and sex), and scalar variables for HIV-related knowledge and sexual behaviors. We used regression analysis using survey weights with the behaviors as dependent variables.

### Results

We pooled survey results from 16,822 women (63% from Tanzania, 19% from Malawi and 18% from Zambia). Altogether, 13.5% of women (17% of those 15-24 years old) exhibited poor agency. Those with a higher degree of agency had higher education, were working, and were wealthier. Women lacking agency were significantly less likely to use condoms (4.7% vs. 6.2%,  $P=0.022$ ). Approximately 95% reported having a single partner over past 12 months, while Zambian women with no agency showed significantly lower rate of 92% (odds ratio, OR=0.66, 95% confidence interval, CI=0.45-0.95,  $P=0.027$ ). The rate of HIV testing across the three countries was 83%-92%. In Tanzania, presence of good knowledge and agency together increased the odds of HIV testing by 60% (interaction term). However, among those with good knowledge yet reporting poor agency, the likelihood of HIV testing decreased by 65%, nullifying knowledge impact. We did not observe similar associations in Malawi. Among women with poor knowledge, lack of agency reduced the odds of condom use by 50% compared to those with agency. Alternatively, for women who exhibited good knowledge without agency, the odds of condom use was more than double compared to women with some agency (OR=2.14, 95% CI=1.07-4.27,  $P=0.032$ )).

### Conclusions

We detected a moderating effect for agency on knowledge-driven behavior. Results on different behaviors and across individual countries are mixed and suggest caution to derive definitive conclusions. Despite limitations, these findings indicate that policies that increase women's agency may help anti-HIV programs' success.

Women have fallen victim to the HIV/AIDS epidemic at disproportionately higher rates than men, especially in African countries.<sup>1</sup> This fact has created a sense of priority to promote improved safe sex practices that could protect women against the infection. In this effort, education-based interventions have been successful in providing

greater access to healthcare services and other resources in low-income countries, though the uptake of disease preventative behaviors has been generally low.<sup>2,3</sup> Women, in particular married women, have very low rates of condom use. For instance, in Kenya, 1.8% and in Zambia 4.7%, of married women use condoms compared to 18.0% and 26.2%

of their unmarried counterparts<sup>4,5</sup> and even though testing and other HIV-related services are provided as part of pre-natal care, participation is reported to be low in several sub-Saharan nations.<sup>6</sup> It has been suggested that women's lack of autonomy and inability to exert their willpower becomes a barrier to practice safe sexual behaviors.<sup>1,7-9</sup> This issue has been recognized within the context of women's empowerment<sup>10,11</sup> and is often referred to as self-efficacy or agency. The general theme refers to one's ability to make decisions and turn those decisions into actions on matters of health and well-being.<sup>8,12</sup> It is influenced by a myriad of cultural and social norms, issues related to women's rights, as well financial and educational opportunities available for women to reach self-efficacy and confidence in taking control over their lives and bodies. Improved self-efficacy and agency can be effective in the uptake of protective measures such HIV testing and condom use,<sup>7,13</sup> and even supersede the force of adversarial factors such as stigma.<sup>14</sup>

While more evidence is accumulating within different cultural contexts, there is a lack of consensus on the most accurate measure for empowerment. Various studies have used factors such as literacy/education and wealth,<sup>15,16</sup> or a mixture of attitudes towards women's autonomy (women can refuse sex or ask for condoms), justification of wife-beating<sup>17,18</sup> and women's participating in household major decision-making as indicators of empowerment.<sup>18,19</sup> A study of 29 Sub-Saharan countries<sup>13</sup> found that women who believed they had the right to ask their husbands to use a condom if he had a sexually transmitted infection were more likely to have been tested for HIV.

On the other hand, in a meta-analysis of 33 sub-Saharan countries, Yaya 2020<sup>18</sup> found no significant relationship between empowerment and HIV testing uptake in more than half of the countries included in their study. This study used a combination of women's role in household decision-making and her attitude towards wife-beating as measures of empowerment.<sup>18</sup> Women's empowerment was associated with increased likelihood of testing in only five out of the 33 sub-Saharan African countries and the direction of association among the rest of the countries was a negative one. While these studies are controlled for demographic and background factors that play a major role in women's agency as well as the actions taken (behavior), they do not account for knowledge of HIV in forming the willingness to take action. We hypothesize that agency mediates the propensity to engage in safe sex practices based on this knowledge.

Our study used a nationally representative data source in three countries: Malawi, Tanzania and Zambia. We focused on agency as the manifestation of empowerment through self-efficacy and discernable action. Therefore, we used survey questions regarding the act of decision making about important household matters and autonomy in requesting and executing protective health-related behavior as a way to measure 'agency'. We investigated the level of personal agency among married women, its relationship with sexual behaviors, and how it may influence the role of knowledge to improve safe sex practices.

## METHODS

### DATA SOURCE AND SAMPLE SELECTION

The cross-sectional Population-based HIV Impact Assessment surveys (PHIA) of three countries were selected for this analysis: Zambia 2016, Tanzania 2016-2017, and Malawi 2015-2016. PHIA surveys are nationally representative and use a stratified, multistage sampling design to accurately estimate incidence of HIV/AIDS at the national level.<sup>20</sup> These surveys include core adult and household questionnaires that are consistently used by participating countries, in addition to modular questionnaires, such as those on knowledge and other HIV-related topics that are opted by some, but not all, countries. To study agency, we limited our analysis only countries whose PHIA surveys included questions for women's response regarding their decision-making roles in the household. This resulted in including only married women since unmarried women were not targeted for these questions. We acquired data from 30,126 responders who were married women over the age of 15. Data from those individuals who were eligible for the HIV knowledge module in Zambia and Malawi (almost half of the sample in each country) were selected for analysis. As all of the women in Tanzania who responded to the survey were questioned on their HIV knowledge, no additional filter was applied to that data. PHIA provides survey weights for all modules which are adjusted for non-response and used in this analysis. However, among the remaining responders, 6,923 (22%) had missing values specifically for agency questions. We did not impute any data points but excluded those with missing responses to agency questions which resulted in 16,822 individuals in our pooled sample. The calculation of the composite knowledge score excluded those individuals with missing responses for all four component questions, which eliminated another 0.7% (119 responders).

### DEPENDENT AND MAIN INDEPENDENT VARIABLES

The dependent variables of interest were three sexual behaviors and a composite scalar variable for total behavior score (see [Table 1](#)). The three sexual behaviors, condom use during sex over last 12 months, having single partner in past 12 months, and ever being tested for HIV, were re-coded separately as 0=no/1=yes responses. Additionally, we generated a separate composite variable that summed up the value of the three variables, as well as additional dichotomized variables for two more behavior questions: no self-report of having paid or received money for sex and having had sexual relations only with spouses or live-in partners (over the past 12 months). The resulting behavior score ranged between 0-5.

The degree of personal agency (independent variable) was conceptualized using two main questions: whether the responder had a role in decision-making about health-related issues, and whether she had a say in decisions regarding spending money. Moreover, a composite HIV knowledge score (independent variable for analysis) was calculated using questions on knowledge of protection against HIV through condom use, having a single partner, refusing the myth about contracting HIV by sharing food, and awareness

**Table 1. Definition of key analytic variables and score ranges**

Key analytic variables	Underlying questions (dichotomized and summed up for score)	Composite score range*
Agency	Being the sole or joint decision maker for health-related matters; Being the sole or joint decision maker for money-related matters	0-2
HIV knowledge	Agree that condoms are protective against HIV infection; Agree that having single partners reduces risk of HIV infection; Agree that HIV does not transmit by sharing food; Agree that otherwise healthy-looking individuals may be infected by HIV	0-4
Safe sex behavior	Have been tested for HIV in the past 12 months; Having used condom in last sexual encounters over past 12 months; Having one sexual partner or fewer over the past 12 months; Not having bought sex or being paid for sex over the past 12 months; All sexual partners are spouse or live-in partners during past 12 months	0-5

Notes: \*Composite scores were calculated by summing up the value to underlying dichotomous questions (0=incorrect response; 1=desired/correct response)

that otherwise healthy-looking individuals may be infected by HIV. Knowledge score was between 0-4 and a score of 3-4 was categorized as 'good knowledge'.

#### ANALYTIC APPROACH

In order to report basic demographic estimates, we applied appropriate survey weights for each country and a re-scaled weight to report totals. We used logistic regression to assess the impact of agency on condom use, having a single partner, and ever being tested for HIV. Furthermore, we used an ordinary least squares (OLS) model in a similar fashion for the scalar behavior score as a dependent variable. The regression models were adjusted for key covariates that potentially impact the relationship between dependent and independent variables of interest including age group (younger participant between 15-24 years old vs. older participants above 25 years old), education (no education/primary education vs. secondary education and higher), history of pregnancy, working in past 12 months, type of union (polygamous or not), living in urban vs. rural setting, and country-specific wealth index (based on household assets as calculated by PHIA). The causal link between behavior and HIV status is complex because of the endogeneity of having a positive HIV result and its subsequent impact on changing one's behavior. Therefore, we also controlled for HIV status in our association analyses. Finally, we included fixed effect for the countries in the models. We used survey weights provided by PHIA for each country and in the cases of Zambia and Malawi, we used module-specific weights since only a subsample of individuals were selected for knowledge questions. When running analysis on pooled sample, we re-scaled the weights according to sample size from each country since the sample size was unbalanced across the three countries (60% from Tanzania). All analyses were carried out using Stata 16, (StataCorp LLC, College Station, TX USA).

#### SENSITIVITY ANALYSIS

We assumed that education and wealth on one hand and knowledge of HIV and agency on the other, have high degrees of correlation that might pose a multiple collinearity

issue. While not affecting estimates for the coefficients in the model, multicollinearity can result in large standard errors, requiring larger sample sizes to achieve statistical significance at traditional confidence intervals, and increases the susceptibility of regression to sample size. Basically, some of the coefficients may not reach the level of significance because of the inflated confidence intervals. We examined the relationship between level of agency and major covariates in regression models to test for correlations and potential for multicollinearity. The agency score was significantly associated with older age, working status, education level, wealth and union type. The variance inflation factor (VIF) scores for the multicollinearity range for these variables remained under 7 (highest for union type with value of 6.88), except for a value of 37 for pregnancy. Knowledge score when added to the model was significantly and positively correlated with agency with a VIF value of 14.76. These results prompted us to run additional sensitivity analyses for our findings using least absolute shrinkage and selection operator (lasso) method ('lasso' command in Stata 16) in order to test the robustness of our findings. In estimating the lasso models, a cross validation cross-fit partialing-out estimator option (which is also known as double machine learning, split sample and re-sampling methodology) was used to help protect against the danger of over-fitting.<sup>21,22</sup> We used the full covariate set and used the local command to include all main-level and one-by-one interaction level of covariates for estimation. Using this command's capabilities, we used an expanded list of covariates for this analysis and included the Gini coefficient for inequality of wealth, wealth quintile and Gini quintiles, number of pregnancies, number of individuals dwelling in the responder's household, relationship of the respondent to the head of the household (self, spouse, co-spouse, other), sex of the head of the household, and HIV status of the head of the household. We used the individual's household Wealth Index provided by the PHIA in order to calculate a Gini coefficient for distribution of wealth at each region (separately calculated for each region of the three countries). Stata command 'fastgini' was used to calculate this coefficient and attributed it to each region of residence. The use of Lasso commands can be an effective technique for

addressing collinearity in logistic regression models.<sup>22</sup>

## RESULTS

Association analyses were conducted on 3,145 responders in Malawi (19%), 10,568 in Tanzania (63%), and 3,109 from Zambia (18%). Detailed background characteristics of the responders are summarized in [Table 2](#). Twenty-four percent of all responders were between 15-24 years old. The HIV positive rate was 7% in this sub-population of married adult women. Altogether, 13% of all married adult women, and 18% of younger women (15-24 years old) report they are not part of household decision-making regarding health behavior or spending money. Characteristics correlated with significantly higher levels of agency are a minimum level of secondary-level education, having a job outside the household, and living in a wealthy household. Results show women with no agency are more likely to live in polygamous unions (except in Malawi).

The overall rate of condom use was 8.2% in Malawi, 5.3% in Tanzania, and 9.7% in Zambia. In Tanzania and in the pooled sample, women lacking agency were significantly less likely to use condoms. The overall rate of having ever been tested for HIV ranged between 83%-92%, but when rates were classified by agency score, Tanzanian women without agency showed a significantly lower rate of being tested than their counterparts (76% vs. 83%-84%,  $P < 0.001$ ). The rate of having a single partner was very high among respondents in all countries, with an average of approximately 95%. Further, in bivariate comparison of groups with different levels of agency, Zambian women with no agency were less likely to have had a single partner over past 12 months (92%) compared to those with other levels of agency. See [Table 2](#) for detailed scores across agency and overall.

## GENERAL DETERMINANTS OF SEXUAL BEHAVIORS

Younger age, higher levels of education or wealth, living in rural areas, and living in non-polygamous marriages all show association with higher likelihood of condom use, *ceteris paribus*. Knowledge of HIV, by itself, did not increase the use of condoms. Even counterintuitively, when tested in Malawi, those with higher knowledge were significantly less likely to use condoms (odds ratio,  $OR=0.550$ , 95% confidence interval,  $CI=0.34-0.89$ ,  $P=0.015$ ). Pregnancy was the largest significant predictor for testing ( $OR=6.79$ , 95%  $CI=5.29-8.55$ ,  $P<0.001$ ). Being young, having higher education and more wealth increased the likelihood of having been tested for HIV. Knowledge of HIV increased the likelihood of being tested ( $OR=1.67$ , 95%  $CI=1.47-1.90$ ,  $P<0.001$ ). Contrary to condom use, living in rural areas decreased the likelihood of having been tested for HIV ( $OR=0.70$ , 95%  $CI=0.59-0.84$ ,  $P<0.001$ ). In the pooled sample, better education, monogamous marriage, and history of pregnancy were significant predictors of having a single sexual partner, but women who worked over the past 12 months showed significantly lower likelihood of single partners ( $OR=0.70$ , 95%  $CI=0.68-0.93$ ,  $P=0.005$ ). Detailed results of multivariate analysis of determinants of sexual behaviors are available in Tables S1-S4 in the **Online Supplementary Document**.

## IMPACT OF AGENCY ON BEHAVIOR SCORES

In Tanzania, married women with poor agency were less likely to have ever been tested for HIV ( $OR=0.75$ , 95%  $CI=0.61-0.93$ ,  $P=0.05$ ). In Zambia, having poor agency is associated with lower odds of having single partner sample ( $OR=0.66$ , 95%  $CI=0.45-0.95$ ,  $P=0.027$ ). We did not observe any significant association when Malawi women were examined as a separate group. [Table 3](#), model-1 summarizes the odds ratio of practicing safe sex with respect to presence of agency and higher knowledge of HIV. Of note, the last dependent variable in this table is behavior score for which linear regression was used to investigate the average change in score with lack of agency and high HIV knowledge as independent variables. All of these models are adjusted for age, pregnancy, working status, education, union/marriage type, urban/rural setting, wealth index, as well as HIV positive status. This table shows results on separate samples from each country as well as on the total pooled sample. The latter model included country dummy variables and used rescaled survey weights that adjusted for unbalanced number of responders from different countries.

## AGENCY AND IMPACT OF HIV KNOWLEDGE ON BEHAVIOR SCORE

In order to study any mediatory effect of agency on the role of knowledge in enhancement of sexual behaviors, we introduced interaction terms between knowledge and agency into the prediction models described before. Model-2 (in [Table 3](#)) uses same independent variables as model-1 but also includes an interaction term between agency and knowledge variables (both binary). In the pooled sample, when controlling for other factors, condom use was lower if responders had poor agency ( $OR=0.50$ , 95%  $CI=0.27-0.95$ ,  $P=0.034$ ), everything else equal. This means that women with low knowledge and poor agency had 50% lower odds of using condoms. Lasso analysis confirmed this observation ( $OR$  of condom use in the group with poor agency= $0.55$ , 95%  $CI=0.31-0.96$ ,  $P=0.037$ ). Interestingly, in the group with poor agency but good knowledge, the odds of condom use increased by twofold ( $OR=2.14$ , 95%  $CI=1.07-4.27$ ,  $P=0.032$ ). Results also show a significant positive effect of higher HIV knowledge when women have some degree of agency on testing ( $OR=1.82$ , 95%  $CI=1.53-2.17$ ,  $P<0.001$ ), and an increase in average behavior score ( $OR=0.18$ , 95%  $CI=0.12-0.24$ ,  $P<0.001$ ). However, higher knowledge among the group of women lacking agency did not significantly affect those outcomes in the pooled sample. In Tanzania, good knowledge among women with agency increased the odds of being tested for HIV by 60%, but among women lacking agency, good knowledge was associated with an almost equal decrease (65%) in the likelihood of having been tested. In Tanzania, there are some mixed effects: the composite behavior score in Tanzania improved with good knowledge [and presence of agency] (mean score increase= $0.254$ , 95%  $CI=0.196-0.311$ ,  $P<0.001$ ). Also, counterintuitively, those who have both low knowledge and poor agency showed a higher behavior score (score increase= $0.148$ , 95%  $CI=0.020-0.276$ ,  $P=0.023$ ). On the other hand, if a woman's knowledge was good but she lacked

**Table 2. Demographic and behavioral characteristics of married adult women (15 years and older) in each level of agency across three countries.**

	Zambia	Tanzania	Malawi	Total
<b>Number of respondents in the sample (% young: 15-24 years-old) ^</b>	3,109 (22.0%)	10,568 (23.7%)	3,145 (24.6%)	16,822 (23.6%)
<b>Agency score=0<sup>¶</sup></b>	524 (16.9%)	1,224 (11.6%)	473 (15.0%)	2,221 (13.2%)
<b>Younger age and agency score=0</b>	137 (20.0%)	407 (16.2%)	154 (19.9%)	698 (17.6%)
<b>Age (years)</b>				
agency score=0	32.3	32.1	31.7	31.8
agency score=1	32.6	33.3	32.1	32.8
agency score=2	33.9	35.4	33.9	34.8
<b>Average age (years)</b>	33.3	34.6	33.2	36.8
<b>Secondary education &amp; higher</b>				
agency score=0	20.1%***	11.6%***	12.9%**	13.2%***
agency score=1	29.3%	13.3%	16.6%	15.7%*
agency score=2	44.7%	18.4%	20.4%	21.2%
<b>Total</b>	36.8%	16.6%	18.5%	19.1%
<b>Working (past 12 months)</b>				
agency score=0	20.1%**	24.4%***	13.3%**	22.1%***
agency score=1	19.5%	26.6%	15.2%	24.6%
agency score=2	26.6%	32.7%	19.7%	30.7%
<b>Total</b>	23.8	30.5%	17.8%	28.3%
<b>Currently in polygamous union</b>				
agency score=0	17.7%**	25.0%***	11.2%ns	21.9%***
agency score=1	13.4%	19.3%	17.2%	18.5%
agency score=2	10.7%	17.0%	15.1%	16.3%
<b>Total</b>	15.2	16.5%	14.8%	17.5%
<b>Poor (lowest wealth index quintile)</b>				
agency score=0	24.1%***	31.4%***	20.5%**	28.9%***
agency score=1	20.8%	25.0%	12.7%	23.2%
agency score=2	13.3%	18.5%	13.9%	17.6%
<b>Total</b>	16.9%	21.4%	14.8%	20.3%
<b>HIV+ cases (prevalence)</b>				
agency score=0	11.77%ns	4.02%ns	10.76%ns	5.9%*
agency score=1	14.55%	5.09%	12.13%	6.77%
agency score=2	14.63%	5.45%	12.43%	7.91%
<b>Total</b>	14.12%	5.21%	12.10%	6.76%
<b>Recent HIV+ (past 130 days)</b>				
agency score=0	0.54%ns	0.24%ns	0ns	0.24%
agency score=1	0.29%	0.08%	0.22%	0.05%
agency score=2	0.12%	0.18%	0.09%	0.16%
<b>Total</b>	0.23%	0.15%	0.10%	0.15%
<b>Condom use (past 12 months)</b>				
agency score=0	7.2%ns	3.5%**	8.3%ns	4.7%**
agency score=1	10.4%	5.1%	7.6%	6.0%
agency score=2	10.2%	5.7%	8.3%	6.4%



	Zambia	Tanzania	Malawi	Total
<b>Total</b>	9.7%	5.3%	8.2%	6.1%
<b>Tested for HIV (ever)</b>				
agency score=0	89.7%ns	75.9%***	92.9%ns	80.3%**
agency score=1	92.0%	82.6%	93.4%	84.8%
agency score=2	91.2%	84.4%	91.6%	85.8%*
<b>Total</b>	91.2%	83.1%	92.2%	84.9%
<b>Single partner (past 12 months)</b>				
agency score=0	91.9%**	94.8%ns	96.3%ns	94.6%
agency score=1	93.2%	92.8%	96.2%	93.2%
agency score=2	95.4%	92.9%	96.2%	93.4%
<b>Total</b>	94.3%	93.1%	96.2%	93.5%
<b>Not having paid sex (past 12 months)</b>				
agency score=0	99.5%ns	97.0%ns	98.9%ns	97.6%
agency score=1	99.9%	96.9%	99.5%	97.5%
agency score=2	99.9%	96.8%	99.1%	97.4%
<b>Total</b>	99.8%	96.9%	99.1%	97.4%
<b>All partners spouse/live-in partners (past 12 months)</b>				
agency score=0	95.9%ns	92.2%ns	97.3%ns	93.5%*
agency score=1	96.6%	90.8%	98.4%	92.3%
agency score=2	97.1%	90.7%	97.9%	92.2%
<b>Total</b>	96.7%	90.9%	97.9%	92.4%

Notes: \* $P<0.05$ , \*\* $P<0.01$ , and \*\*\* $P<0.001$ :  $p$ -values are for difference across three levels of agency. ^ Survey weights were applied.

† No decision-making role in health or money-matters. Ns denotes not significant.

Source: Population-based HIV Impact Assessment (PHIA) Data<sup>20</sup>

agency, her behavior score significantly decreased (score change=-0.216, 95% CI=-0.371-(-0.060),  $P=0.007$ ).

To further clarify the implication of levels of knowledge and agency, we ran separate analyses on individuals with low- and high-levels of knowledge. We defined high knowledge as a knowledge score of 3 or 4 (max). As before, each behavior of interest and the composite behavior score were analyzed as dependent variables, with agency as an independent predictor along with other covariates used previously. The side-by-side comparison of the results on low-versus high-level of knowledge reveals that among women with poor knowledge of HIV, lack of agency showed a significant reduction in condom use by a magnitude of 50% reduction in OR, but any change in other behaviors did not reach the level of significance (Table 4).

#### SENSITIVITY ANALYSIS

The lasso regression (in Table 5) results confirmed the restrictive effect of lack of agency on condom use (OR=0.55, 95% CI=0.31-0.96,  $P=0.037$ ). It also supported the previous finding that among women with some level of agency, HIV knowledge increases the likelihood of ever being HIV tested

(OR=1.69, 95% CI=1.47-1.94,  $P<0.001$ ). More interestingly, lack of agency attenuated the impact of knowledge on behavior score showing a reduction in the behavior score even when responders had high HIV-related knowledge (change in score=-0.12295% CI=-0.238-(-0.007),  $P=0.038$ ).

#### DISCUSSION

We found evidence that personal agency is effective in reducing HIV risk by improving safe sexual behaviors among married adult women across three African countries. More importantly, we observed that lack of agency impedes the positive impact of good HIV-related knowledge on the adoption of some behaviors. To our knowledge, there is no currently available observational study looking at the moderating effect of agency on the relationship between knowledge and behavior in the context of HIV/AIDS in Africa. However, a few studies have been published looking into the (direct) role of agency in the uptake of certain protective behaviors which yielded mixed findings.<sup>23</sup>

**Table 3. Direct and indirect effect of agency and HIV knowledge on safe sex practices across each country and among pooled sample from all three study countries.**

	Country	Zambia		Tanzania		Malawi		Total (all 3 countries)	
Behavior		Model-1 <sup>†</sup> OR <sup>+</sup> (SE)	Model-2 <sup>†</sup> OR <sup>+</sup> (SE)	Model-1 <sup>†</sup> OR <sup>+</sup> (SE)	Model-2 <sup>†</sup> OR <sup>+</sup> (SE)	Model-1 <sup>†</sup> OR <sup>+</sup> (SE)	Model-2 <sup>†</sup> OR <sup>+</sup> (SE)	Model-1 <sup>†</sup> OR <sup>+</sup> (SE)	Model-2 <sup>†^</sup> OR <sup>+</sup> (SE)
Condom use (past 12 months)	NO agency	0.863 0.81	0.623 0.566	0.755 0.816	0.477 0.645	1.155 0.826	0.682 0.581	0.901 0.891	0.501* 1.38
	High knowledge	1.245 0.791	1.157 0.566	1.149 0.867	1.079 0.861	0.623** 0.8	0.55** 0.783	1.037 0.899	0.896 0.136
	Poor agency & High knowledge	--	1.464 0.543	--	1.846 0.61	--	1.842 0.56	--	2.136* 1.42
Tested for HIV (ever)	NO agency	1.059 0.85	1.487 0.747	0.752** 0.891	0.979 0.84	1.276 0.806	1.283 0.662	0.899 0.921	1.119 1.189
	High knowledge	1.893*** 0.857	2.16*** 0.838	1.49*** 0.924	1.589*** 0.919	2.659*** 0.832	2.609*** 0.816	1.672*** 0.937	1.821*** 1.093
	Poor agency & High knowledge	--	0.608 0.705	--	0.652** 0.805	--	0.994 0.616	--	0.770 1.228
Single partner (past 12 months)	NO agency	0.655** 0.826	1.023 0.668	1.132 0.853	1.718 0.721	0.913 0.776	0.5 0.589	0.899 0.898	1.070 1.275
	High knowledge	1.215 0.807	1.471 0.776	0.901 0.891	0.962 0.886	1.519 0.762	1.247 0.72	1.009 0.909	1.235 1.129
	Poor agency & High knowledge	--	0.561 0.634	--	0.564 0.689	--	2.145 0.546	--	0.830 1.323
Average Behavior Score (range 0-5)	NO agency <sup>+</sup>	-0.068 (0.046)	-0.034 (0.098)	0.003 (0.038)	0.148** (0.065)	0.028 (0.043)	-0.058 (0.118)	-0.009 (0.025)	0.032 0.062
	High knowledge <sup>+</sup>	0.074 (0.050)	0.086 (0.058)	0.225 (0.027)	0.254*** (0.029)	0.168** (0.052)	0.147** (0.058)	0.195*** (0.0215)	0.181*** 0.031
	Poor agency & High knowledge <sup>+</sup>	--	-0.043 (0.111)	--	-0.216** (0.079)	--	0.010 (0.126)	--	-0.046 0.069

Notes: \* $P < 0.05$ , \*\*  $P < 0.01$ , and \*\*\* $P < 0.001$ . OR denotes odds ratio. Main effect shown in "model-1" column, main effect and interaction shown in "model-2" column. Data presented as odds ratio (regression coefficient). Regression coefficients of other covariates in the model are not shown here (please refer to Tables S1-S4 in the Online Supplementary Document for further details). <sup>†</sup> Model-1: adjusted for: age group, history of pregnancy, working (past 12 months), education (below or over secondary-level), union type, residential setting (urban vs. rural), wealth index, HIV status, country dummies, the high/low level of knowledge (high=knowledge score of 3-4; low=knowledge score of 0-2).

<sup>†</sup> Model-2: adjusted for previous covariates in addition to interaction terms between agency (binary) and knowledge (binary).

<sup>^</sup> This analysis is using rescaled survey weights for each country to adjust the unbalanced sample size from the three countries.

<sup>+</sup> The statistics presented for behavior score is average change in behavior score (OLS coefficient and SE).

Source: Population-based HIV Impact Assessment (PHIA) Data<sup>20</sup>

**Table 4. Comparison of the effect of poor agency on safe sexual behaviors for women from Malawi, Tanzania, Zambia with low knowledge of HIV transmission versus those with high knowledge.**

Behavior	Low knowledge (score 0-2)		High knowledge (score 3-4)	
	Unadj. OR <sup>+</sup> (SE)	Adj OR <sup>†</sup> <sup>+</sup> (SE)	Unadj. OR <sup>+</sup> (SE)	Adj OR <sup>†</sup> <sup>+</sup> (SE)
Condom use (past 12 months)	0.574* 0.773	0.492* 1.380	0.89 0.89	1.090 1.151
Tested for HIV (ever)	1.013 0.905	1.223 1.194	0.778** 0.919	0.834 1.122
Single partner (past 12 months)	1.293 0.828	1.132 1.278	0.872 0.892	0.871 1.150
Average behavior score (range 0-5)	0.117** <sup>+</sup> 0.47	0.012 <sup>+</sup> 0.063	-0.0130 <sup>+</sup> 0.026	-0.012 <sup>+</sup> 0.031

Notes: \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ . OR denotes odds ratio; Unadj denotes unadjusted; Adj denotes adjusted; SE denotes standard error. The results are drawn from pooled sample of all three countries (Malawi, Tanzania, Zambia) <sup>†</sup> Adjusted for: age group, history of pregnancy, working (past 12 mo), education (below or over secondary level), union type, residential setting (urban vs. rural), wealth index, HIV status, country dummies. The analysis is using rescaled survey weights for each country <sup>+</sup> The statistics presented for behavior score is average change in behavior score (OLS coefficient and SE). Source: Population-based HIV Impact Assessment (PHIA) Data<sup>20</sup>

Lack of agency coupled with low-HIV knowledge reduces the odds of condom use in the pooled sample. Through a lasso regression sensitivity analysis, we confirmed that lack of agency reduces condom use among women cumulatively from all three countries; however, this effect was undetected in a separate analysis of each country individually. This inconsistency in findings may be attributed to low overall rate of condom use, which is below 10% in all observed countries and the distributional effect of each of the independent variables, rendering agency obscure. Previous research reports that women have indicated feeling stigmatized when asking to use a condom.<sup>14</sup> This fear of shame, compounded with lack of agency and insufficient knowledge of HIV prevention, arguably further decreases the possibility for success of safe sex practices. These results reveal that the extremely low rate of condom use among married women can be attributed to many factors hidden from regular databases and analyses, and that the dynamic of power and decision making between partners is justifiably significant.

Our results correspond to previous findings in Tanzania. Bashemera et al.<sup>12</sup> reports that HIV testing is positively associated with empowerment for both groups of women who did and did not have a recent childbirth in the past five years. As our results show, the role of agency in promotion of testing is robustly significant beyond the effect of improved access through antenatal visits (we controlled for history of pregnancy). What this study adds to the literature

is showing the interaction between knowledge and agency, as lack of agency among women with good HIV knowledge reduced the likelihood of HIV testing compared to their counterparts. This is significant because antenatal care is widely promoted in Tanzania which facilitates access to HIV testing, but according to these findings, lack of agency would be barrier for success of these efforts.

We created a composite measure to quantify risk behavior in a more comprehensive way over the entire sample. The lasso results, which are robust to multicollinearity and relatively small sample size, reveal the impact of women's lack of agency in increasing risk behavior and blunting the effect of knowledge. Once cumulative behavior measures are established and studied for larger samples, detailed analyses of individual behaviors and vulnerable populations are warranted to assess nuances and their policy implications among certain pockets of populations that are otherwise different in terms of type of risky behavior. For instance, women in urban/rural settings and different types of unions may each show a prominent type of risky behavior, such as very low condom use among older married women towards the later edge of reproductive years, having multiple partners among women in areas that are afflicted by poverty and inequality, or cultural or gender norms that prohibit very young women who have been a child-bride to make decisions for getting tested or use protection.



**Table 5. Odds ratio of separate behaviors (presented in rows) for individuals with low agency using lasso regression.**

Variable	Main effect <sup>§</sup>			Model with interaction <sup>¥</sup>				
	Odds Ratio for poor agency (SE)	Number of obs.	Possible combinations of covariates (number retained)	Odds Ratio for poor agency (SE)	Odds Ratio for good knowledge (SE)	Odds Ratio for poor agency AND good knowledge (SE)	Number of obs.	Possible combinations of covariates (number retained)
Condom use (past 12 months)	0.899 (0.078)	17,599	159 (29)	0.549** (0.158)	0.945 (0.120)	1.776 (0.563)	11,929	159 (48)
Tested for HIV (ever)	0.833** (0.056)	20,426	159 (36)	0.989 (0.141)	1.691*** (0.120)	0.811 (0.138)	14,065	159 (49)
Single partner (past 12 months)	0.981 (0.091)	20,349	159 (21)	1.141 (0.260)	1.081 (0.106)	0.728 (0.187)	13,998	159 (43)
Average behavior score <sup>+</sup> (range 0-5)	0-0.037 (0.025) <sup>+</sup>	14,113	162 (40)	0.072 (0.05) <sup>+</sup>	0.208*** (0.025)	-0.122** (0.06) <sup>+</sup>	14,078	159 (59)

Notes: \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ . SE denotes standard error; obs denotes observations.

<sup>§</sup> Controls in the model include: age group, history of pregnancy, working (past 12 months), education (below or over secondary-level), union type, residential setting (urban vs. rural), wealth index, HIV status, country dummies, and the high/low level of knowledge, Gini coefficient for inequality of wealth, wealth quintile and Gini quintiles, number of pregnancies, number of individuals dwelling in the responder's household, relationship of the respondent to the head of the household (self, spouse, co-spouse, other), sex of the head of the household, and HIV status of the head of the household. STATA tests inclusion of all these covariates and their one-to-one interactions into the model, automatically removing collinear controls (for details on lasso regression command, please refer to the methodology section)

<sup>¥</sup> Controls in the model: same as the previous model, knowledge and the interaction of knowledge X agency are forced into the model.

<sup>+</sup> The statistics presented for behavior score is average change in behavior score (linear regression coefficient and SE).

Source: Population-based HIV Impact Assessment (PHIA) Data<sup>20</sup>

## LIMITATIONS

Because of the observational and cross-sectional nature of available data, direct causal inferences are not possible. Despite this limitation, large observational surveys are the more generalizable sources of data, enabling the researchers to recognize associations in support of theories of behaviors that account for the complex nature of decision making and forming behaviors. It is important to note that like any cross-cultural and multi-national studies, there is considerable heterogeneity in the sample with respect to social and structural factors that affects the outcome. This study uses socioeconomic and residential factors, as well as country dummies to adjust for some of those differences. However, there are other factors that will remain unobserved in the error term. This issue potentially weakens the ability of the study to identify significant associations but does not invalidate the significant results presented here. A major limitation was that a large number of respondents had missing values for agency questions and were eliminated from the sample (22%). This impacts the generalizability of the findings. We specifically caution about the rates observed for individual behaviors which may not be generalized to the population level. However, the associations of interest within the sample at hand provides evidence in support of our hypothesis about implications of agency in the practice of safe sex in the study countries. Further studies with ample sample size are required to make inferences about this particular population (married women) in these countries and with specific attention to the role of agency and its impact on knowledge and behavior.

## CONCLUSIONS

Agency enhances use of more protective sexual behaviors. Additionally, lack of agency inhibits knowledge of HIV to translate into safer actions, indicating that arming women with awareness and knowledge is not sufficient to protect those who are not empowered to act in their own self-interest. The DREAMS approach to HIV prevention focuses on empowerment as a defense for young women with specific methods of strengthening community and building assets to be available to girls.<sup>24</sup> Specific attention to increased autonomy at an early age, and potentially enabling regular access to money on a small scale, not just for times of emergency, could be a method to increasing decision-making abilities specifically on financial matters and, in turn, empowerment.

## FINDING WEAKNESSES IN CURRENT STRATEGIES TO REACH UNAIDS 90-90-90 GOALS

Though current possibilities of measuring agency are limited, women's agency may be an important factor to consider in planning for UNAIDS 90-90-90 targets, understanding antiretroviral treatment (ARV) adherence differentials and viral load (VL) suppression and other areas of compliance.<sup>25</sup> Looking at differences in agency can provide clues for potential strategies to improve local response to HIV/AIDS within the context of receiving global aid. For instance, Tanzania has close to 5% HIV prevalence among its

adult female population (much lower than the other two study countries with greater than 10% infection rate), but according to the 90-90-90 goals, merely 60.6% of Tanzanian men and women are aware of their HIV status. This poses a major risk of transmission. As a case in point, the rate of mother-to-child transmission accounts for 18% of new cases in Tanzania annually, which is higher than other two countries.<sup>26</sup> This indicates a blind spot in program planning and an opportunity for intervention. While antenatal care is widely provided in Tanzania (received by about 97% of pregnant women,<sup>27</sup>) HIV testing among women has room for improvement (83% in our sample of adult, married women). We found that lack of agency decreases likelihood of being tested, and even blunts the effect of HIV-related knowledge on opting for testing.

Also, of importance is the significant association of poor agency with having had more than one sexual partner in Zambia. Zambia has the highest HIV prevalence (14%) among these three countries, with reports of incidence rate of 8.3-9.3% for younger and older adult women. Zambia showed a higher rate of 'no agency' compared to Tanzania and Malawi (16% vs. 12% and 14%, respectively). Zambia is also trailing the other two countries with respect to 90-90-90 goals (71-87-59), and our findings on aforementioned behaviors showed that Zambian women with no agency were more likely to have multiple partners compared to women in Tanzania and Malawi. This creates an opportunity to focus on the intersection of agency and partner dynamics in this country.

## IMPLICATIONS FOR FUTURE RESEARCH

There is great need for in-depth qualitative research to gain a better understanding of the dynamics and contextual factors that affect agency for married adult women at risk for HIV in African countries, but perhaps more importantly, reaching some consensus on the way to measure this concept. Advanced research on agency in the context of health care behavior will require more attention to survey instrument designs. Widely used databases that collect key information on nationally representative samples, such as DHS and PHIA, simply lack cross-country consistency in measuring agency. For instance, the questions pertaining to decision-making agency are part of the 'gender norm' module in PHIA surveys and are not part of the core individual questionnaire. Therefore, some key demographic groups, such as women with no history of marriage, are not represented. A generalizable and robust assessment of the level of agency across generations and different demographics is necessary.

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#### AUTHORSHIP CONTRIBUTIONS

Study design and review: RS, GG, WB, ED, AN; computation and analysis: RS, GG, WB, ED; literature review: RS, JB, FN;

writing: RS, JB, GG; policy review and conclusions: RS, GG, WB, ED, AN.

#### COMPETING INTERESTS

The authors have completed the Unified Competing Interest form from <http://www.icmje.org/disclosure-of-interest/> (available upon request from the corresponding author) and declare no conflicts of interest.

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## SUPPLEMENTARY MATERIALS

### Online Supplementary Document

Download: <https://www.joghr.org/article/26104-lack-of-agency-and-sexual-behaviors-among-married-women-a-study-of-population-based-hiv-impact-assessment-phia-surveys-in-malawi-tanzania-and-zamb/attachment/66099.docx>

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