Examining the influence of contextual factors on risky sexual behavior among young women in Zomba district, Malawi: A multilevel analysis

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EXAMINING THE INFLUENCE OF CONTEXTUAL FACTORS ON RISKY SEXUAL BEHAVIOR AMONG YOUNG WOMEN IN ZOMBA DISTRICT, MALAWI: A MULTILEVEL ANALYSIS

A dissertation submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

PUBLIC HEALTH

by

Melissa Kari Ward-Peterson

2017
To: Dean Tomás R. Guilarte  
Robert Stempel College of Public Health and Social Work

This dissertation, written by Melissa Kari Ward-Peterson, and entitled Examining the Influence of Contextual Factors on Risky Sexual Behavior among Young Women in Zomba District, Malawi: A Multilevel Analysis, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Kristopher Fennie, Major Professor

Date of Defense: September 5, 2017

The dissertation of Melissa Kari Ward-Peterson is approved.

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Vice President for Research and Economic Development  
Dean of the University Graduate School

Florida International University, 2017
DEDICATION

This dissertation is dedicated to my grandmothers, Winnie Ward and Barbara Bryan Rojas. Thank you for your tenacity and sacrifice.
ACKNOWLEDGMENTS

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I would also like to thank my family. To my husband and partner, Chris: thank you for your endless support and for cheering me on through the highs and lows of this journey. To my parents, Barby and Peter: thank you for all of the times you answered my questions by handing me a book and telling me to figure it out on my own. You made me a lifelong learner, and I am forever grateful for that. To my siblings, Linda, Ben, and Faith: thank you for helping me to see the world in different ways.

And, to all of the incredible people that have impacted my life since I began my journey in public health 10 years ago: words cannot express how grateful I am for you. You come from more than 15 countries and 23 states. You are nurses, social workers, activists, doctors, builders, writers, poets, potters, engineers, creatives, teachers, academics, political strategists, communicators, lawyers, consultants, veterans, educators,
entrepreneurs, bankers, computer programmers, sociologists, biologists, academics, clergy, statisticians, epidemiologists, policy wonks, fitness instructors, journalists, professional travelers. You work in finance, non-profits, advocacy, state and federal agencies, higher education, public health, international development, high schools, space exploration, software development, construction, real estate, hospitality, health care. You empower women, build businesses, support at-risk youth, feed the hungry, and give voice to the voiceless. You represent every major religion and span the political spectrum. You have made me a better researcher, and a better human. Thank you for being a part of my story.
ABSTRACT OF THE DISSERTATION

EXAMINING THE INFLUENCE OF CONTEXTUAL FACTORS ON RISKY SEXUAL BEHAVIOR AMONG YOUNG WOMEN IN ZOMBA DISTRICT, MALAWI: A MULTILEVEL ANALYSIS

by

Melissa Kari Ward-Peterson

Florida International University, 2017

Miami, Florida

Professor Kristopher Fennie, Major Professor

The objective of this study was to examine the association between risky sexual behavior and contextual factors related to economic resources, woman’s empowerment, and health facility characteristics among young women in Zomba district, Malawi. Secondary analyses of the Schooling, Income, and Health Risk (SIHR) study were undertaken. Four outcomes related to risky sexual behavior were examined: if participants had ever had sex, consistent condom use, and two scores measuring risk related to partner history and age during sexual activity. Regression models with cluster-robust standard errors and multilevel regression models were used to estimate associations; analyses were stratified by school enrolment status at baseline of the SIHR study and utilized weights to account for SIHR sampling design.

For participants in school at baseline, the percent of girls enrolled in school at the community level was associated with ever having sex and consistent condom use. Belief in the right to refuse sex was protective against ever having sex, lower household education was associated with higher odds of ever having sex, and near rural and far rural
residence was associated with decreased odds of condom. For participants not in school at baseline, lower individual education was associated with riskier scores related to age and partner history and lower household education was associated with lower age during sexual activity. Private or non-governmental health facilities were associated with decreased odds of condom use and higher age during sexual activity. In both strata, increasing age and near rural residence (within 16 kilometers of urban center) increased odds of ever having sex; lower educational achievement was associated with lower age during sexual activity. A history of pregnancy was associated with lower odds of condom use and riskier partner history.

Risky sexual behavior is multifaceted and complex. While various factors related to women’s empowerment played a role, the most consistent variables associated with risky sexual behavior were those related to education. Interventions and programs seeking to reduce risky sexual behavior among young women, thereby reducing their risk of HIV infection, should continue to focus on improving access to education at multiple levels.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION ...............................................................</td>
<td>1</td>
</tr>
<tr>
<td>Aims of the Dissertation ..................................................</td>
<td>5</td>
</tr>
<tr>
<td>References .................................................................</td>
<td>7</td>
</tr>
<tr>
<td>MANUSCRIPT 1 ..............................................................</td>
<td>11</td>
</tr>
<tr>
<td>Abstract .................................................................</td>
<td>11</td>
</tr>
<tr>
<td>Introduction ..............................................................</td>
<td>12</td>
</tr>
<tr>
<td>Materials and Methods ....................................................</td>
<td>14</td>
</tr>
<tr>
<td>Results .................................................................</td>
<td>16</td>
</tr>
<tr>
<td>Discussion ..............................................................</td>
<td>21</td>
</tr>
<tr>
<td>Conclusions .............................................................</td>
<td>24</td>
</tr>
<tr>
<td>References .............................................................</td>
<td>24</td>
</tr>
<tr>
<td>Tables and Figures .......................................................</td>
<td>36</td>
</tr>
<tr>
<td>MANUSCRIPT 2 ..............................................................</td>
<td>83</td>
</tr>
<tr>
<td>Abstract .................................................................</td>
<td>83</td>
</tr>
<tr>
<td>Introduction ..............................................................</td>
<td>83</td>
</tr>
<tr>
<td>Materials and Methods ....................................................</td>
<td>85</td>
</tr>
<tr>
<td>Results .................................................................</td>
<td>91</td>
</tr>
<tr>
<td>Discussion ..............................................................</td>
<td>93</td>
</tr>
<tr>
<td>Conclusions .............................................................</td>
<td>96</td>
</tr>
<tr>
<td>Supplement 1. Methods for computing risky sexual behavior indices</td>
<td>96</td>
</tr>
<tr>
<td>Supplement 2. Methods for computing community-level composite indicators</td>
<td>98</td>
</tr>
<tr>
<td>References .............................................................</td>
<td>99</td>
</tr>
<tr>
<td>Tables and Figures .......................................................</td>
<td>103</td>
</tr>
<tr>
<td>MANUSCRIPT 3 ..............................................................</td>
<td>117</td>
</tr>
<tr>
<td>Abstract .................................................................</td>
<td>117</td>
</tr>
<tr>
<td>Introduction ..............................................................</td>
<td>118</td>
</tr>
<tr>
<td>Materials and Methods ....................................................</td>
<td>119</td>
</tr>
<tr>
<td>Results .................................................................</td>
<td>123</td>
</tr>
<tr>
<td>Discussion ..............................................................</td>
<td>127</td>
</tr>
<tr>
<td>Conclusions .............................................................</td>
<td>131</td>
</tr>
<tr>
<td>References .............................................................</td>
<td>131</td>
</tr>
<tr>
<td>Tables and Figures .......................................................</td>
<td>135</td>
</tr>
<tr>
<td>CONCLUSIONS ..............................................................</td>
<td>143</td>
</tr>
<tr>
<td>References .............................................................</td>
<td>145</td>
</tr>
<tr>
<td>VITA .................................................................</td>
<td>146</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1-1. Search strategy for identifying studies using multilevel models to evaluate the influence of contextual factors on HIV/AIDS, STIs, and risky sexual behavior in sub-Saharan Africa by keyword</td>
<td>36</td>
</tr>
<tr>
<td>Table 1-2. Studies utilizing multilevel models to evaluate the impact of a contextual-level intervention on individual-level HIV/AIDS-related outcomes in sub-Saharan Africa</td>
<td>37</td>
</tr>
<tr>
<td>Table 1-3. Studies utilizing multilevel models to evaluate the associations between contextual-level factors and HIV/AIDS or risky sexual behavior-related outcomes in sub-Saharan Africa, sorted by study design</td>
<td>41</td>
</tr>
<tr>
<td>Table 1-4. Ratings for randomized controlled trials or cohort studies using the Quality Assessment Tool for Quantitative Studies</td>
<td>80</td>
</tr>
<tr>
<td>Table 1-5. Ratings for cross-sectional studies using an adapted Quality Assessment Tool for Quantitative Studies</td>
<td>81</td>
</tr>
<tr>
<td>Table 2-1. Characteristics of baseline schoolgirls and dropouts in the control group of the Schooling, Income, and Health Risk study in Zomba District Malawi</td>
<td>103</td>
</tr>
<tr>
<td>Table 2-2. Characteristics of baseline schoolgirls and dropouts in the control group of the Schooling, Income, and Health Risk study in Zomba District Malawi</td>
<td>104</td>
</tr>
<tr>
<td>Table 2-3. Associations between multilevel factors related to economic factors and women’s autonomy with ever having sex and age factor score among schoolgirls in Zomba district, Malawi</td>
<td>105</td>
</tr>
<tr>
<td>Table 2-4. Associations between multilevel factors related to economic conditions and women’s autonomy with condom use and partner history factor score among schoolgirls in Zomba district, Malawi</td>
<td>108</td>
</tr>
<tr>
<td>Table 2-5. Associations between multilevel factors related to economic conditions and women’s autonomy with risky sexual behavior among dropouts in Zomba district, Malawi</td>
<td>110</td>
</tr>
<tr>
<td>Table 3-1. Age and partner history factor loadings, by school enrolment status at baseline of the Schooling, Income, and Health Risk Study, Zomba, Malawi</td>
<td>135</td>
</tr>
</tbody>
</table>
Table 3-2. Characteristics of schoolgirls and dropouts in the control group at Round 2 of the Schooling, Income, and Health Risk study, Zomba district, Malawi 136

Table 3-3. Associations between multilevel factors and risky sexual behavior outcomes among young women in the schoolgirl stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi 138

Table 3-4. Associations between multilevel factors and Partner History Factor score among young women in the schoolgirl stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi 139

Table 3-5. Associations between multilevel factors and risky sexual behavior outcomes among young women in the school dropout stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi 140
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS</td>
<td>acquired immunodeficiency syndrome</td>
</tr>
<tr>
<td>ASSIA</td>
<td>Applied Social Sciences Index and Abstracts</td>
</tr>
<tr>
<td>CINAHL</td>
<td>Cumulative Index to Nursing and Allied Health Literature</td>
</tr>
<tr>
<td>DHS</td>
<td>Demographic and Health Surveys</td>
</tr>
<tr>
<td>HIV</td>
<td>human immunodeficiency virus</td>
</tr>
<tr>
<td>HSV-2</td>
<td>herpes simplex virus 2</td>
</tr>
<tr>
<td>ICC</td>
<td>intraclass correlation coefficient</td>
</tr>
<tr>
<td>IPV</td>
<td>intimate partner violence</td>
</tr>
<tr>
<td>MeSH</td>
<td>medical subject heading</td>
</tr>
<tr>
<td>MLM</td>
<td>multilevel model</td>
</tr>
<tr>
<td>OVC</td>
<td>orphans and vulnerable children</td>
</tr>
<tr>
<td>PEPFAR</td>
<td>President’s Emergency Plan for AIDS Relief</td>
</tr>
<tr>
<td>PMTCT</td>
<td>prevention of mother-to-child transmission</td>
</tr>
<tr>
<td>PRISMA-P</td>
<td>Preferred Reporting Items for Systematic review and Meta-Analysis Protocols</td>
</tr>
<tr>
<td>PROSPERO</td>
<td>International Prospective Register of Systematic Reviews</td>
</tr>
<tr>
<td>QATQS</td>
<td>Quality Assessment Tool for Quantitative Studies</td>
</tr>
<tr>
<td>RCT</td>
<td>randomized controlled trial</td>
</tr>
<tr>
<td>RSB</td>
<td>risky sexual behavior</td>
</tr>
<tr>
<td>SIHR</td>
<td>Schooling, Income and Health Risk Study</td>
</tr>
<tr>
<td>SSA</td>
<td>sub-Saharan Africa</td>
</tr>
<tr>
<td>SES</td>
<td>socioeconomic status</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>STI</td>
<td>sexually transmitted infection</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
</tbody>
</table>
INTRODUCTION

Risky sexual behavior, including early sexual debut and sexual activity without condoms, is a critical factor in the causal pathway for human immunodeficiency virus (HIV) (1). HIV attacks the immune system, causing acquired immunodeficiency syndrome (AIDS) which eventually leads to death (2). Despite recent progress marked by an 11% reduction in new infections since 2010, HIV remains a global challenge (3). Sub-Saharan Africa (SSA) carries approximately 70% of the world’s HIV burden, a disproportionate amount considering it is home to only 16% of the world’s population (4-6). While there are a number of ways HIV can be transmitted, heterosexual sexual activity is the most common mode of transmission in SSA (4). Reducing risky sexual behavior can reduce the incidence of HIV (7).

There has been progress in SSA, with a 29% decrease in the number of new HIV infections in eastern and southern Africa between 2000 and 2016 (3). However, more progress is needed, particularly for women, who carry approximately 58% of the burden in SSA (3). Young women are particularly vulnerable: HIV acquisition affects a young woman’s educational outlook and economic productivity, puts the health of her future children at risk, and can further destabilize a household which may already be living in extreme poverty (8, 9).

This is the case in Malawi, a small, landlocked country located in southeastern Africa and bordered by Zambia, Tanzania, and Mozambique. It has a very young population: of its approximate 18.57 million residents, 46.5% are below the age of 15 (10). Although it is politically stable, Malawi is one of the poorest country in the world
with a gross domestic product per capita of $301 (11). Approximately 71\% of the population lives below the international poverty line of $1.90 per day (12). Malawi has one of the worst life expectancies (61.2 years) and one of the highest fertility rates (5.54 children per woman) in the world. Health infrastructure is weak, with 0.02 physicians and 1.3 hospital beds per 1,000 population (10).

The first case of AIDS in Malawi was diagnosed in 1985 (13). Currently, Malawi has a generalized HIV epidemic with a 2015 estimated adult prevalence of 9.1\%, the ninth highest HIV prevalence in the world, as well as in the region (14, 15). Overall, the adult prevalence of HIV has decreased, declining from an estimated 15.2\% in 2003 (16). The annual HIV incidence rate has decreased to an estimated 0.38\% from 1.33\% in 2003 (16). The infrastructure available to combat HIV has improved dramatically as well: between January 2004 and December 2005, the number of public facilities offering antiretroviral therapy increased from nine, serving approximately 4,000 patients, to sixty, serving close to 37,480 patients (17).

While women are biologically more vulnerable to sexual transmission of HIV, contextual factors that may lead to risky sexual behavior exacerbate this vulnerability (8, 18). The influence of contextual factors—social, political, economic, or environmental—on health and health behavior is well-documented in the literature (19-23). The social determinants of adolescent health and HIV infection have been examined by numerous researchers (24, 25). Relevant conceptual frameworks can be drawn from the social
capital literature, as well as work that combines behavioral and biological mechanisms of disease transmission (26, 27).

In Malawi, the contextual factors related to risky sexual behavior are complex. A known driver of risky sexual behavior among young women is transactional sex. Due to economic hardships, young girls may decide to date and have sex with older men in exchange for gifts or economic support (18, 28). Women living in communities with increased economic development may not face the same pressures to engage in risky sexual behavior compared to women who do not. Education is another factor that has implications for HIV prevention. Additionally, sociocultural norms driven by factors such as a community’s tribe or religion may affect risky sexual behavior (29-32). Women living in communities where women have higher social status may be more empowered to negotiate condom use in sexual encounters, and may have more autonomy in choosing their partners (29-32). Furthermore, some evidence suggests access to voluntary counseling and testing (VCT) services may be important for behavior change and HIV prevention (33, 34).

These contextual factors have partially led to the gender disparities evident in Malawi’s HIV distribution. Among men aged 15-49, HIV prevalence decreased from 10.2% to 8.3% between 2004 and 2015-2016. The same gains were not observed among women aged 15-49, who had HIV prevalence of 13.3% in 2004 and 12.2% in 2015-2016 (35, 36). In urban settings, HIV prevalence among women aged 15-49 is 17.8% compared to 11.0% among men of the same age (36). The disproportionately higher prevalence among women compared to men holds among the young population: 3.3% for
women aged 15-19 as compared to 1.0% among men of the same age, and 6.4% compared to 1.1% for women and men aged 20-24, respectively (36). The difference between women and men aged 15-24 is even more pronounced in the Southern region of Malawi (6.3% versus 1.6%, respectively), among those with no education (7.2% versus 1.7%, respectively), and in urban settings (9.1% versus 1.0%, respectively) (36).

The complexity of contextual factors suggest structural interventions may be effective prevention strategies. The Schooling, Income, and Health Risk (SIHR) study, conducted by Baird and colleagues, was a cluster randomized trial examining the effect of an intervention addressing poverty and education on sexual behavior and the prevalence of HIV and herpes simplex virus 2 (HSV-2) among young women in Zomba District, located in the Southern Region of Malawi (37). Zomba District includes both a large rural population and an urban center in Zomba City, one of Malawi’s four large cities (38). Agriculture represents 87% of economic activity; farming and fishing, supported by Lake Chilwa in eastern Zomba district, are the main agricultural activities. A 2009 profile of Zomba District reported that 97% of adults 15 years and older were employed in some way. However, most residents of Zomba District did not receive a formal income (38). In 2008, only 6% of the population received a regular income. A vast majority of the population was unpaid or received casual payments. The average household lived on 183 Malawian kwacha, or approximately $0.39 per day, well under the international poverty line of $1.90 per day (12, 38). As of 2009, Zomba District was the third poorest district in Malawi (38). In 2015-2016, HIV prevalence among women aged 15-49 in Zomba District was 16.8%, compared to 9.3% among men (36).
The SIHR intervention consisted of a cash transfer program. The study included two cohorts: girls who were enrolled in school at baseline and girls who were not. Among baseline schoolgirls, the experimental arm of the study was subdivided into a conditional cash transfer group, in which receiving the cash transfer was contingent upon attending school regularly, and an unconditional cash transfer group. Among baseline dropouts, the experimental arm consisted only of conditional cash transfers. The control group in both cohorts received no cash transfers (37). Among the baseline schoolgirls, results showed a decrease in risky sexual behaviors and lower prevalence of HIV and HSV-2 in the intervention group (those receiving cash transfers) compared to those in the control group (37). These findings strengthen the argument that improving education and reducing poverty has a positive influence on HIV-related behaviors and outcomes.

Aims of the Dissertation

While the SIHR study is the only cash transfer intervention to date to show better HIV outcomes among the intervention group, other conditional cash transfer programs have had positive effects on the upstream drivers of HIV risk, including risky sexual behavior, health service utilization, poverty, and gender inequities, highlighting the potential of structural interventions to prevent HIV (8, 39, 40). However, the influence of higher-level contextual factors—such as community-level economic activity, women’s empowerment, and health services offered in the community—on risky sexual behavior has not been fully explored in Malawi and warrants further investigation.
The primary aim of this dissertation is to determine whether contextual factors are related to risky sexual behavior among a representative, weighted sample of young women in Zomba District, Malawi, by examining the following specific aims:

Specific Aim 1: To examine the ways in which economic contextual factors affect risky sexual behavior.

Specific Aim 2: To examine the ways in which sociocultural contextual factors, specifically those related to women’s empowerment, affect risky sexual behavior.

Specific Aim 3: To examine the ways in which contextual factors related to health services proximal to HIV risk affect risky sexual behavior.

These aims were examined through several studies and secondary analyses of data available from the control group of the SIHR study. The results of the dissertation are presented here in three manuscripts. The first manuscript is a systematic review which sought to describe the use of multilevel models in evaluating the influence of contextual factors on HIV/AIDS, sexually transmitted infections, and risky sexual behavior in sub-Saharan Africa. The second manuscript sought to examine the ways in which economic contextual factors and women’s empowerment in the community are associated with risky sexual behavior (Specific Aims 1 and 2). The final manuscript examined the ways in which health services and facility characteristics, as well as other factors related to HIV awareness, are associated with risky sexual behavior (Specific Aim 3).
References


Using multilevel models to evaluate the influence of contextual factors on HIV/AIDS, STIs, and risky sexual behavior in sub-Saharan Africa: a systematic review

Abstract

**Purpose.** To describe the use of multilevel models (MLMs) in evaluating the influence of contextual factors on HIV/AIDS, sexually transmitted infections (STIs), and risky sexual behavior (RSB) in sub-Saharan Africa. **Methods.** Ten databases were searched through May 29, 2016. Two reviewers completed screening and full-text review. Studies examining the influence of contextual factors on HIV/AIDS, STIs, and RSB and utilizing MLMs for analysis were included. The Quality Assessment Tool for Quantitative Studies was used to evaluate study quality. **Results.** A total of 118 studies met inclusion criteria. Seventy-four studies focused on HIV/AIDS-related topics; forty-six focused on RSB. No studies related to STIs other than HIV/AIDS met the eligibility criteria. Of five studies examining HIV serostatus and community socioeconomic factors, three found an association between poverty and measures of inequality and increased HIV prevalence. Among studies examining RSB, associations were found with numerous contextual factors, including poverty, education, and gender norms. **Conclusions.** Studies utilizing MLMs indicate that several contextual factors, including community measures of socioeconomic status and educational attainment, are associated with a number of outcomes related to HIV/AIDS and RSB. Future studies utilizing MLMs should focus on contextual-level interventions in order to strengthen the evidence base for causality.
Keywords: multilevel analysis; HIV; sexually transmitted diseases; sexual behavior; sub-Saharan Africa; social determinants of health

Introduction

Multilevel models (MLMs), also referred to as hierarchical linear models or mixed-effects models, allow researchers to account for both ecological, or contextual, and individual-level, or compositional, variables. While other statistical methods (including population-averaged methods, such as cluster-robust standard errors and generalized estimating equations) may be used to account for potential clustering of data collected within hierarchical structures, MLMs are unique because they provide estimates of variance for contextual-level units (1). For example, a researcher interested in exploring how community-level factors influence the prevalence of HIV/AIDS among individuals might collect data at both the community (or contextual) and individual (or compositional) levels. Analysis with population-averaged methods adjusts variance estimates to account for the clustered-nature of the data. However, analysis with MLMs will provide the researcher with the additional information of variance estimates at the community level (1). Such information may be useful when determining if a community intervention is appropriate, and if such an intervention has potential to influence individual-level health outcomes.

Relatively recent advances in the computational abilities of statistical programs have made MLMs more accessible to researchers. While MLMs were developed and have been utilized extensively in other fields, they have recently gained popularity within epidemiology to examine the contextual factors, such as community or household
variables, that may be part of the causal pathway for various health outcomes. MLMs are particularly useful in interpreting clustered data, causal processes that occur at multiple levels, and variation and heterogeneity--inferences that might be incorrectly made through the use of single-level modelling (2).

Montgomery and Hewett examined Demographic and Health Survey data and found that poor communities in developing countries are not homogenous, noting a need for future research related to contextual factors in these settings (3). Given the complexity of the processes leading to HIV/AIDS, sexually transmitted infections (STIs), and risky sexual behavior (RSB), MLMs may be particularly useful for exploring how contextual factors might influence these outcomes at the individual level. For example, how might community-level poverty influence RSB among adolescent girls and young women? A scoping search conducted by the authors showed that, to date, no systematic review has been undertaken to describe the use of MLMs for such outcomes in sub-Saharan Africa (SSA).

The objective of this systematic review was to describe the use of MLMs in evaluating the influence of contextual factors on HIV/AIDS, STIs, and RSB in SSA. We addressed the following questions: 1) to what extent are MLMs being used to evaluate the impact of interventions related to contextual factors on HIV/AIDS, STIs, and RSB in SSA; 2) what do the results of MLMs indicate about the role of contextual factors in HIV/AIDS, STIs, or RSB in SSA; 3) in what settings are MLMs being used for analysis of the influence of contextual factors on HIV/AIDS, STIs, and RSB in SSA; 4) among what populations are MLMs being used to analyze the influence of contextual factors on
HIV/AIDS, STIs, and RSB in SSA; 5) for non-interventional studies, which study designs utilize MLMs to analyze the influence of contextual factors on HIV/AIDS, STIs, and RSB in SSA; 6) what are the quality of studies that utilize MLMs to analyze the influence of contextual factors on HIV/AIDS, STIs, and RSB in SSA; and 7) what are the funding sources for these studies.

Materials and Methods

The protocol for this systematic review was drafted in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) guideline (4) and registered with the International Prospective Register of Systematic Reviews (PROSPERO: CRD42016038580) (5).

We searched ten databases, including PubMed; Embase; Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus; Scopus; Global Index Medicus; Web of Science Core Collection; EconLit; ABI/INFORM Complete; Business Source Complete; and Applied Social Sciences Index and Abstracts (ASSIA).

The search terms used are shown in Table 1-1. The list of STIs included in the search was defined by the Centers for Disease Control and Prevention (6), and the list of countries was defined by the World Bank’s definition of SSA (7). Recognizing studies utilizing MLMs in their analysis may not have specified this in their abstracts, we sought to be as inclusive as possible in the MLM-related keywords utilized in the search strategy (Table 1-1). Database-specific subject headings were also included for each keyword when available.
Studies eligible for inclusion examined the influence of contextual factors on HIV/AIDS, STIs, and RSB and utilized MLMs for analysis. Studies examining public health topics related to HIV/AIDS, STIs, and RSB, such as counseling, testing, prevention of mother-to-child transmission (PMTCT), treatment, and stigma, were also eligible for inclusion. MLMs were defined as regression techniques that produce estimates of variation at more than one level (2). Studies examining contextual factors but utilizing multivariate regression modeling methods which do not provide estimates of higher-level variation (such as cluster-robust standard errors or generalized estimating equations) were considered ineligible for inclusion (1). Studies examining repeated measures and dyad studies (i.e. relationship dynamics of couples) were excluded, since these topics were not considered to be related to contextual factors. Inclusion was limited to peer-reviewed articles, published in English, Spanish, or French. Gray literature, including conference abstracts and non-peer-reviewed publications, was excluded from the search. Databases were searched through May 29, 2016; no time limits were applied.

Screening was carried out in two stages. First, two reviewers on the screening team (MWP, DM, MS, CC, & PB) independently screened titles and abstracts for eligibility based on the inclusion criteria. A second screen of full text articles by two reviewers on the screening team was conducted to determine final eligibility for inclusion. Because it was possible authors may have stated in their titles or abstracts that they utilized a multilevel approach, while in reality they utilized a standard regression modeling procedure, only papers which, upon full-text review, explicitly stated they utilized multilevel regression modeling techniques were deemed eligible for inclusion. At both screening stages, any conflicts were resolved through discussion and consensus. The
bibliographies of studies selected for inclusion were hand-searched for additional studies that might meet eligibility criteria.

After study selection was complete, information was extracted into an electronic database. Quality was assessed for studies implementing non-secondary analyses. Studies utilizing a randomized controlled trial (RCT), quasi-experimental, cohort, or case-control study design were evaluated using the Quality Assessment Tool for Quantitative Studies (QATQS) (8), recommended by the Cochrane Collaboration (9). The quality of cross-sectional studies was assessed using an adapted version of QATQS, examining risk for selection bias, data collection methods, and confounders included. Information was extracted independently by two reviewers; conflicts were resolved through discussion and consensus.

Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) was used to manage article screening and selection by the team of reviewers and to eliminate duplicates. NVivo 11 (QSR International, Melbourne, Australia) was used to manage full text articles and a standardized table in Excel (Microsoft, Seattle, United States) was used for information extraction. RefWorks (ProQuest, Ann Arbor, United States) was used to manage citations.

Results

The flowchart in Figure 1-1 shows the number of studies at each stage of the screening process. A total of 118 studies were included in the review (Tables 1-2 and 1-3). Seventy-four studies focused on the broad topic of HIV/AIDS; ten of these focused on PMTCT, and eight focused on orphans and vulnerable children (OVCs). Forty-six studies
focused on the broad topic of RSB; 13 focused on condom use or contraception, and 11 examined intimate partner violence (IPV). No studies related to STIs other than HIV/AIDS met eligibility criteria. Only two studies were published prior to 2000, and two studies between 2000 and 2006; all remaining studies were published in 2007 or later. All included studies were published in English.

Aim 1: Interventions

Of the 118 studies that met final inclusion criteria, five represented primary evaluation of interventions targeting contextual factors (Table 1-2). Two were interventions conducted in health facilities, one in a church congregation, one in a school, and one was a community-wide intervention. All studies reported improvement on HIV/AIDS-related outcomes in the intervention group compared to the control group (see Table 1-2 for details).

Aim 2: Role of Contextual Factors in HIV/AIDS and Risky Sexual Behavior

The included studies found associations between HIV infection and a number of contextual factors. Of nineteen studies that examined HIV serostatus as the outcome of interest, three found associations between contextual-level poverty and the likelihood of HIV positivity. One of the three found that women living in communities with lower socioeconomic status (SES) had higher risk of HIV infection (10). In contrast, two of the three found a lower odds of HIV positivity in poorer communities (11, 12). Findings from studies examining contextual-level measures of inequality were more consistent. Durevall et al. found that increased consumption inequality increased HIV risk (13). Brodish found increases in Gini coefficients and wealth ratios similarly increased HIV risk (14). Of the
remaining fourteen studies, researchers found positive associations between HIV serostatus, community ethnic diversity (15), and levels of sexual concurrency (16). One study found higher community-level educational attainment was protective (17), while another found mixed associations depending on levels of globalization (18). Magadi et al. found mixed associations between regional and country-level media exposure and HIV prevalence (19). One study found no association between country-level HIV prevalence and HIV status (20). Two others examined variance at the country level (21, 22), while six utilized MLMs but did not report results related to contextual-level factors (23-28).

The forty-six studies reporting results related to RSB examined a variety of outcomes, including abstinence, age of sexual initiation, number of partners, extramarital sex, and condom use; many studies examined more than one (Table 1-3). Associations were found with numerous contextual factors, including community aggregate women’s employment and control of earnings (29), educational attainment (18, 30-32), SES and community development (33-38), concentrated disadvantage (39), HIV knowledge (40), gender norms and inequality (41-49), women’s average age of marriage (41, 50-52), and community sexual norms (53). A total of 6 studies examining RSB did not report contextual findings (54-59). The studies included in this review were too heterogeneous for meta-analysis.

**Aim 3: Settings**

Two aspects of study setting were considered: country and the unit for which the random effect (or the contextual level studied) was used. The most frequently studied country was Nigeria (26 studies). Of the 47 countries classified as SSA by the World
Bank, 11 were not represented by studies included in this review: Burundi, Cape Verde, Equatorial Guinea, Eritrea, Gambia, Guinea-Bissau, São Tomé and Príncipe, Seychelles, Somalia, Sudan, and South Sudan. Community was the most frequently reported unit for random effects (75 studies). Nineteen studies used health facility or health system as the unit for random effects. Less frequently used units for random effects included country, region, school, church congregation, and household (Table 1-3).

Aim 4: Populations Studied

Forty-five studies focused solely on women or girls. Most of these studies focused generally on women of reproductive age, while others focused on subgroups such as those who were pregnant or participating in PMTCT programs, those who were post-partum or recently had a live birth, those who were sexually active, those who were married, or those who reported experiencing IPV. Thirty-eight studies focused on infants, children, adolescents, and young adults. These studies focused on topics ranging from OVCs and youth-friendly services to sexual initiation, coercive sex, and condom use (Table 1-3).

Aim 5: Study Designs

A total of 108 studies were cross-sectional. Four studies were RCTs, and four were retrospective cohorts. One study utilized a prospective cohort design, and one reported using a pre-post randomized group design (Table 1-3). A majority of studies, 89, conducted secondary data analysis. The most frequently used data source was The Demographic and Health Surveys (DHS) Program (51 studies), which is funded by the
United States Agency for International Development (USAID) and is implemented in 90 countries globally, including 43 within SSA (60).

Aim 6: Study Quality

The full QATQS was used for a total of nine studies representing primary data analysis of RCTs or cohort studies. Four studies were rated moderate and five as weak (Table 1-4). Weak ratings were largely due to lack of reporting on the validity and reliability of data collection methods employed.

An adapted QATQS was used for a total of 20 studies representing primary analysis of cross-sectional data (Table 1-5). A total of three studies were rated as strong in regards to minimizing selection bias; 13 were rated as moderate. Eighteen studies were rated as strong with regard to confounders, while two were rated as weak. Four studies were rated moderate with regards to the validity and reliability of data collection methods; the remaining were rated as weak.

Aim 7: Funding Sources

The most frequently reported funder was the Eunice Kennedy Shriver Institute of Child Health and Human Development (14 studies), followed by USAID (11 studies), the National Institute of Mental Health (9 studies), the United Kingdom Medical Research Council (8 studies), and the President’s Emergency Plan for AIDS Relief (6 studies). Other funding from bilateral agencies came from France, the United Kingdom, Canada, Norway, and Japan.
Reporting Multilevel Modelling

A secondary finding was related to variation in the statistics reported for MLMs. Sixty-nine of 118 studies reported random effects, while only 49 reported the intraclass correlation coefficient (ICC). Twenty-one studies reported statistics comparing different models to one another (such as deviance or log likelihood), and nine studies reported measures of model fit (such as deviance, Akaike, or Bayesian information criterions). The most frequently reported software used for analysis was Stata (45 studies).

Discussion

Nearly all studies consisted of a cross-sectional design, and most represented secondary data analysis, with DHS being the most frequently utilized data source. Only five studies evaluated the impact of a contextual-level intervention. While cross-sectional studies provide insight into associations between contextual-level factors and individual-level outcomes, they cannot be used to establish temporality or determine causality. This presents one of the greatest challenges to the expanded focus on multilevel modelling among social epidemiologists (61, 62). While it is clear that contextual disparities are associated with HIV/AIDS and RSB, the mechanisms underlying these associations and their causal pathways require more exploration.

The use of the QATQS is best suited for RCTs, and therefore may have resulted in overly conservative quality assessments for cohort studies. Additionally, we noted gaps in the instructions provided by the QATQS, leaving criteria open to interpretation by the rater (8). In spite of this, use of the QATQS draws attention to the importance of reporting on the validity and reliability of data collection methods, which was lacking in
most studies conducting primary data analysis. While failure to report this aspect of the methodology may indicate the validity and reliability of measures were not taken into consideration, it may also be due to the fact that the instruments were validated elsewhere, or the researchers only examined some aspect of validity. If one of the latter reasons was true, it is still important to report any element of known validity.

To our knowledge, there are no standardized reporting guidelines for MLMs. The heterogeneity in the measures reported among the studies included in this review highlight the potential benefit of such guidelines. In our opinion, estimates of random effects (or contextual-level variation) and ICCs represent the most insightful information for readers and should be included in all studies reporting the results of MLMs. It should be noted that, since ICC is a measure of how similar individuals within a contextual unit are to one another, even small ICCs may represent important opportunities for intervention (63). For example, if individuals living within the same community tend to have a similarly high likelihood of being HIV-positive, it may be worthwhile to invest in community-level interventions to impact individual-level practices, even if the ICC is low.

Since women and young girls are among the highest risk groups for HIV infection in SSA, it is encouraging that approximately 38% of the studies included focused on this vulnerable population (64). However, it should be noted that none of the studies included examined samples of men who have sex with men or injection drug users. These groups historically have been underrepresented in HIV/AIDS research in SSA due to marginalization and criminalization, as well as social stigma and donor funding priorities.
However, both groups are at high risk and may play an important role in generalized epidemics (65, 66). Future research related to contextual factors should intentionally seek to include these groups.

One strength of our study is the use of ten databases to search the existing literature, including databases from the fields of medicine, public health, nursing/health sciences, and economics. Another strength is our broad inclusion of topics related to HIV/AIDS and RSB, particularly given the complex and multifaceted nature of these public health issues in SSA. The compendium of studies presented in this review provide members of the global health community a valuable starting point before undertaking additional research related to the role of contextual factors.

One limitation of this review is reflected in the need to include language related to MLMs in keyword criteria for screening titles and abstracts in order to manage the number of studies in the screening process. It is possible some studies utilizing MLMs in their analysis did not specify this in their abstracts and therefore did not meet eligibility criteria for this review. However, we did our best to mitigate this limitation by being as inclusive as possible in the MLM-related keywords we used in the search strategy. Another limitation includes our lack of meta-analyses of results, namely contextual factors; future studies should explore meta-analyses further as more data become available. Finally, it is possible that studies with non-significant findings may not have been published, leading to publication bias.
Conclusions

MLMs have gained increasing popularity among social epidemiologists. To our knowledge, this is the first systematic review to describe the use of MLMs in evaluating the influence of contextual factors on HIV/AIDS, STIs, and RSB in SSA. The results of the studies included indicate numerous contextual factors, such as community-level poverty and education, are associated with a number of outcomes related to HIV/AIDS and RSB. Future studies utilizing MLMs should focus on contextual-level interventions and include measures of potential mediators in order to elucidate the mechanisms underlying these associations and to strengthen the evidence base for causality.

References


5. PROSPERO: International Prospective Register of Systematic Reviews [Internet].: University of York [cited March 1, 2016]. Available from: https://www.crd.york.ac.uk/PROSPERO/.


7. World Bank Country and Lending Groups [Internet].: World Bank [cited April 3, 2016]. Available from:


Table 1-1. Search strategy for identifying studies using multilevel models to evaluate the influence of contextual factors on HIV/AIDS, STIs, and risky sexual behavior in sub-Saharan Africa by keyworda

**Includes at least one of:**
- contextual* OR communit* OR neighborhood* OR neighbourhood* OR network* OR "social support" OR "social capital" OR "social determinants" OR "structural determinants" OR "proximal determinants" OR "intermediate determinants" OR "distal determinants" OR "social inequality" OR "social inequalities" OR "social inequity" OR "social inequities" OR "social class" OR "social classes" OR socioeconomic OR SES OR SEP OR disparit* OR catchment* OR "health service area" OR "health service areas" OR "health services area" OR "health services areas" OR "administrative boundary" OR "administrative boundaries" OR "administrative area" OR "administrative areas" OR "administrative unit" OR "administrative units" OR income OR "income inequality" OR "income inequities" OR poverty OR education OR "social gradient" OR "social gradients" OR "social status" OR deprivation

**And one of (A), (B), or (C):**

(A) HIV OR AIDS OR "human immunodeficiency virus" OR "acquired immune deficiency syndrome"

(B) STI OR STIs OR STD OR STDs OR "sexually transmitted infection" OR "sexually transmitted infections" OR "sexually transmitted disease" OR "sexually transmitted diseases" OR "bacterial vaginosis" OR chlamydia OR gonorrhea OR hepatitis OR herpes OR HSV OR "human papillomavirus" OR HPV OR "pelvic inflammatory disease" OR PID OR syphilis OR trichomoniasis OR chancroid OR "lymphogranuloma venereum" OR LGV OR "mycoplasma genitalium" OR "pubic lice" OR crabs OR scabies

(C) (sex OR sexual* OR intercourse) AND ((unsafe OR safe OR unprotect* OR protect* OR risk* OR condom*) OR (behavior* OR behaviour*))

**And includes at least one of:**
- multilevel OR multi-level OR MLM OR MLMs OR hierarch* OR HLM OR HLMs OR ICC OR ICCs OR "intraclass correlation coefficient" OR "intra-class correlation coefficient" OR "intraclass correlation coefficients" OR "intra-class correlation coefficients" OR "intraclass correlation coefficient" OR "intra-cluster correlation coefficient" OR "intra-cluster correlation coefficients" OR "intra-cluster correlation coefficients" OR "median odds ratio" OR "median odds ratios" OR MOR OR MORs OR "mixed model" OR "mixed models" OR "mixed effect" OR "mixed effects" OR cluster* OR nested

**And includes at least one of:**
- Africa* OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR Cameroon OR “Cape Verde” OR "Central African Republic" OR Chad OR Comoros OR Congo OR “Côte d’Ivoire” OR “Cote d’Ivoire” OR “Equatorial Guinea” OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR “Ivory Coast” OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR "São Tomé and Principe" OR “Sao Tome and Principe” OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "South Africa" OR “South Sudan” OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR Zambia OR Zimbabwe

aDatabase-specific subject headings (such as Emtree and MeSH terms for Embase and PubMed, respectively) were also included for each keyword when available.
Table 1-2. Studies utilizing multilevel models to evaluate the impact of a contextual-level intervention on individual-level HIV/AIDS-related outcomes in sub-Saharan Africa

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Topic</th>
<th>Study Design</th>
<th>Description of Intervention</th>
<th>Study Setting</th>
<th>Study Time Period</th>
<th>Participant Characteristics</th>
<th>Sample Size</th>
<th>Unit of Random Effect</th>
<th>Summary of Individual-Level Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliyu et al. (2016) (67)</td>
<td>HIV/AIDS- PMTCT</td>
<td>Clustered RCT</td>
<td>&quot;The intervention sites received an integrated package of PMTCT services in maternal and child health settings that included point-of-care CD4 cell count or percentage testing, transition of decentralised PMTCT tasks to trained midwives (task shifting), integrated mother and infant care services, active influential family&quot;</td>
<td>&quot;12 sites located in the rural Niger state of north-central Nigeria&quot;</td>
<td>April 1, 2013-March 31, 2014</td>
<td>&quot;HIV-infected women (age was not included in the eligibility criteria, but the youngest participant was 16 years old) and their infants, presenting for antenatal care or delivery who met one of the following inclusion criteria: unknown HIV status at time of presentation; history of antiretroviral prophylaxis or treatment, but not receiving prophylaxis or treatment at the time of presentation; or known HIV status but had never&quot;</td>
<td>369</td>
<td>Health Facility</td>
<td>&quot;After adjustment for maternal age, education, travel time to facility, employment, maternal ethnicity, and time of HIV diagnosis, mothers in the intervention group were more likely to initiate ART than mothers in the control group (adjusted relative risk [RR] 3.3, 95% CI 1.4-7.8; table 3). After adjustment for maternal age, education, travel time, employment, ethnicity, and time of HIV diagnosis, mother and infant pairs in the intervention group were roughly ten times more likely to be retained in care at 6 weeks (adjusted RR 9.1, 95% CI&quot;</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Topic</td>
<td>Study Design</td>
<td>Description of Intervention</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Unit of Random Effect</td>
<td>Summary of Individual-Level Findings</td>
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<tr>
<td>Carlson et al. (2012) (68)</td>
<td>HIV/AIDS-Health Promotion</td>
<td>Clustered RCT</td>
<td>The Youth Citizens program, an individual- and neighborhood-level health promotion training</td>
<td>Moshi Urban District, Kilimanjaro Region, northern Tanzania</td>
<td>2004-2006</td>
<td>Children between the ages of 9-14</td>
<td>724</td>
<td>Community</td>
<td>&quot;...post-treatment scores on deliberative self-efficacy, communicative self-efficacy and emotional control were significantly higher in the treatment group than in the control group.&quot;</td>
</tr>
</tbody>
</table>
| Ezeanolue et al. (2015) (69) | HIV/AIDS-Testing | Clustered RCT | "Healthy Beginning Initiative (HBI), a culturally adapted, family-centred approach that relies on the widely distributed religious infrastructure | Enugu state, southeast Nigeria | Jan 20, 2013- Aug 31, 2014 | Pregnant women 18 years or older who attended any of the study sites | 3,002 | Congregation | "The odds of pregnant women not being HIV tested were 11 times higher in the control group than in the intervention group after controlling for age, educational level, employment, area of residence, age at first pregnancy, number of previous..."
<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Topic</th>
<th>Study Design</th>
<th>Description of Intervention</th>
<th>Study Setting</th>
<th>Study Time Period</th>
<th>Participant Characteristics</th>
<th>Sample Size</th>
<th>Unit of Random Effect</th>
<th>Summary of Individual-Level Findings</th>
</tr>
</thead>
</table>
| Jenning s et al. (2015) (70) | HIV/AIDS- Health Facilities | Pre–post randomized group design | and church-based community networks to promote individual testing, tracking, and retention of participants... provides free, integrated on-site laboratory tests during a church organised baby shower..." | "14 public health facilities in the Zou/Colli nes region of Benin" | August-October 2008 | Women who had recently given birth | 411 | Health facility, Provider | "Women in the intervention arm received significantly higher reinforcement messages regarding immediate neonatal care as compared to the control arm for skin-to-skin contact, newborn wrapping for warmth, exclusive breastfeeding.

pregnancies, and a history of previous HIV testing...
Women in the intervention group were more likely to be linked to care before delivery than were those in the control group and were more likely to access care and receive ART during pregnancy."
Kaljee et al. (2016) (71)

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Topic</th>
<th>Study Design</th>
<th>Description of Intervention</th>
<th>Study Setting</th>
<th>Study Time Period</th>
<th>Participant Characteristics</th>
<th>Sample Size</th>
<th>Unit of Random Effect</th>
<th>Summary of Individual-Level Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaljee et al. (2016) (71)</td>
<td>HIV/AIDS-Social Support</td>
<td>RCT Teachers’ Diploma Programme</td>
<td>Primary schools in Lusaka and Eastern Province, Zambia</td>
<td>2013-2014</td>
<td>3rd and 4th grade teachers and students</td>
<td>325 teachers; 1,378 students</td>
<td>School</td>
<td>continued delayed bathing, and umbilical cord care... Improvements in knowledge were observed in all topic areas, except postnatal care-seeking, which significantly increased in the intervention arm from 4 to 22%, but remained low and was not statistically significant after adjusting for changes in the control arm. For teachers, &quot;gender equity for boys and girls were significant.&quot; For students, &quot;perceived social support within schools was marginally significantly greater at post intervention for intervention students.&quot;</td>
<td></td>
</tr>
</tbody>
</table>
Table 1-3. Studies utilizing multilevel models to evaluate the associations between contextual-level factors and HIV/AIDS or risky sexual behavior-related outcomes in sub-Saharan Africa, sorted by study design

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Broad Topic</th>
<th>Narrow Topic</th>
<th>Study Design</th>
<th>Study Setting</th>
<th>Study Time Period</th>
<th>Participant Characteristics</th>
<th>Sample Size</th>
<th>Random Effect</th>
<th>Individual-Level Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahonkhai et al. (2012)</td>
<td>HIV/AIDS</td>
<td>Continuity of Care</td>
<td>Retrospective cohort study</td>
<td>71 treatment sites in 8 South African provinces</td>
<td>January 2004-December 2008</td>
<td>&quot;Adults 15 years or older enrolled in the treatment programs... were eligible for ART at clinic enrollment (baseline CD4 count &lt;200/uL or WHO stage III or IV disease), subsequently initiated ART, and had at least 400 days of potential follow-up time on ART before the end of the study.&quot;</td>
<td>11,397 patients</td>
<td>Health Facility</td>
<td>Interrupted Laboratory Monitoring, Early Death, Loss to Follow Up</td>
</tr>
<tr>
<td>Charalambous et al. (2016)</td>
<td>HIV/AIDS</td>
<td>ART Outcomes</td>
<td>Retrospective cohort study</td>
<td>&quot;Clinics owned by private practitioners or nongovernmental&quot;</td>
<td>2006-2010</td>
<td>&quot;Adults (&gt;18 years old) who started on ART from 1 January 2006 to 31 December 2009&quot;</td>
<td>10,055 patients</td>
<td>Health Facility</td>
<td>Unsuppressed viral load at 24 months, time to loss to follow-up, composite poor outcome at 24 months</td>
</tr>
<tr>
<td>Author et al. (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
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<tr>
<td>Lahuerta et al. (2012) (74)</td>
<td>HIV/AIDS</td>
<td>ART Initiation</td>
<td>Retrospective cohort study</td>
<td>organizations which were part of the Aurum Institute’s HIV treatment programme funded through the President’s Emergency Plan for AIDS Relief (PEPFAR)” in South Africa Health facilities in Maputo, Gaza, Inhambane, Nampula and Zambezia provinces, Mozambique</td>
<td>January 1, 2005-June 30, 2009</td>
<td>ART patients 15 years old or older</td>
<td>36,411</td>
<td>Health Facility</td>
<td>Late ART initiation</td>
</tr>
<tr>
<td>Lessells et al. (2011) (75)</td>
<td>HIV/AIDS</td>
<td>Retention in Care</td>
<td>Retrospective cohort study</td>
<td>Hlabisa health sub-district, northern KwaZulu-Natal, South Africa</td>
<td>2007-2009</td>
<td>Patients with ”a first recorded CD4 cell count from a sample between Jan 1st 2007 – Dec 31st 2007; ART</td>
<td>4,223</td>
<td>Health Facility</td>
<td>Pre-ART retention</td>
</tr>
<tr>
<td>Author</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
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<tr>
<td>Alio et al. (2011)</td>
<td>Risky Sexual Behavior</td>
<td>IPV</td>
<td>Cross-sectional</td>
<td>nationally representative survey</td>
<td>2004</td>
<td>&quot;Women of childbearing age, 15-49 years old.&quot;</td>
<td>2,570</td>
<td>Sampling Units</td>
<td>Induced Abortion</td>
</tr>
<tr>
<td>Allen et al. (2007)</td>
<td>HIV/AIDS</td>
<td>VCT</td>
<td>Cross-sectional</td>
<td>Couples' Voluntary Counseling and Testing Centers &amp; surrounding communities in Kigali, Rwanda &amp; Lusaka, Zambia</td>
<td>January-July 2003</td>
<td>&quot;The average ages of invited men and women in each country were similar (Rwanda: Men = 35.6 years, Women = 29.6 years; Zambia: Men = 34.5 years, Women = 28.1 years). Couples had been married or cohabiting for a mean of 8.0 years (Rwanda = 7.8 years, Zambia = 8.0)… Of 9,900 couples who received invitations, 1,411 (14.3%) requested CVCT.&quot;</td>
<td>&quot;9,900 couples (2,680 in Rwanda, 7,220 in Zambia)… Of 9,900 couples who received invitation s, 1,411 (14.3%) requested CVCT.&quot;</td>
<td>Influence Network Agents</td>
<td>Couple VCT</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
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<tr>
<td>Antai (2011) (32)</td>
<td>Risky Sexual Behavior</td>
<td>IPV</td>
<td>Cross-sectional</td>
<td>Nigeria-nationally representative sample</td>
<td>2008</td>
<td>Women aged 15-49 years</td>
<td>23,752</td>
<td>Community</td>
<td>Traumatic physical consequences- i) bruises; ii) injuries, sprains, dislocations or burns; iii) wounds, broken bones, broken teeth or other serious; and iv) severe burns Terminated pregnancy</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
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<tr>
<td>Audureau (2013) (78)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>269 Viramune Donation Program sites were included, participating in 20 PMTCT programs in 15 sub-Saharan countries (Benin, DR Congo, Côte d'Ivoire, Gabon, Ghana, Kenya, Lesotho, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Togo, Uganda and Zambia)</td>
<td>January 2002-December 2005</td>
<td>Participants in PMTCT programs</td>
<td>283,410</td>
<td>Program, Country</td>
<td>Nevirapine coverage indicator (by site)</td>
</tr>
<tr>
<td>Avila et al. The IeDEA and ART cohort collabora</td>
<td>HIV/AIDS</td>
<td>ART Initiation</td>
<td>Cross-sectional</td>
<td>Data from &quot;the International epidemiological Databases to Evaluate&quot;</td>
<td>2000-2009</td>
<td>Patients aged ≥16 years at cART initiation</td>
<td>379,865, including 86,390 patients from nine LIC</td>
<td>Country</td>
<td>Median CD4 count at start of ART</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
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<tr>
<td>tions (2014)</td>
<td>AIDS (IeDEA), a global consortium structured through regional centres to pool clinical and epidemiological data on HIV-positive individuals, particularly patients on cART. The seven regions included in IeDEA are North America, Caribbean/Central and South America, Asia/Pacific, East Africa, West Africa, Central Africa and Southern</td>
<td>(23%), 176,858 from four LMIC (47%), 82,152 from four UMIC (22%) and 34,465 from six HIC (9%).</td>
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<td>(79)</td>
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<tr>
<td>Babalola et al. (2009) (80)</td>
<td>HIV/AIDS</td>
<td>Health Promotion/Communication</td>
<td>Cross-sectional</td>
<td>Africa. 23 countries, Nigeriannationally representative sample</td>
<td>2005</td>
<td>Women aged 15-49 years, men aged 15-64 years</td>
<td>10,081</td>
<td>Community</td>
<td>Accepting attitudes of PLHIV</td>
</tr>
<tr>
<td>Benefo (1995) (29)</td>
<td>Risky Sexual Behavior</td>
<td>Abstinence</td>
<td>Cross-sectional</td>
<td>Cameroon, Cote d’Ivoire, Ghana (nationally representative surveys)</td>
<td>1978, 1979</td>
<td>Currently married women ages 15-49 with at least one birth in the five years preceding the survey</td>
<td>15,432</td>
<td>Community</td>
<td>Duration of postpartum sexual abstinence</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Benefo (2008) (82)</td>
<td>Risky Sexual Behavior</td>
<td>Concurrent sexual partners</td>
<td>Cross-sectional</td>
<td>Zambian nationally representative sample</td>
<td>2003</td>
<td>Married men aged 15–59 years</td>
<td>1,118</td>
<td>Community</td>
<td>Men's extramarital sex</td>
</tr>
<tr>
<td>Birungi et al. (2011) (83)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>Regions with the highest HIV prevalence in Kenya—Nyanza, Nairobi, Rift Valley and Coast provinces.</td>
<td>2009</td>
<td>HIV positive male and female adolescents aged 15–19</td>
<td>393</td>
<td>Health Facility</td>
<td>Receiving prenatal care; making four or more prenatal care visits (0–3, ≥4); receiving PMTCT services; receiving skilled assistance (being assisted by a doctor, nurse or facility midwife during delivery or induced or spontaneous abortion); and receiving postnatal/post abortion care services</td>
</tr>
<tr>
<td>Bonnenfant et al. (2012) (84)</td>
<td>HIV/AIDS</td>
<td>VCT</td>
<td>Cross-sectional</td>
<td>Ethiopia</td>
<td>2008</td>
<td>Voluntary counseling and testing clients at least 15 years of age or older</td>
<td>1,858</td>
<td>Health Facility</td>
<td>Coupling counseling, individual counseling</td>
</tr>
<tr>
<td>Author et al. (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
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<tr>
<td>Burgard et al. (2009)</td>
<td>Risky Sexual Behavior</td>
<td>Sexual Initiation, Condom Use</td>
<td>Cross-sectional</td>
<td>Durban metropolitan area of KwaZulu-Natal, South Africa; South Africa-nationally representative sample</td>
<td>1999-2001, 1996</td>
<td>Black respondents age 14 to 24</td>
<td>2,736; 1,697</td>
<td>Community</td>
<td>Age of sexual initiation, condom use</td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Chiao</td>
<td>2009</td>
<td>HIV/AIDS</td>
<td>Stigma</td>
<td>Cross-sectional</td>
<td>Kenya-nationally representative sample</td>
<td>2003</td>
<td>Women aged 15-49 years, men aged 15-54 years</td>
<td>10,486</td>
<td>Community</td>
</tr>
<tr>
<td>Crea et al.</td>
<td>2015</td>
<td>HIV/AIDS</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Manicaland, Zimbabwe</td>
<td>2009-2010</td>
<td>School-aged children</td>
<td>5,331</td>
<td>Household</td>
</tr>
<tr>
<td>Denison et al.</td>
<td>2006</td>
<td>HIV/AIDS</td>
<td>ART Adherence</td>
<td>Cross-sectional</td>
<td>Health facilities in Tanzania</td>
<td>2006</td>
<td>ART patients 18 years or older</td>
<td>4,489</td>
<td>Health facility</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<tr>
<td>Denoeud-Ndam et al. (2015)</td>
<td>HIV/AIDS</td>
<td>Malaria</td>
<td>Cross-sectional</td>
<td>Uganda, and Zambia Maternity clinics, Benin</td>
<td>2005-2008; 2009-2011</td>
<td>Pregnant women between 16 and 28 weeks of gestation, who had no history of a neuropsychiatric disorder or severe kidney or liver disease, and had no history of severe adverse reactions with mefloquine or sulfa drugs</td>
<td>524</td>
<td>Health facility</td>
<td>Tolerance of mefloquine</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Fox (2014) (16)</td>
<td>HIV/AIDS</td>
<td>Concurrent sexual partners</td>
<td>Cross-sectional</td>
<td>Liberia, Madagascar, Mali, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, Zimbabwe-nationally representative samples</td>
<td>Unspecified</td>
<td>Survey participants married for at least 1 year</td>
<td>83,366</td>
<td>Region, Country</td>
<td>HIV serostatus</td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<tr>
<td>Gage (2013)</td>
<td>47</td>
<td>Risky Sexual Behavior</td>
<td>Child Marriage</td>
<td>Cross-sectional</td>
<td>Amhara region, Ethiopia</td>
<td>2007</td>
<td>One co-resident parent/guardian of adolescents (female aged 10-19 and male aged 15-24) per household</td>
<td>4,445</td>
<td>Community</td>
</tr>
<tr>
<td>Gari et al. (2013)</td>
<td>54</td>
<td>HIV/AIDS, Risky Sexual Behavior</td>
<td>HIV Testing, IPV</td>
<td>Cross-sectional</td>
<td>South and central provinces of Zambia Hospitals in Kenya</td>
<td>September 2010-February 2011</td>
<td>Members of selected households, 18 years or older Pediatric patients</td>
<td>1,716</td>
<td>Community</td>
</tr>
<tr>
<td>Gathara et al. (2015)</td>
<td>91</td>
<td>HIV/AIDS</td>
<td>Health Facilities</td>
<td>Cross-sectional</td>
<td>Clinics offering Youth Friendly Services in Soweto, South Africa</td>
<td>November 2011-March 2012</td>
<td>Soweto youth</td>
<td>58</td>
<td>Health Facility, Client</td>
</tr>
<tr>
<td>Geary et al. (2015)</td>
<td>92</td>
<td>HIV/AIDS</td>
<td>Youth Friendly Services</td>
<td>Cross-sectional</td>
<td>Clinics offering Youth Friendly Services in Soweto, South Africa</td>
<td>November 2011-March 2012</td>
<td>Soweto youth</td>
<td>58</td>
<td>Health Facility, Client</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
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<td>Goodman et al. (2016) (57)</td>
<td>Risky Sexual Behavior</td>
<td>Socioeconomic Resources</td>
<td>Cross-sectional</td>
<td>Meru County, Kenya</td>
<td>March 2014</td>
<td>Vulnerable households of OVC siblings identified by community leaders</td>
<td>1,060</td>
<td>Region, Working group</td>
<td>&quot;sexual initiation, unprotected last sex among those sexually active in the previous six months (versus no sex in same time period), and multiple sex partners in the previous year&quot;</td>
</tr>
<tr>
<td>Hutchins et al. (2007) (94)</td>
<td>HIV/AIDS</td>
<td>Stigma, Testing, Disclosure</td>
<td>Cross-sectional</td>
<td>Eastern Cape, South Africa</td>
<td>2002-2003</td>
<td>Men and women 15 years or older</td>
<td>1,065</td>
<td>Community</td>
<td>Heard HIV/AIDS information from media in last 4 weeks, Discussed HIV/AIDS with anyone in last 2</td>
</tr>
<tr>
<td>Author</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Ishida et al.</td>
<td>HIV/AIDS</td>
<td>Socio-economic Resources</td>
<td>Cross-sectional</td>
<td>Kenya-nationally representative sample</td>
<td>2003, 2007</td>
<td>Women aged 15-49 years and men aged 15-54 years</td>
<td>5,706</td>
<td>Community</td>
<td>Risk of unintended pregnancies- they were not using any method of contraception (either modern or traditional methods) but stated that they either did not want a child within two years or did not want any more children. Use of a modern contraceptive method.</td>
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<tr>
<td>(2012)</td>
<td>(12)</td>
<td></td>
<td></td>
<td>Ghana-nationally representative sample</td>
<td></td>
<td>Fecund, non-pregnant, and sexually active women who were married or living with a partner</td>
<td></td>
<td></td>
<td>HIV serostatus</td>
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<tr>
<td>Johnson et al.</td>
<td>Risky Sexual</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>1998, 2003</td>
<td></td>
<td>6,575</td>
<td>Community</td>
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<tr>
<td>(2011)</td>
<td>Behavior</td>
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<tr>
<td>Kaggwa et al.</td>
<td>Risky Sexual</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>Mali-nationally representative sample</td>
<td>2001</td>
<td>Women ages 15-49 years old in a union (married or co-habiting) residing in clusters with at least 25 women</td>
<td>7,671</td>
<td>Community</td>
<td>Use of a modern contraceptive method.</td>
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<tr>
<td>(2008)</td>
<td>Behavior</td>
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<td>Author (Year)</td>
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<td>Study Time Period</td>
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<tr>
<td>Kamunda ya et al. (2015) (58)</td>
<td>Risky Sexual Behavior</td>
<td>Coercive Sex</td>
<td>Cross-sectional</td>
<td>Blantyre, Malawi</td>
<td>June-July 2013</td>
<td>18-23 year olds</td>
<td>1,071</td>
<td>Community</td>
<td>Coercive sex</td>
</tr>
<tr>
<td>Kankeu et al. (2016) (96)</td>
<td>HIV/AIDS</td>
<td>Health System</td>
<td>Cross-sectional</td>
<td>Hospitals in Cameroon</td>
<td>2006-2007</td>
<td>HIV patients who consulted with a doctor</td>
<td>1,637</td>
<td>Health Facility</td>
<td>Informal payments</td>
</tr>
<tr>
<td>Kayeeyi et al. (2013) (40)</td>
<td>Risky Sexual Behavior</td>
<td>Adolescents</td>
<td>Cross-sectional</td>
<td>Zambia-nationally representative sample</td>
<td>2000, 2009</td>
<td>Men and women aged 15–24 years</td>
<td>2000-1,376; 2009-1,594</td>
<td>Community</td>
<td>Premarital sex, multiple partnership, condom use at last premarital sex</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Kidman et al. (2012) (99)</td>
<td>HIV/AIDS</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Malawi-nationally representative sample</td>
<td>2004-2005</td>
<td>&quot;children between 6 and 14 years (the official primary school ages) with information on whether their parents are alive&quot;</td>
<td>13,090</td>
<td>Community, Household</td>
<td>Currently out of school and highest grade level attained</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<td>Participant Characteristics</td>
<td>Sample Size</td>
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<tr>
<td>Lamidi (2015)</td>
<td>HIV/AIDS</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>nationally representative sample Nigeria-nationally representative sample</td>
<td>2013</td>
<td>&quot;sexually active, married and cohabiting women who were at risk of conceiving&quot;</td>
<td>18,910</td>
<td>State</td>
<td>Modern contraceptive use</td>
</tr>
<tr>
<td>Larose et al. (2011)</td>
<td>HIV/AIDS</td>
<td>HIV Testing</td>
<td>Cross-sectional</td>
<td>49 countries (18 countries in sub-Saharan Africa: Burkina Faso, Chad, Comoros, Congo, Cote d’Ivoire)</td>
<td>2002-2003</td>
<td>&quot;all men and women of reproductive age (18–49 years old)&quot;</td>
<td>106,705</td>
<td>Country</td>
<td>Voluntary counseling and testing</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
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<tr>
<td>Linos et al. (2013) (45)</td>
<td>Risky Sexual Behavior IPV</td>
<td>Cross-sectional</td>
<td>Tigray region, Ethiopia</td>
<td>2008</td>
<td>Ever-married women, 15-49 years old</td>
<td>18,798</td>
<td>State, Community</td>
<td>Spousal violence</td>
<td></td>
</tr>
<tr>
<td>Linos et al. (2014) (46)</td>
<td>Risky Sexual Behavior IPV</td>
<td>Cross-sectional</td>
<td>Nigeria-nationally representative sample</td>
<td>2008</td>
<td>Women that reported physical or sexual violence victimization, 15-49 years old</td>
<td>5,553</td>
<td>State, Community</td>
<td>Help-seeking behaviour</td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<td>Participant Characteristics</td>
<td>Sample Size</td>
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<tr>
<td>Lumbiganon et al. (2014)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>29 countries (6 countries in sub-Saharan Africa: Angola, Democratic Republic of the Congo, Kenya, Niger, Nigeria, Uganda)</td>
<td>2010-2012</td>
<td>Women giving birth</td>
<td>314,574</td>
<td>Country, Health Facility</td>
<td>Maternal outcomes: &quot;maternal near miss (MNM), maternal death (MD), and severe maternal outcome (SMO)&quot;; Perinatal outcomes: &quot;preterm birth, fetal mortality, early neonatal mortality, perinatal mortality, neonatal intensive care unit (NICU) admission, and an Apgar score &lt;7 at 5 minutes&quot;</td>
</tr>
<tr>
<td>Luseno et al. (2014)</td>
<td>HIV/AIDS</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Machingi District, Central Malawi</td>
<td>2007</td>
<td>Children ages 6-17 years old</td>
<td>1,197</td>
<td>Household</td>
<td>Illness in the past month, illness that stopped normal activities in the past month, missing school due to illness or injury in the past month and health care use</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Maslovska et al. (2009) (23)</td>
<td>HIV/AIDS</td>
<td>Female Genital Mutilation</td>
<td>Cross-sectional</td>
<td>nationally representative samples Kenya-nationally representative sample, excluding the North Eastern province</td>
<td>2003</td>
<td>Women aged 15–49 years old with documented HIV and female genital cutting status</td>
<td>3,114</td>
<td>Community</td>
<td>HIV serostatus</td>
</tr>
<tr>
<td>Medema-Wijnveen et al. (2012) (111)</td>
<td>HIV/AIDS</td>
<td>Stigma</td>
<td>Cross-sectional</td>
<td>ANC clinics, Nyanza Province, Kenya</td>
<td>November 2007-April 2009</td>
<td>&quot;Women at least 18 years old in their first seven months of pregnancy, who were visiting the antenatal care clinic (ANC) for the first time in their pregnancy and did not know their current HIV status&quot;</td>
<td>1,777</td>
<td>Health facility</td>
<td>Intention to deliver with a skilled healthcare provider</td>
</tr>
<tr>
<td>Miller et al.</td>
<td>HIV/AIDS</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Botswana-nationally</td>
<td>2000</td>
<td>Under five year olds (data collected from</td>
<td>2,723</td>
<td>Community</td>
<td>Growth failure (underweight)</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<tr>
<td>Mohan et al. (2007) (112)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>representative sample Rural areas of Morogoro District Council, Mvomero, Kilosa, Ulanga districts, Morogoro Region, Tanzania</td>
<td>August-November 2011</td>
<td>women aged 12-49 years old) &quot;Rural women who had a childbirth in the preceding 2-14 months&quot;</td>
<td>1,931</td>
<td>Community</td>
<td>Use of postnatal care</td>
</tr>
<tr>
<td>Msisha et al. (2008) (11)</td>
<td>HIV/AIDS</td>
<td>Contextual influences</td>
<td>Cross-sectional</td>
<td>nationally representative sample Tanzania- nationally representative sample</td>
<td>2003-2004</td>
<td>&quot;women and men aged 15–49 years”</td>
<td>8,010</td>
<td>Region, Community</td>
<td>HIV serostatus</td>
</tr>
<tr>
<td>Mulawa et al. (2016) (114)</td>
<td>Risky Sexual Behavior</td>
<td>Social Networks</td>
<td>Cross-sectional</td>
<td>Urban social networks, locally referred to as “camps,” in Dar es Salaam, Tanzania</td>
<td>October 8, 2013-March 23, 2014</td>
<td>Men 15 years of age or older, who were camp members for more than 3 months, visited the camp at least once a week, and planned on residing in Dar es Salaam for the next 30 months</td>
<td>1,249</td>
<td>Social Network</td>
<td>Normative beliefs, risk behaviors</td>
</tr>
<tr>
<td>Nash et al.</td>
<td>HIV/AIDS</td>
<td>CD4 Counts</td>
<td>Cross-sectional</td>
<td>HIV care clinics in</td>
<td>2003, 2004,</td>
<td>Patient cohorts, including</td>
<td>1,690</td>
<td>Region</td>
<td>Low median CD4+ cell count at</td>
</tr>
<tr>
<td>Author et al. (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Ngome et al. (2014) (38)</td>
<td>Risky Sexual Behavior</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>Zimbabwe-nationally representative sample</td>
<td>2010-2011</td>
<td>Non-pregnant, adolescent women ages 15-19 years old who had their last sex within 12 months prior to the survey</td>
<td>457</td>
<td>Community</td>
<td>Use of modern contraception</td>
</tr>
<tr>
<td>Paek et al. (2008) (44)</td>
<td>Risky Sexual Behavior</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>Villages within 5 km of health centers, Uganda</td>
<td>2001</td>
<td>Adults older than 18 years old</td>
<td>350</td>
<td>Community</td>
<td>Family planning behavior</td>
</tr>
<tr>
<td>Author et al.</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
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<tr>
<td>Robertso...</td>
<td>Risky...</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Democratic...</td>
<td>2004, 2005,...</td>
<td>Adolescents ages 15-17 years old</td>
<td>889</td>
<td>Country, Community</td>
<td>Ever had sex, HIV serostatus</td>
</tr>
<tr>
<td>Robinson et...</td>
<td>Risky...</td>
<td>Condom use</td>
<td>Cross-sectional</td>
<td>KwaZulu-Natal,...</td>
<td>1999</td>
<td>Sexually experienced youth ages 14-22 years old</td>
<td>1,178</td>
<td>Community</td>
<td>Condom use</td>
</tr>
<tr>
<td>Sagna et...</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>Swaziland-nationally representative sample</td>
<td>2006-2007</td>
<td>Women age 15–49 with a live birth in the past 5 years preceding the survey who received antenatal care for the most recent birth</td>
<td>1,788</td>
<td>Community</td>
<td>HIV pre-test counseling during antenatal care, uptake of HIV testing during antenatal care</td>
</tr>
<tr>
<td>Schwandt et...</td>
<td>Risky...</td>
<td>IPV</td>
<td>Cross-sectional</td>
<td>&quot;...four communities in the Thyolo district of...&quot;</td>
<td>September-December 2010</td>
<td>Adolescent girls ages 11–18 living in households in Botswana-352, Malawi-...</td>
<td>1,249</td>
<td>Community</td>
<td>&quot;...increase, no change, or decrease in teachers: encouraging girls&quot;</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
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<tr>
<td>Shi et al. (2013)</td>
<td>HIV/AIDS</td>
<td>IPV</td>
<td>Cross-sectional</td>
<td>Malawi, four communities in the Francistown district of Botswana, and eight communities in Mozambique – four in Zambezia Province and four in Nampula Province.</td>
<td>2008-2009</td>
<td>Women ages 15-49, currently married or living with someone, who completed the IPV questions and obtained HIV testing</td>
<td>372, Mozambique-525</td>
<td>Location, Ethnicity</td>
<td>to participate in class, encouraging girls to excel in math, encouraging girls to stay in school, mostly calling on boys in class, using physical punishment, and in asking for sex in exchange for good grades or other ‘favors.’ Girls were also asked how safe they felt in school: very safe, somewhat safe, neutral, not very safe, and not at all safe.</td>
</tr>
<tr>
<td>Smolak (2014)</td>
<td>HIV/AIDS</td>
<td>Female Genital Mutilation</td>
<td>Cross-sectional</td>
<td>Mali-nationally</td>
<td>Not specified</td>
<td>Women of reproductive</td>
<td>13,015</td>
<td>Community, Household</td>
<td>HIV serostatus, number of partners,</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Stephens et al. (2007) (42)</td>
<td>Risky Sexual Behavior</td>
<td>Contraception</td>
<td>Cross-sectional</td>
<td>Burkina Faso, Côte d’Ivoire, Ghana, Kenya, Malawi, Tanzania nationally representative sample</td>
<td>1998, 1999, 2000</td>
<td>Women of reproductive age (15-49 years old) who were not currently pregnant and were sexually active</td>
<td>30,532 (Burkina Faso-4,960, Côte d’Ivoire-2,437, Ghana-3,784, Kenya-6,013, Malawi-10,291, District, Community</td>
<td>Use of a modern contraceptive method</td>
<td></td>
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<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
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<tr>
<td>Stringer et al. (2013)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>Health facilities in Cameroon, Côte d'Ivoire, South Africa, Zambia, Cameroon -nationally</td>
<td>April 2007-May 2009</td>
<td>Household mother of a child born within the prior 2 years</td>
<td>Country, Community</td>
<td>HIV-free survival among HIV-exposed infants</td>
<td></td>
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<tr>
<td>Author et al. (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
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<tr>
<td>Tabana et al. (2012) (124)</td>
<td>HIV/AIDS</td>
<td>Knowledge of Status</td>
<td>Cross-sectional</td>
<td>Communities in Sisonke district, KwaZulu-Natal, South Africa</td>
<td>September - November 2008</td>
<td>Household members 18 years old or older</td>
<td>5,821</td>
<td>Unspecified</td>
<td>HIV testing</td>
</tr>
<tr>
<td>Taha et al. (2012) (125)</td>
<td>HIV/AIDS</td>
<td>PMTCT</td>
<td>Cross-sectional</td>
<td>Participants in 6 mother-to-child transmission studies in Blantyre, Malawi</td>
<td>Infants born to mothers participating in the studies</td>
<td>8,874</td>
<td>Study Cohort</td>
<td>Low birth weight, preterm birth</td>
<td></td>
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<tr>
<td>Tenkorang et al. (2011) (126)</td>
<td>Risky Sexual Behavior</td>
<td>Socioeconomic Resources</td>
<td>Cross-sectional</td>
<td>Cape Town, South Africa</td>
<td>Young adults responding to the survey</td>
<td>1,319</td>
<td>Community</td>
<td>Sexual risk taking</td>
<td></td>
</tr>
<tr>
<td>Tenkorang et al. (2013) (127)</td>
<td>HIV/AIDS</td>
<td>Testing</td>
<td>Cross-sectional</td>
<td>Secondary schools in the Central, Coast, Eastern, Nairobi, and Rift Valley provinces, Kenya</td>
<td>Form 1-3 students, ages 13-20 years old</td>
<td>14,173</td>
<td>School</td>
<td>HIV testing</td>
<td></td>
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<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
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<td>Ukwuani et al. (2003) (34)</td>
<td>Risky Sexual Behavior</td>
<td>Condom use</td>
<td>Cross-sectional</td>
<td>Zimbabwe-nationally representative samples Uganda, Tanzania-nationally representative samples</td>
<td>1995, 1996</td>
<td>Women ages 15-49 years old and men ages 15-59 years old who were sexually active in the past year and ever used condoms</td>
<td>5,842 (Uganda-3,816, Tanzania-2,026)</td>
<td>Community</td>
<td>Condom use</td>
</tr>
<tr>
<td>Underwood et al. (2015) (130)</td>
<td>HIV/AIDS</td>
<td>Women</td>
<td>Cross-sectional</td>
<td>&quot;...four communities in the Thyolo district in Malawi, four communities in the Francistown district of Botswana, and eight in Mozambique (four in Zambezia and four in Nampula province).&quot;</td>
<td>September-December 2010</td>
<td>Adolescent girls ages 11-18 years old</td>
<td>1,418</td>
<td>Community</td>
<td>Situation for girls has improved, confident to ask partner to use a condom, refuse unwanted sex with a boyfriend…</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>Uthman et al. (2008) (131)</td>
<td>Risky Sexual Behavior</td>
<td>Socio-economic Resources</td>
<td>Cross-sectional</td>
<td>Nigeria-nationally representative sample</td>
<td>2003</td>
<td>currently married, with at least one episode of sexual intercourse</td>
<td>6,362</td>
<td>Community</td>
<td>High risk sexual behaviour (2 or more partners in the last year)</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
</tr>
<tr>
<td>-----------------------</td>
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<td>---------------</td>
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<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Uthman et al. (2014)</td>
<td>Risky Sexual Behavior</td>
<td>Education</td>
<td>Cross-sectional</td>
<td>nationally representative sample from Kenya, Malawi, Tanzania, Zambia.</td>
<td>2007-2011</td>
<td>Women and men ages 15-49 years old with information on HIV serostatus and indicators</td>
<td>45,802</td>
<td>Community, Household</td>
<td>HIV serostatus, condom use at last intercourse, current contraceptive use, lifetime number of sexual partners, age at first intercourse,</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Broad Topic</td>
<td>Narrow Topic</td>
<td>Study Design</td>
<td>Study Setting</td>
<td>Study Time Period</td>
<td>Participant Characteristics included in the study</td>
<td>Sample Size</td>
<td>Random Effect</td>
<td>Individual-Level Outcome(s)</td>
</tr>
<tr>
<td>--------------</td>
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<td>---------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Whetten et al. (2009) (133)</td>
<td>HIV/AIDS</td>
<td>OVCs</td>
<td>Cross-sectional</td>
<td>Communities and institutions in 6 countries, 3 in sub-Saharan Africa (Ethiopia, Kenya, Tanzania)</td>
<td>May 2006-February 2008</td>
<td>Children ages 6-12 years old</td>
<td>2,837</td>
<td>Study Site, Care setting</td>
<td>child mortality, age at first birth, fertility Subjective health, objective health growth, behavior and emotional health, cognitive development</td>
</tr>
</tbody>
</table>
Table 1-4. Ratings for randomized controlled trials or cohort studies using the Quality Assessment Tool for Quantitative Studies

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Selection Bias Rating</th>
<th>Study Design Rating</th>
<th>Confounders Rating</th>
<th>Blinding Rating</th>
<th>Data Collection Rating</th>
<th>Withdrawals/ Dropouts Rating</th>
<th>Global Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahonkhai et al. (2012)(72)</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
</tr>
<tr>
<td>Aliyu et al. (2016)(67)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Carlson et al. (2012)(68)</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Charalambous et al. (2016)(73)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Ezeanolue et al. (2015)(69)</td>
<td>Weak</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Kaljee et al. (2016)(71)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Lahuerta et al. (2012)(74)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Lessells et al. (2011)(75)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
</tr>
<tr>
<td>Yao et al. (2014)(76)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
<td>Weak</td>
</tr>
</tbody>
</table>
Table 1-5. Ratings for cross-sectional studies using an adapted Quality Assessment Tool for Quantitative Studies

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Selection Bias Rating</th>
<th>Confounders Rating</th>
<th>Data Collection Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen et al. (2007)(77)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Andersson et al. (2012)(56)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Babalola et al. (2009)(80)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Birungi et al. (2011)(83)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Boyer et al. (2011)(86)</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Boyer et al. (2011)(85)</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Denison et al. (2015)(89)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Gari et al. (2013)(54)</td>
<td>Strong</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Geary et al. (2015)(92)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Kamndaya et al. (2015)(58)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Kayeyi et al. (2009)(17)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Lerebo et al. (2014)(103)</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Maticka-Tyndale et al. (2010)(35)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medema-Wijnveen et al. (2012)(111)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mohan et al. (2015)(113)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Mulawa et al. (2016)(114)</td>
<td>Moderate</td>
<td>Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Schwandt et al. (2016)(118)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Tabana et al. (2012)(124)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Tenkorang et al. (2013)(127)</td>
<td>Moderate</td>
<td>Strong</td>
<td>Moderate</td>
</tr>
<tr>
<td>Whetten et al. (2009)(133)</td>
<td>Moderate</td>
<td>Weak</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Figure 1-1. Flowchart of search for studies using multilevel models to evaluate the influence of contextual factors on HIV/AIDS, STIs, and risky sexual behavior in sub-Saharan Africa

7,588 records identified through database searching:
- PubMed: 1,849
- Scopus: 1,711
- Web of Science: 1,503
- Embase: 1,388
- CINAHL: 463
- ABI/INFORM Complete: 350
- ASSIA: 226
- Business Source Complete: 62
- EconLit: 23
- Global Index Medicus: 13

4,003 duplicates removed

3,585 records screened

3,308 records excluded

277 full-text articles assessed for eligibility

163 full-text articles excluded:
- 135 ineligible analysis method or study design
- 23 abstract only/no full text
- 5 ineligible setting

4 studies added after hand searching references

118 studies included in qualitative synthesis
MANUSCRIPT 2

Assessing the influence of women’s empowerment and economic resources on risky sexual behavior among young women in Zomba district, Malawi: A multilevel exploration

Abstract

This study’s objective was to explore associations between individual and community economic resources and women’s empowerment with risky sexual behavior (RSB) among young women in Zomba, Malawi. Four measures of RSB were examined: ever had sex, condom use, and two indices measuring age during sexual activity and partner history. Multilevel regression models and regression models with cluster-robust standard errors were used to estimate associations, stratified by school enrollment status. Among the schoolgirl strata, the percent of girls enrolled in school at the community level was associated with ever having sex and consistent condom use. Belief in the right to refuse sex was protective against ever having sex. Among the dropout strata, individual education was associated with riskier scores related to age and partner history. These results suggest that while RSB is complex, women’s empowerment and education at individual and community levels play a role.

Keywords: Risky sexual behavior; contextual factors; economic resources; women’s empowerment; education

Introduction

Malawi has made progress in its control of the human immunodeficiency virus (HIV) epidemic. In 2010, Malawi’s HIV prevalence was 11% (1); 2015–2016 estimates
place national HIV prevalence at 8.8% (2). However, disparities by region and gender remain. HIV prevalence in the Southern Region is twice as high as that in the Northern and Central Regions (12.8%, 5.1%, and 5.6%, respectively) (2). Gender disparities among youth are particularly concerning; HIV prevalence is 4.9% among women ages 15–24 years old, compared to 1% among men of the same age (2). Gender disparities are even more pronounced in the southern Zomba district, where among women ages 15–49, HIV prevalence is 16.8%, compared to 9.3% among men of the same age (2). While these most recent estimates represent a considerable improvement from a decade ago (in 2004, HIV prevalence in Zomba district was 24.4% and 10.5% for women and men, respectively (3)), it is critical that research and intervention efforts continue to focus on women and eliminating HIV gender disparities.

The structural factors associated with risky sexual behavior leading to HIV infection are complex. One known driver of risky sexual behavior among young women is transactional sex. Due to economic hardships, adolescent women may decide to date and have sex with older men in exchange for gifts or economic support (4-6). Women living in communities or households with more resources may not face the same economic pressures to engage in risky sexual behavior (6). Sociocultural norms may also be drivers; women residing in communities where they are given more autonomy may be more empowered to negotiate condom use in sexual encounters, and may have more autonomy in choosing their partners (6-9).
The objective of this study was to explore associations between factors related to economic resources and women’s empowerment, at both individual and community levels, with risky sexual behavior among young women in Zomba district, Malawi.

Materials and Methods

Conceptual Framework

The conceptual framework in Figure 1, adapted from work by Barnett and Whiteside as well as Sweat and Denison (10, 11), guided study design and analyses. In this framework, factors that may be part of the causal pathway for risky sexual behavior are represented in relation to HIV status at four different levels (superstructural, structural/macroenvironmental, microenvironmental, and individual). These factors occur at varying distances from risky sexual behavior, ranging from distal to proximal. Factors from all but the superstructural level were included in these analyses.

Study Design

Secondary analysis was carried out on cross-sectional data from the Schooling, Income, and Health Risk (SIHR) study conducted by Baird et al. among young women in Zomba district, Malawi; full study methodology is available elsewhere (12). Briefly, a randomized controlled trial of a cash transfer intervention was carried out in 176 randomly selected enumeration areas (EAs; approximately 4-5 villages) of Zomba district among two strata of unmarried young women: those enrolled in school at baseline (referred to throughout as schoolgirls), and those who were school dropouts at baseline (referred to throughout as dropouts) (12). The baseline survey (Round 1) was conducted in 2007. After program implementation began and allocation to intervention or control.
group was completed, a follow-up survey (Round 2) was conducted approximately 12 months after Round 1 in 2008. During Round 2 and later during Round 3, data on community characteristics and women’s autonomy in the community were collected from leaders of villages included in the SIHR study. The analyses presented here are limited to participants in the control group with data at Round 2, which consisted of 1,407 schoolgirls and 407 dropouts in 88 enumeration areas with 59 community surveys. (It should be noted that the terms “schoolgirls” and “dropouts” refer to the participants’ status at baseline of the SIHR study, and may not be representative of participants’ school enrolment status at Round 2. For example, participants who were dropouts at baseline may have returned to school by Round 2.)

Measures

Outcomes

Risky sexual behavior was examined using a total of four different outcomes. The first outcome was if the individual had ever had sex; the second outcome, for those who reported sexual activity, was if the individual consistently used condoms. Recognizing these outcomes might represent an over-simplified approach to risky sexual behavior, indices for participants reporting sexual activity were created using exploratory factor analysis. Variables loaded on two distinct factors, one related to partner history (which included number of lifetime partners, number of partners in the last year, frequency of sex with last partner, and an age difference with last partner of greater than five years; referred to here as partner history factor) and one related to age (girls’ age at sexual debut and age when sexual relationship with last partner began; referred to here as age factor).
To create a standardized score for each index, a z-score (with a mean of 0 and a standard deviation of 1) for the values of each variable was generated. The score for each factor was generated by taking the mean of these z-scores (13, 14). A higher score on the Partner History Factor indicated more risky sexual behavior. Since, for the original age variables, lower ages indicated higher risk, the age factor score was reverse coded whereby a higher age factor score indicated higher risk. (See Supplement 1 for further details.)

*Multilevel Factors Related to Economic Resources*

Two variables related to economic resources at the community level were included: a community resources score and the number of development projects in the community in the past five years. The community resources score was derived from principal components analysis of four variables: children typically wear neat clothes; children under 10 years old typically wear shoes; type of housing (traditional, semi-permanent, or permanent); and distance from Zomba Town (the urban center). All variables loaded on to one factor; a z-score for each variable was then calculated, and the mean of those z-scores generated the community resources score. (See Supplement 2 for further details.) Data related to community resource scores were available from 55 community surveys.

Variables related to economic resources at the individual level included household consumption quintiles (monthly consumption, per person, in market unit prices, U.S. dollars); number of shocks experienced by the household in the past three years (such as low crop yields, loss of employment, large rise in the price of food, or death of a
household member); and the number of safety nets used by the household in the past three years (such as free food distribution, scholarships for education, or direct cash transfers).

**Multilevel Factors Related to Women’s Empowerment**

Two variables related to women’s empowerment at the community level were included: a score of women’s autonomy in the community and the percent of girls in school. The score for women’s autonomy in the community was derived from principal components analysis of four variables: how land is transferred within families; how individuals trace descent (through their mother, father, or both); if a wife can inherit land after her husband dies; and if either the man or woman must move out of the community after a divorce. All variables loaded on to one factor; a z-score for each variable was then calculated, and the mean of those z-scores generated the women’s autonomy score. (See Supplement 2 for further details.) Data for the women’s autonomy scores were available from 59 community surveys.

Variables related to women’s empowerment at the individual level included: her belief in her right to refuse unprotected sex and perceived household support for her health. Belief in the right to refuse unprotected sex was based on an aggregate count of the statements the participant agreed with—“Does a woman have the right to refuse unprotected sex with her husband when she thinks her husband may have HIV/AIDS” and “Does a woman have the right to refuse unprotected sex with her husband when she doesn’t want to risk getting pregnant”—and ranged from zero to two. Perceived household support was based on the question, “Compared to 12 months ago, would you
say your household cares about your health: more than one year ago, same as one year ago, and less than one year ago.” Since religion and tribe may also play a role in women’s empowerment, these variables were controlled for as well, with religion categorized as Protestant, Catholic, or Muslim and tribe categorized as Yao, Chewa, Lomwe, and Other (which included Tumbuka, Ngoni, Sena, Tonga, Nyanja, and Mang’anja).

Additional Covariates

Additional covariates included the girl’s age (measured continuously), her highest level of education (primary school vs. secondary or higher), and the household’s highest level of education (primary school vs. secondary or higher); all participants and households achieved at least primary school. Age was excluded from analysis examining the age factor as an outcome.

Data Source

With two exceptions, the cross-sectional data set utilized for analysis was composed of information from Round 2 of the SIHR study. The first exception was related to characteristics of last sexual partner. If a participant reported ever having sex in Round 2 but had not had a partner in the last 12 months (and therefore information related to the most recent sexual partner was not present in Round 2), information on the last partner reported in the Round 1 survey was used. Finally, for 8 of 59 communities in the control group, data were not available from Round 2 of data collection; SIHR survey enumerators completed data collection from these communities during Round 3, and that data were utilized in this study.
Statistical Analysis

The sampling strategy for Baird et al. considered baseline schoolgirls and baseline dropouts as separate strata, so that procedure was followed here (12). Descriptive statistics included frequency distributions or means with standard deviations. Given the hierarchical nature of the data, multilevel regression models were used (multilevel logistic regression for binary outcomes and multilevel linear regression for continuous outcomes). Initially, an empty model was estimated (using the GLIMMIX procedure for binary outcomes and the MIXED procedure for continuous outcomes) in order to partition the variance and calculate the intraclass correlation coefficient (ICC). Next, a random intercepts model was estimated, using community as the level of the random effect. If the multilevel regression models did not converge, regression with cluster-robust standard errors (using the SURVEYLOGISTIC procedure for binary outcomes and the SURVEYREG procedure for continuous outcomes) was carried out (15, 16).

Multilevel models for the odds of ever having sex and the age factor score converged for the schoolgirl strata (Table 2-3). The remaining regression models utilized cluster-robust standard errors (Tables 2-4 and 2-5). Age was centered at the grand mean for all models. Final models included variables as follows: Model 1 incorporated variables related to economic resources, Model 2 incorporated variables related to women’s empowerment, and Model 3 incorporated variables related to both economic resources and women’s empowerment. In all models, weights were used to account for SIHR sampling design (in which probability of inclusion varied by age and rural or urban residence). SAS 9.4 (Cary, North Carolina) was used for all analyses.
This research was approved by the Florida International University Social and Behavioral Institutional Review Board.

Results

Tables 2-1 and 2-2 show descriptive statistics for the baseline schoolgirls and dropouts. Compared to schoolgirls, dropouts were older and less educated (achieving primary school as their highest level of education). Schoolgirls resided in communities with higher resource scores, came from better educated and wealthier households, reported increased household support for health more frequently, were less likely to have ever had sex, and more likely to consistently use condoms.

Schoolgirls

Ever Having Sex and Age Factor Score

Table 2-3 shows the final adjusted multilevel regression models for ever having sex and age factor score among schoolgirls. In Model 3, which controlled for both economic factors and factors related to women’s autonomy, the odds of ever having sex increased by 73% with each increasing year of age (OR=1.73; 95% CI: 1.61, 1.86). Participants from households with a highest education level of primary school had 59% higher odds of ever having sex compared to those from households with a secondary school education or higher (OR=1.59; 95% CI: 1.14, 2.22). The odds of having sex decreased with increased belief in a woman’s right to refuse unprotected sex (OR=0.76; 95% CI: 0.60, 0.96). Perceived household support for health was strongly associated with ever having sex, with those reporting less support or the same level of support as one year ago having increased odds of ever having sex compared to those reporting increased
support (OR=3.23; 95% CI: 2.16, 4.84, and OR=1.97; 95% CI: 1.51, 2.56, respectively). Increasing household consumption quintile was also associated with higher odds of ever having sex (OR=1.11; 95% CI: 1.01, 1.23). At the community level, the odds of ever having sex decreased with each increasing percentage point of girls enrolled in school (OR=0.97; 95% CI: 0.95, 0.996).

In the combined Model 3 for age factor score, participants who had achieved a primary school level of education had a higher age factor score compared to those achieving secondary school or higher (β=0.47; 95% CI: 0.23, 0.71), indicating higher risk. At the community level, increasing scores for women’s autonomy were associated with a higher age factor score (β=0.22; 95% CI: 0.05, 0.40).

**Consistent Condom Use and Partner History Factor Score**

Table 2-4 shows the final adjusted regression models, utilizing cluster-robust standard errors, for consistent condom use and partner history factor score among schoolgirls. In Model 3, the odds of consistent condom use decreased by 16% for each additional year of age (OR=0.84; 95% CI: 0.71, 0.98). Perceived household support for health was strongly associated with consistent condom use, with those reporting less support or the same level of support as one year ago having decreased odds of consistent condom use compared to those reporting increased support (OR=0.37; 95% CI: 0.16, 0.86, and OR=0.58; 95% CI: 0.34, 0.99, respectively). At the community level, the odds of consistent condom use increased with each increasing percentage point of girls enrolled in school (OR=1.06; 95% CI: 1.01, 1.11).
In the combined Model 3 for partner history factor score, participants who had achieved a primary school level of education had a higher partner history factor score compared to those with a secondary school education or higher (β=0.26; 95% CI: 0.08, 0.44), indicating higher risk.

Dropouts

Table 2-5 shows the final adjusted regression models, utilizing cluster-robust standard errors, for risky sexual behavior among dropouts. In Model 3, the odds of ever having sex increased by 80% for each increasing year of age (OR=1.80; 95% CI: 1.52, 2.13). Participants who had achieved a primary school level of education had higher age factor and partner history factor scores compared to those with a secondary school education or higher (β=0.51; 95% CI: 0.23, 0.79, and β=0.24; 95% CI: 0.07, 0.41, respectively). Additionally, participants from households with only a primary school level of education had higher age factor scores compared to those from households with a secondary school education or higher (β=0.26; 95% CI: 0.03, 0.48).

Discussion

Our results suggest that the various aspects of risky sexual behavior are associated with different factors. Among schoolgirls, the percent of girls enrolled in school at the community level was negatively associated with the odds of ever having sex and positively associated with the odds of consistent condom use. Interestingly, increasing scores for women’s autonomy in the community were associated with riskier scores related to age of sexual activity. At the individual level, increased perceived household support for health lowered the odds of ever having sex and improved the odds of condom
use. Belief in the right to refuse sex was protective against ever having sex. Lower educational attainment among the participants was associated with riskier scores related to age and partner history factors, while lower education in households increased the odds of ever having sex. In contrast, among the dropout strata, age was the only variable associated with ever having sex, while individual and household education were the only variables associated with riskier scores related to age and partner history factors.

Our results differed considerably between the schoolgirl and dropout strata, suggesting the underlying mechanisms related to risky sexual behavior vary based on one’s history of school enrollment. Since age was a consistent predictor of ever having sex in both strata, our findings suggest that keeping girls in school so that they may achieve a secondary level of education in a timely manner may be an effective intervention to reduce risky sexual behavior. These findings align with existing literature on the topic in sub-Saharan Africa (17). There is strong evidence that low educational attainment negatively impacts condom use (17). There is also evidence that, for women, low educational attainment increases the risk of early sexual debut (17). Our findings also suggest that the percentage of girls enrolled in school at the community level and household education play important roles in risky sexual behavior.

Among schoolgirls, an increased perception of household support for health was protective for ever having sex and improved consistent condom use. These findings deserve further exploration, particularly because existing evidence related to social support and HIV risk behaviors is mixed (18). Additionally, further research is needed to
fully explore the sociological phenomenon underlying our results related to tribe and religion.

The finding that, among schoolgirls, belief in women’s right to refuse unprotected sex was associated with lower odds of ever having sex aligns with existing theoretical frameworks (19). However, the finding that increasing community-level scores related to women’s autonomy were associated with riskier scores related to age of sexual activity requires further exploration, since literature on this topic is scarce (6, 20-23). Data were not available to fully assess this potentially complex dynamic.

We found that belonging to households in higher quintiles of household consumption (a measure of wealth) increased the odds of ever having sex among the schoolgirl strata. This finding is consistent with other studies, although the literature on the topic is mixed. Some have hypothesized that associations between wealth and risky sexual behavior are due to increases in the likelihood of mobility or having multiple partners (19). At the community level, we found no associations between our measures of economic resources and risky sexual behavior. This may be because, as one of the poorest countries in the world, poverty is ubiquitous in Malawi (24). Our null findings may be accounted for by the lack of variation in community-level economic resources across our sample.

A strength of this study includes the use of indices for assessing risky sexual behavior. Risky sexual behavior is a multifaceted outcome that cannot be fully measured simply by looking at the presence of any sexual behavior or the use of condoms. Our use of indices represents an attempt to move away from oversimplified constructs of risky
sexual behavior. Additionally, we created and utilized composite indicators at the community level to more fully measure community resources and women’s autonomy. While other studies have utilized multilevel analysis to examine risky sexual behavior in Malawi (25-33), to our knowledge this is the first to utilize such a composite for women’s autonomy in the community.

There are several limitations to this study. First, the risky sexual behavior indices and community composite measures presented here require further validation in other data sets. Additionally, limited variation across communities for condom use and partner history factor score among the schoolgirl strata and for all outcomes among the dropout strata may have contributed to the failure of the multilevel models to converge. Finally, the cross-sectional nature of this data set prohibits any inferences related to causality.

Conclusions

Risky sexual behavior is multifaceted and complex. While various factors related to women’s empowerment played a role, the most consistent variables associated with risky sexual behavior were those related to education, including the girl’s level of education, the highest level of education of her household of origin, and the community percentage of girls enrolled in school. Interventions and programs seeking to reduce risky sexual behavior among young women, thereby reducing their risk of HIV infection, should continue to focus on improving access to education at multiple levels.

Supplement 1. Methods for computing risky sexual behavior indices

Exploratory factor analysis (EFA) with principal factor analysis and varimax rotation was used to generate composite indicators for risky sexual behavior. The Kaiser
criterion (number of eigenvalues greater than 1) was used for determining the number of factors to retain. EFA was performed on a total of six variables: girls’ age at sexual debut; age when sexual relationship with last partner began; number of lifetime partners; number of partners in the last year; frequency of sex with last partner; and an age difference with last partner of greater than five years. EFA was performed in SAS 9.4 separately for the schoolgirl and dropout strata. In both strata, results were two distinct factors, one related to the age variables (referred to as Age Factor) and one related to the remaining variables (referred to as Partner History Factor).

Among the schoolgirl strata, eigenvalues were 2.05 and 1.15. For the Age Factor, rotated factor scores were 0.88 for age at sexual debut and 0.82 for age when sexual relationship with last partner began. For the Partner History Factor, rotated factor scores were as follows: number of lifetime partners, 0.74; number of partners in the last year, 0.64; frequency of sex with last partner, 0.54; and age difference with last partner of greater than five years, 0.46. Among the dropout strata, eigenvalues were 1.52 and 1.13. For the Age Factor, rotated factor scores were 0.83 for age at sexual debut and 0.79 for age when sexual relationship with last partner began. For the Partner History Factor, rotated factor scores were as follows: number of lifetime partners, 0.67; number of partners in the last year, 0.58; frequency of sex with last partner, 0.44; and age difference with last partner of greater than five years, 0.36. The scores were then computed using a simple method, which has been shown to be more stable than methods based on factor loadings (13, 14). To create a standardized score for each index, a z-score (with a mean of 0 and a standard deviation of 1) for the values of each variable was generated, by strata. The score for each factor was then generated by taking the mean of these z-scores.
A higher score on the Partner History Factor indicated more risky sexual behavior; conversely, a lower score on the Age Factor indicated more risky sexual behavior.

Supplement 2. Methods for computing community-level composite indicators

Principal components analysis (PCA) with varimax rotation was used to create community-level composite indicators for community resources and the status of women. The Kaiser criterion (number of eigenvalues greater than 1) was used for determining the number of factors to retain. SAS 9.4 was used for all analyses.

For community resources, PCA was performed on four variables: do children typically wear neat clothes; do children under 10 years old typically wear shoes; type of housing (traditional, semi-permanent, or permanent); and distance from Zomba town (the urban center) in kilometers. Type of housing was constructed based on Malawi’s Integrated Household Survey Household Socio-Economic Characteristics Report, which classifies dwellings based on the type of materials used for construction of the walls and roof (34). Variables were coded so that increasing values indicated more favorable conditions, except for Zomba Town. For this variable, the further one resided from Zomba Town, the least favorable. Variables loaded onto one factor with an eigenvalue of 2.12. Factor scores were as follows: children typically wear neat clothes, 0.59; children under 10 years old typically wear shoes, 0.86; type of housing, 0.68; and distance to Zomba Town, -0.76. The composite indicator was computed using a simple method, which has been shown to be more stable than methods based on factor loadings (13, 14). After the PCA was completed, distance to Zomba Town (the urban center) was given negative values, so that living closer to Zomba Town was considered more favorable than
living in a rural area. A z-score for each variable was then calculated, and the mean of those z-scores generated the community resources score.

PCA was performed on four variables in the community survey hypothesized to be related to the status of women on the community: method of land transfer within families (always/almost always transferred through father, usually transferred through father, sometimes through father/sometimes through mother, usually through mother, always/almost always through mother); method individuals use to trace their descent (father, both father and mother, mother); if it is customary for a woman to inherit land when her husband dies; and if it is customary for either the man or woman to have to move out of the community after a divorce (woman, either woman or man, man, neither). Variables were coded so that increasing values indicated more favorable conditions for women. Variables loaded onto one factor with an eigenvalue of 2.42. Factor scores were as follows: method of land transfer, 0.70; method to trace descent, 0.75; land inheritance, 0.89; and move after divorce, 0.75. As with community resources, the composite indicator was computed using a simple method. A z-score for each variable was calculated, and the mean of those z-scores then generated the community resources score.

References


### Table 2-1. Characteristics of baseline schoolgirls and dropouts in the control group of the Schooling, Income, and Health Risk study in Zomba District Malawi

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<th></th>
<th>Schoolgirls</th>
<th>Dropouts</th>
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<tr>
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<td>N=1,407</td>
<td>N=407</td>
</tr>
<tr>
<td></td>
<td>Weighted %a</td>
<td>Weighted %a</td>
</tr>
<tr>
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<tr>
<td>No</td>
<td>75.78</td>
<td>21.62</td>
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<tr>
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<tr>
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<td>65.17</td>
<td>86.14</td>
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<tr>
<td>Always/Almost Always</td>
<td>34.83</td>
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<td>Secondary or Higher</td>
<td>45.91</td>
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<td><strong>Household's Highest Education Level</strong></td>
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<td>Primary</td>
<td>26.98</td>
<td>45.91</td>
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<td>Secondary or Higher</td>
<td>73.02</td>
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<td><strong>Perceived Household Support for Health</strong></td>
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<td>Less than 1 year ago</td>
<td>8.38</td>
<td>13.37</td>
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<td>Same as 1 year ago</td>
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<td>More than 1 year ago</td>
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<td></td>
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<tr>
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<tr>
<td>Lomwe</td>
<td>18.10</td>
<td>12.10</td>
</tr>
<tr>
<td>Other</td>
<td>19.19</td>
<td>17.53</td>
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</table>

*a*Weights were used to account for the sampling design of the Schooling, Income, and Health Risk study.

*b*Among those who had ever had sex (Schoolgirls: n=348; Dropouts: n=303).
Table 2-2. Characteristics of baseline schoolgirls and dropouts in the control group of the Schooling, Income, and Health Risk study in Zomba District Malawi

<table>
<thead>
<tr>
<th>Individual Variables</th>
<th>Schoolgirls N=1,407</th>
<th>Dropout N=407</th>
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<tbody>
<tr>
<td>Age</td>
<td>16.23 (2.34)</td>
<td>18.57 (2.36)</td>
</tr>
<tr>
<td>Household Consumption^b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quintile 1</td>
<td>7.00 (1.98)</td>
<td>5.67 (1.41)</td>
</tr>
<tr>
<td>Quintile 2</td>
<td>12.04 (1.53)</td>
<td>10.11 (1.32)</td>
</tr>
<tr>
<td>Quintile 3</td>
<td>17.66 (2.47)</td>
<td>15.52 (1.71)</td>
</tr>
<tr>
<td>Quintile 4</td>
<td>25.34 (3.48)</td>
<td>23.08 (3.12)</td>
</tr>
<tr>
<td>Quintile 5</td>
<td>48.50 (22.55)</td>
<td>43.37 (15.92)</td>
</tr>
<tr>
<td>Number of Household Shocks</td>
<td>3.78 (2.70)</td>
<td>3.88 (2.30)</td>
</tr>
<tr>
<td>Number of Safety Nets Used by Household</td>
<td>1.40 (1.30)</td>
<td>1.65 (1.10)</td>
</tr>
<tr>
<td>Number of Statements of Agreement: Women’s Right to Refuse Unprotected Sex^c</td>
<td>1.77 (0.62)</td>
<td>1.70 (0.59)</td>
</tr>
<tr>
<td>Partner History Factor^d</td>
<td>0.02 (0.74)</td>
<td>0.00 (0.62)</td>
</tr>
<tr>
<td>Age Factor^d</td>
<td>0.05 (0.99)</td>
<td>0.00 (0.89)</td>
</tr>
<tr>
<td>Community Variables</td>
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<td></td>
</tr>
<tr>
<td>Community Resource Score</td>
<td>0.52 (0.97)</td>
<td>0.27 (0.73)</td>
</tr>
<tr>
<td>Number of Development Programs</td>
<td>2.04 (1.40)</td>
<td>2.23 (1.19)</td>
</tr>
<tr>
<td>Community Women’s Autonomy Score</td>
<td>0.13 (0.64)</td>
<td>0.14 (0.58)</td>
</tr>
<tr>
<td>Percentage of Girls Enrolled in School</td>
<td>85.76 (8.53)</td>
<td>81.99 (8.05)</td>
</tr>
</tbody>
</table>

SD=standard deviation.

^aWeights were used to account for the sampling design of the Schooling, Income, and Health Risk study.
^bMonthly consumption, per person, in market unit prices, U.S. dollars.
^cStatements included: “Does a woman have right to refuse unprotected sex with her husband when she thinks her husband may have HIV/AIDS” and “Does a woman have right to refuse unprotected sex with her husband when she doesn’t want to risk getting pregnant.”
^dAmong those who had ever had sex and had information available on all variables used to estimate the score (Schoolgirls: n=347; Dropouts: n=30)
Table 2-3. Associations between multilevel factors related to economic factors and women’s empowerment with ever having sex and age factor score among schoolgirls in Zomba district, Malawi

<table>
<thead>
<tr>
<th>Individual &amp; Household Variables</th>
<th>Ever Had Sex</th>
<th>Age Factor Score</th>
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<tbody>
<tr>
<td></td>
<td>Model 1(^c)</td>
<td>Model 2(^d)</td>
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<td><strong>OR (95% CI)</strong></td>
<td><strong>OR (95% CI)</strong></td>
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<tr>
<td><strong>Age</strong></td>
<td>1.73 (1.61, 1.86)</td>
<td>1.77 (1.64, 1.91)</td>
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<td><strong>Girl's Highest Education Level</strong></td>
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<td></td>
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<tr>
<td>Primary</td>
<td>1.42 (1.04, 1.96)</td>
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<td><strong>Household’s Highest Education Level</strong></td>
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<td>1.55 (1.12, 2.14)</td>
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<td><strong>Household Consumption Quintile(^h)</strong></td>
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<td>Number of Household Shocks</td>
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<tr>
<td>Number of Safety Nets Used by Household</td>
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<tr>
<td>Belief in Women's Right to Refuse Unprotected Sex</td>
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<td>0.78 (0.61, 0.99)</td>
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<tr>
<td>Perceived Household Support for Health</td>
<td>Less than 1 year ago</td>
<td>Same as 1 year ago</td>
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<td>3.41 (2.25, 5.16)</td>
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<td>0.00 (-0.01, 0.02)</td>
<td>0.00 (-0.01, 0.02)</td>
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OR = odds ratio. CI = confidence interval. aEstimated using PROC GLIMMIX. Intraclass correlation coefficient (ICC) was 0.037 in empty model. 
bEstimated using PROC MIXED. ICC was 0.005 in empty model. cMonthly consumption, per person, in market unit prices, U.S. dollars. dN=1332; observations were dropped from the final model if they had incomplete information on the variables included. eN=1353; observations were dropped from the final model if they had incomplete information on the variables included. fN=1318; observations were dropped from the final model if they had incomplete information on the variables included. gN=333; observations were dropped from the final model if they had incomplete information on the variables included.
(348 schoolgirls reported ever having sex). \(^{\text{a}}\)N=340; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). \(^{\text{b}}\)Monthly consumption, per person, in market unit prices, U.S. dollars.
Table 2-4. Associations between multilevel factors related to economic conditions and women’s empowerment with condom use and partner history factor score among schoolgirls in Zomba district, Malawi

<table>
<thead>
<tr>
<th>Individual &amp; Household Variables</th>
<th>Condom Use&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Partner History Factor Score&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Model 2&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td><strong>Individual &amp; Household Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.79 (0.68, 0.92)</td>
<td>0.84 (0.72, 0.99)</td>
</tr>
<tr>
<td>Girl's Highest Education Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>0.56 (0.29, 1.07)</td>
<td>0.54 (0.27, 1.10)</td>
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<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
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<tr>
<td>Household's Highest Education Level</td>
<td></td>
<td></td>
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<tr>
<td>Primary</td>
<td>0.74 (0.39, 1.42)</td>
<td>0.83 (0.36, 1.90)</td>
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<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Household Consumption Quintile&lt;sup&gt;i&lt;/sup&gt;</td>
<td>1.05 (0.89, 1.24)</td>
<td>--</td>
</tr>
<tr>
<td>Number of Household Shocks</td>
<td>0.90 (0.79, 1.03)</td>
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</tr>
<tr>
<td>Number of Safety Nets Used by Household</td>
<td>0.79 (0.58, 1.07)</td>
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</tr>
<tr>
<td>Belief in Women's Right to Refuse Unprotected Sex Perceived Household Support</td>
<td>--</td>
<td>0.84 (0.54, 1.30)</td>
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<td>0.50 (0.21, 1.18)</td>
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<td>--</td>
<td>0.61 (0.38, 0.98)</td>
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<td>Chewa</td>
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<td>Lomwe</td>
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<td><strong>Community</strong></td>
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<td>Development</td>
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<tr>
<td>Programs</td>
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<td>Women's Autonomy</td>
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<tr>
<td>Community Score</td>
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<tr>
<td>Percentage of</td>
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<tr>
<td>girls in school</td>
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</table>

OR = odds ratio. CI = confidence interval. aEstimated using PROC SURVEYLOGISTIC. bEstimated using PROC SURVEYREG. cN=338; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). dN=345; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). eN=338; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). fN=334; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). gN=341; observations were dropped from the final model if they had incomplete information on the variables included (348 schoolgirls reported ever having sex). hMonthly consumption, per person, in market unit prices, U.S. dollars.
Table 2-5. Associations between multilevel factors related to economic conditions and women’s empowerment with risky sexual behavior among dropouts in Zomba district, Malawi

<table>
<thead>
<tr>
<th></th>
<th>Ever Had Sex&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Condom Use&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td></td>
<td>Model 1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Model 2&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td><strong>Individual &amp; Household Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>1.78 (1.53, 2.06)</td>
<td>1.74 (1.47, 2.06)</td>
</tr>
<tr>
<td><strong>Girl's Highest Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.79 (0.67, 4.81)</td>
<td>1.30 (0.51, 3.33)</td>
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<tr>
<td>Secondary or Higher</td>
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<tr>
<td><strong>Household's Highest Education Level</strong></td>
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<td></td>
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<tr>
<td>Primary</td>
<td>1.06 (0.59, 1.90)</td>
<td>1.12 (0.60, 2.08)</td>
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<tr>
<td>Secondary or Higher</td>
<td>ref</td>
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<tr>
<td><strong>Household Consumption Quintile</strong></td>
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<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.22 (0.99, 1.51)</td>
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</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td><strong>Number of Household Shocks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.02 (0.87, 1.18)</td>
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</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td><strong>Number of Safety Nets Used by Household</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.21 (0.92, 1.60)</td>
<td>--</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td><strong>Belief in Women's Right to Refuse Unprotected Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>--</td>
<td>1.06 (0.73, 1.54)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
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<tr>
<td><strong>Perceived Household Support</strong></td>
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<tr>
<td>Time Period</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
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<tr>
<td>--------------------------</td>
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<td>-------------</td>
</tr>
<tr>
<td>Less than 1 year ago</td>
<td>1.04 (0.40, 2.72)</td>
<td>0.80 (0.31, 2.08)</td>
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<td>Same as 1 year ago</td>
<td>1.24 (0.67, 2.31)</td>
<td>1.27 (0.66, 2.42)</td>
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<tr>
<td>More than 1 year ago</td>
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</tbody>
</table>

**Religion**

<table>
<thead>
<tr>
<th>Religion</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muslim</td>
<td>1.11 (0.50, 2.47)</td>
<td>1.04 (0.42, 2.56)</td>
<td>--</td>
<td>1.52 (0.47, 4.88)</td>
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<tr>
<td>Catholic</td>
<td>0.93 (0.51, 1.72)</td>
<td>0.86 (0.44, 1.68)</td>
<td>--</td>
<td>1.06 (0.37, 3.08)</td>
</tr>
<tr>
<td>Protestant</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
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</table>

**Tribe**

<table>
<thead>
<tr>
<th>Tribe</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yao</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Chewa</td>
<td>--</td>
<td>0.76 (0.37, 1.53)</td>
<td>0.72 (0.33, 1.59)</td>
<td>--</td>
</tr>
<tr>
<td>Lomwe</td>
<td>--</td>
<td>0.57 (0.27, 1.21)</td>
<td>0.57 (0.24, 1.36)</td>
<td>--</td>
</tr>
<tr>
<td>Other</td>
<td>--</td>
<td>0.98 (0.39, 2.49)</td>
<td>0.97 (0.35, 2.67)</td>
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</table>

**Community Variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Resources Score</td>
<td>0.83 (0.58, 1.19)</td>
</tr>
<tr>
<td>Number of Development Programs</td>
<td>0.88 (0.73, 1.07)</td>
</tr>
<tr>
<td>Women’s Autonomy Community Score</td>
<td>0.82 (0.57, 1.20)</td>
</tr>
<tr>
<td>Percentage of girls in school</td>
<td>0.98 (0.94, 1.01)</td>
</tr>
</tbody>
</table>

OR = odds ratio. CI = confidence interval. *Estimated using PROC SURVEYLOGISTIC. bEstimated using PROC SURVEYREG. *N=385; observations were dropped from the final model if they had incomplete information on the variables included. b*N=398; observations were dropped from the final model if they had incomplete information on the variables included. *N=380; observations were dropped from the final model if they had incomplete information on the variables included.
the variables included. ¹N=289; observations were dropped from the final model if they had incomplete information on the variables included (303 dropouts reported ever having sex). ²N=295; observations were dropped from the final model if they had incomplete information on the variables included (only 303 dropouts reported ever having sex). ³N=284; observations were dropped from the final model if they had incomplete information on the variables included (only 303 dropouts reported ever having sex). ¹Monthly consumption, per person, in market unit prices, U.S. dollars.
Table 2-5 ctd. Associations between multilevel factors related to economic conditions and women’s empowerment with risky sexual behavior among dropouts in Zomba district, Malawi

<table>
<thead>
<tr>
<th>Individual &amp; Household Variables</th>
<th>Age Factor Score&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Partner History Factor Score&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Model 1&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Model 2&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Girl's Highest Education Level</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Primary</td>
<td>0.50 (0.23, 0.78)</td>
<td>0.50 (0.23, 0.77)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Household's Highest Education Level</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Primary</td>
<td>0.29 (0.06, 0.51)</td>
<td>0.26 (0.04, 0.48)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Household Consumption Quintile&lt;sup&gt;i&lt;/sup&gt;</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Number of Household Shocks</td>
<td>-0.07 (-0.14, -0.002)</td>
<td>--</td>
</tr>
<tr>
<td>Number of Safety Nets Used by Household</td>
<td>0.01 (-0.03, 0.05)</td>
<td>--</td>
</tr>
<tr>
<td>Belief in Women's Right to Refuse Unprotected Sex Perceived Household Support</td>
<td>0.05 (-0.04, 0.15)</td>
<td>--</td>
</tr>
<tr>
<td>Less than 1 year ago</td>
<td>--</td>
<td>-0.02 (-0.21, 0.18)</td>
</tr>
</tbody>
</table>

<sup>b</sup> Model 1: Baseline model; Model 2: Model 1 with additional individual-level variables; Model 3: Model 2 with additional household-level variables.

<sup>f</sup> β (95% CI).

<sup>g</sup> β (95% CI).

<sup>h</sup> β (95% CI).
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<th>More than 1 year ago</th>
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<tbody>
<tr>
<td><strong>Religion</strong></td>
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<tr>
<td>Muslim</td>
<td>--</td>
<td>0.11 (-0.15, 0.36)</td>
<td>0.05 (-0.21, 0.32)</td>
<td>--</td>
<td>-0.09 (-0.26, 0.08)</td>
<td>-0.15 (-0.31, 0.01)</td>
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<tr>
<td>Catholic</td>
<td>--</td>
<td>0.14 (-0.06, 0.33)</td>
<td>0.10 (-0.10, 0.30)</td>
<td>--</td>
<td>-0.02 (-0.17, 0.13)</td>
<td>-0.01 (-0.16, 0.14)</td>
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<tr>
<td>Chewa</td>
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<td>-0.02 (-0.24, 0.19)</td>
<td>-0.02 (-0.24, 0.20)</td>
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<td>-0.07 (-0.25, 0.10)</td>
<td>-0.06 (-0.23, 0.12)</td>
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<tr>
<td>Lomwe</td>
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<td>-0.16 (-0.39, 0.07)</td>
<td>-0.12 (-0.40, 0.17)</td>
<td>--</td>
<td>0.03 (-0.24, 0.30)</td>
<td>-0.02 (-0.31, 0.27)</td>
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<tr>
<td>Other</td>
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<td>-0.11 (-0.42, 0.21)</td>
<td>-0.11 (-0.41, 0.20)</td>
<td>--</td>
<td>-0.14 (-0.36, 0.08)</td>
<td>-0.17 (-0.41, 0.08)</td>
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<tr>
<td><strong>Community Variables</strong></td>
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<tr>
<td>Community Resources Score</td>
<td>0.05 (-0.08, 0.18)</td>
<td>--</td>
<td>0.05 (-0.11, 0.21)</td>
<td>-0.03 (-0.13, 0.08)</td>
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<td>-0.04 (-0.17, 0.08)</td>
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<tr>
<td>Number of Development Programs</td>
<td>0.04 (-0.06, 0.14)</td>
<td>--</td>
<td>0.05 (-0.05, 0.15)</td>
<td>0.03 (-0.03, 0.09)</td>
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<td>0.04 (-0.03, 0.10)</td>
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<tr>
<td>Women’s Autonomy Community Score</td>
<td>--</td>
<td>0.21 (0.02, 0.39)</td>
<td>0.17 (0.00, 0.34)</td>
<td>--</td>
<td>0.03 (-0.08, 0.15)</td>
<td>0.07 (-0.03, 0.17)</td>
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</tr>
<tr>
<td>Percentage of Girls in School</td>
<td>--</td>
<td>0.00 (-0.01, 0.01)</td>
<td>0.00 (-0.01, 0.02)</td>
<td>--</td>
<td>0.00 (-0.01, 0.01)</td>
<td>0.00 (-0.01, 0.01)</td>
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</table>

OR = odds ratio. CI = confidence interval. aEstimated using PROC SURVEYLOGISTIC. bEstimated using PROC SURVEYREG. cN=385; observations were dropped from the final model if they had incomplete information on the variables included. dN=398; observations were dropped from the final model if they had incomplete information on the variables included. eN=380; observations were dropped from the final model if they had incomplete information on the variables included. fN=289; observations were dropped from the final model if they had incomplete information on the variables included (303 dropouts reported ever having sex). gN=295; observations were dropped from the final model if they had incomplete information on the variables included (only 303
dropouts reported ever having sex). N=284; observations were dropped from the final model if they had incomplete information on the variables included (only 303 dropouts reported ever having sex). Monthly consumption, per person, in market unit prices, U.S. dollars.
Figure 2-1. Conceptual framework of the multilevel factors contributing to knowledge and awareness around risky sexual behavior and HIV status

Adapted from work by Barnett and Whiteside as well as Sweat and Denison (10,11).
MANUSCRIPT 3

Associations between health facility, household and individual factors related to HIV awareness and risky sexual behavior among young women in Zomba district, Malawi

Abstract

The objective of this study was to examine the association between multilevel factors related to HIV awareness and risky sexual behavior among young women in Zomba district, Malawi. Secondary analyses of the Schooling, Income, and Health Risk (SIHR) study were undertaken. Four outcomes related to risky sexual behavior were examined: if participants had ever had sex, consistent condom use, and two scores measuring risk related to partner history and age during sexual activity. Independent variables included individual factors such as education and type of residence, as well as household education and health facility characteristics. Regression models with cluster-robust standard errors and multilevel regression models were used to estimate associations; analyses were stratified by school enrolment status at baseline of the SIHR study. In both strata, increasing age and near rural residence (within 16 kilometers of urban center) increased odds of ever having sex; lower educational achievement was associated with lower age during sexual activity. A history of pregnancy was associated with lower odds of condom use and riskier partner history. For participants in school at baseline, lower household education was associated with higher odds of ever having sex (OR=1.48; 95% CI: 1.06, 2.07); near rural and far rural residence was associated with decreased odds of condom use (OR=0.47; 95% CI: 0.28, 0.78 and OR=0.27; 95% CI: 0.11, 0.65, respectively). For participants not in school at baseline, lower household education was associated with lower age during sexual activity (β=0.31, 95% CI: 0.05,
0.58). Also among this stratum, private or non-governmental health facilities were associated with decreased odds of condom use (OR=0.51; 95% CI: 0.39, 0.67) and higher age during sexual activity (β=-0.30; 95% CI: -0.52, -0.09). While individual factors were associated with risky sexual behavior in both strata, contextual factors differed. Further research is needed to elucidate mechanisms underlying these associations.

**Keywords:** Risky sexual behavior, multilevel models, contextual factors, educational attainment, HIV awareness, health facilities

**Introduction**

Prevalence of human immunodeficiency virus (HIV) in Malawi differs by gender; nationally, HIV prevalence is currently estimated to be 10.8% among women and 6.4% among men (1). The disparity begins among the young population: among 15–19 year olds, HIV prevalence is 3.3% for women and 1.0% for men. Among 20–24 year olds, HIV prevalence is 6.4% for women and 1.1% for men (1); these numbers represent an improvement for men since 2010, when HIV prevalence for this age group was estimated to be 2.8%, but there has been no improvement for women (in 2010, prevalence was also 6.4%) (2). Gender disparities are even more pronounced in the Southern Region; in the southern Zomba district, HIV prevalence among women ages 14–49 is 16.8%, compared to 9.3% among men (1).

Given such disparities, efforts to increase HIV knowledge and awareness among young women are crucial. Higher levels of HIV awareness may manifest in lower risky sexual behavior, a critical factor in the causal pathway for HIV. As has been documented using multilevel conceptual frameworks in the sub-Saharan African context, various
factors may contribute to higher levels of HIV knowledge and awareness. For example, at the individual level, a woman’s educational attainment, perceived HIV risk, or age may all contribute (3-6). Her history of pregnancy and likely subsequent exposure to prevention of mother-to-child-transmission (PMTCT) programs may also play a role (7). The level of education in the household she grew up in could also contribute, as well as her health facility’s capacity for voluntary counselling and testing (VCT) services (8-10). However, the role of these factors has not been fully explored using a multilevel approach within the context of Malawi.

The objective of this study was to add a multilevel perspective to the existing literature by examining individual, household, and health facility factors related to HIV awareness and their associations with risky sexual behavior among young women in Zomba district, Malawi.

Materials and Methods

Conceptual Framework

Study design and analyses were guided by a conceptual framework adapted from work by Barnett and Whiteside as well as Sweat and Denison (Figure 1) (11, 12). In this framework, factors that influence HIV awareness and may lead to the outcome of interest—risky sexual behavior—are represented in relation to HIV status at four different levels (superstructural, structural/macroenvironmental, microenvironmental, and individual). These factors occur at varying distances from risky sexual behavior, ranging from distal to proximal. Indicators from all but the superstructural level were included in this study.
Study Design and Data Source

Secondary analysis was carried out on cross-sectional data from the Schooling, Income, and Health Risk (SIHR) study conducted by Baird et al. among young women in Zomba district, Malawi (13). Full study methodology is available elsewhere. Briefly, a randomized controlled trial of a cash transfer intervention was carried out in 176 randomly selected enumeration areas (EAs; approximately 4-5 villages) of Zomba district among two strata of unmarried young women: those enrolled in school at baseline of the SIHR study (referred to throughout as schoolgirls), and those who were school dropouts at baseline (referred to throughout as dropouts) (13). The baseline survey (Round 1) was conducted in 2007. After program implementation began and allocation to intervention or control group was completed, a follow-up survey (Round 2) was conducted approximately 12 months after Round 1 in 2008; during Round 2, data were also collected from the health facilities serving the EAs included in the SIHR study. The analyses presented here are limited to participants in the control group with data at Round 2, which consisted of 1,407 schoolgirls and 407 dropouts in 88 EAs served by a total of 17 health facilities. (It should be noted that the terms “schoolgirls” and “dropouts” refer to the participants’ status at baseline of the SIHR study, and may not be representative of participants’ school enrolment status at Round 2. For example, participants who were dropouts at baseline may have returned to school by Round 2.)

Measures

Risky sexual behavior was operationalized using a total of four different outcomes. The primary outcomes of interest were if the individual had ever had sex and,
for those who reported sexual activity, if the individual consistently used condoms. Recognizing these outcomes might represent an over-simplified approach to risky sexual behavior, additional experimental indices for sexually active participants were created using exploratory factor analysis. Shown in Table 3-1, variables loaded on two distinct factors: one related to partner history (which included number of lifetime partners, number of partners in the last year, frequency of sex with last partner, and an age difference with last partner of greater than five years; referred to here as “Partner History Factor”) and one related to age (girls’ age at sexual debut and age when sexual relationship with last partner began; referred to here as “Age Factor”). To create a standardized score for each index, a z-score (with a mean of 0 and a standard deviation of 1) for the values of each variable was generated. The score for each factor was then generated by taking the mean of these z-scores (14, 15). Since, for the original age variables, lower ages indicated higher risk, the Age Factor score was reverse coded whereby a higher Age Factor score indicated higher risk.

Independent variables included participants’ highest level of education (primary school vs. secondary or higher), age (measured continuously), HIV literacy, HIV risk perception (none/low vs. medium/high), the highest level of education in her household of origin (primary school vs. secondary or higher), and type of residence. HIV literacy was based on four true or false survey questions related to AIDS transmission and treatment; a maximum score of 4 was possible. Residence was categorized as urban, near rural (residing within 16 kilometers of the urban center), or far rural (residing outside of 16 kilometers of the urban center). Since, due to outreach efforts, PMTCT programming is widespread throughout Malawi and participation may increase one’s HIV awareness,
history of pregnancy was controlled for in all models except for those examining if participants had ever had sex. Age was excluded from analysis examining Age Factor score as an outcome. Facility-level covariates included the number of VCT counsellors employed and the type of health care facility (government vs. private/non-governmental). If a participant was served by more than one health facility with differing numbers of VCT counsellors, data from the facility with the highest number of VCT counsellors was used. If a participant was served by two health facilities that employed the same number of VCT counsellors, the government facility was used.

Participants were linked to health facilities utilizing the EA they resided in at baseline of the SIHR study. With two exceptions, the cross-sectional data set utilized for analysis was composed of information from Round 2 of the SIHR study. The first exception was related to educational attainment of the household of origin. Because some participants were married between Rounds 1 and 2 of survey administration, results reported in the Round 1 survey were used for this variable, since it gave a more accurate description of the households the young women grew up in. The second exception was related to characteristics of last sexual partner. If a participant reported ever having sex in Round 2 but had not had a partner in the last 12 months (and therefore information related to the most recent sexual partner was not present in Round 2), information on the last partner reported in the Round 1 survey was used.

Statistical Analysis

The sampling strategy for Baird et al. considered baseline schoolgirls and baseline dropouts as separate strata, so that procedure was followed here (13). Descriptive
statistics included frequency distributions or means with standard deviations and ranges. Given the hierarchical nature of the data, multilevel regression models were used (multilevel logistic regression for binary outcomes and multilevel linear regression for continuous outcomes). Initially, an empty model was estimated (using the GLIMMIX procedure for binary outcomes and the MIXED procedure for continuous outcomes) in order to partition the variance and calculate the intraclass correlation coefficient (ICC). Next, a random intercepts model was estimated, using health facility as the level of the random effect. Where the multilevel regression models did not converge, regression with cluster-robust standard errors (using the SURVEYLOGISTIC procedure for binary outcomes and the SURVEYREG procedure for continuous outcomes) was carried out in three separate models, the first including only individual covariates, the second including only health facility covariates, and the third including both individual and health facility covariates (16). Multilevel models converged only for analysis related to Partner History Factor score among the schoolgirl strata; logistic or linear regression with cluster-robust standard errors was used for all other models. In all models, weights were used to account for SIHR sampling design. SAS 9.4 (Cary, North Carolina) was used for all analyses.

This study was reviewed and approved by the Florida International University Institutional Review Board.

Results

Table 3-2 presents descriptive statistics for the schoolgirls and dropouts. When compared to schoolgirls, dropouts were older, less educated (achieving primary school as their highest level of education), more likely to have ever been pregnant, have higher
levels of HIV literacy and perceived risk, come from less-educated households, and reside in near rural or far rural areas. They were also more likely to be served by government health facilities and facilities with fewer VCT counsellors on average. The schoolgirls were less likely to have ever had sex and more likely to use condoms; compared with dropouts, there was greater variation in Age Factor scores among schoolgirls. Participants were served by a total of 17 health facilities.

Schoolgirls

Table 3-3 shows the associations between individual and health facility factors and ever having sex, condom use, and the Age Factor score. The final model for ever having sex included a total of 1,373 observations (observations were dropped from the final model if they had incomplete information on the variables included). With each additional year of age, schoolgirls had 74% higher odds of becoming sexually active (OR=1.74; 95% CI: 1.55, 1.95). Young women coming from households with a primary school education had approximately 50% higher odds of ever having sex compared to those from households completing secondary school or higher (OR=1.48; 95% CI: 1.06, 2.07). Similarly, those residing in near rural areas had an OR of 1.52 (95% CI: 1.19, 1.94) compared with those residing in urban areas (the referent group).

The final model for condom use included a total of 346 observations (a total of 393 respondents indicated they had ever had sex; observations were dropped from the final model if they had incomplete information on the variables included). Among schoolgirls who were sexually active, increasing age reduced the odds of condom use (OR=0.85; 95% CI: 0.75, 0.97). Those who had never been pregnant were almost
seventeen times more likely to use condoms compared to those who had been pregnant (OR=16.93; 95% CI: 6.79, 42.26). Those residing in near rural and far rural areas were considerably less likely to use condoms consistently than those residing in urban areas, with ORs of 0.47 (95% CI: 0.28, 0.78) and 0.27 (95% CI: 0.11, 0.65), respectively.

The final model for Age Factor score included a total of 341 observations. Those with primary school as their highest level of education had an Age Factor score of 0.46 standard deviations above those achieving secondary school or higher (95% CI: 0.26, 0.67), indicating higher risk. Those residing in near rural areas had a significantly lower Age Factor score of 0.36 standard deviations below those residing in urban areas (95% CI: -0.56, -0.16), indicating lower risk.

Table 3-4 shows estimates produced by the multilevel models for the Partner History Factor score. The final model for Partner History Factor score included a total of 342 observations. Participants who had never been pregnant scored approximately half of a standard deviation below those who had been pregnant on the Partner History Factor score ($\beta$=-0.49; 95% CI: -0.63, -0.36), indicating lower risk.

Dropouts

Table 3-5 shows the associations between individual and health facility factors and the various risky sexual behavior outcomes. The final models examining associations between factors related to HIV awareness and ever having sex among the dropout strata included a total of 403 observations. Among the dropout strata, young women had a 70% higher odds of becoming sexually active with each additional year of age (OR=1.70; 95%
CI: 1.42-2.04). Those residing in a near rural area had 88% higher odds of ever having sex compared to those residing in urban areas (OR=1.88; 95% CI: 1.35, 2.62).

The final model examining the associations between factors related to HIV awareness and consistent condom use included a total of 300 observations (a total of 319 respondents indicated they had ever had sex; observations were dropped from the final model if they had incomplete information on the variables included). Those who had never been pregnant had approximately five times the odds of condom use compared to those who had been pregnant (OR=4.62; 95% CI: 2.25, 9.48). An increasing HIV literacy score increased the odds of consistent condom use (OR=1.93; 95% CI: 1.11, 3.35) and those with low levels of HIV risk perception were less likely to use condoms compared to those with medium or high risk perceptions (OR=0.35; 95% CI: 0.24, 0.53). Dropouts were also more likely to use condoms consistently as the number of VCT counsellors in the health facility they were served by increased (OR=1.15; 95% CI: 1.03, 1.29), and had decreased odds of consistent condom use if served by private or non-governmental health facilities (OR=0.51; 95% CI: 0.39, 0.67).

The final models examining Age Factor and Partner History Factor scores included a total of 300 observations. Those with primary school as their highest level of education had an Age Factor score of 0.47 standard deviations above those achieving secondary school or higher (95% CI: -0.19, 0.76), indicating higher risk. Similarly, those from households with primary school as their highest level of education had an Age Factor score of 0.31 standard deviations above those achieving secondary school or higher (95% CI: 0.05, 0.58). Those served by private or non-governmental health
facilities had lower Age Factor scores compared to those served by government facilities ($\beta=-0.30; 95\% \text{ CI: -0.52, -0.09}$), indicating lower risk.

Participants with a primary school education had a Partner History Factor score of 0.17 standard deviations greater than those with a secondary school education or greater (95% CI: 0.04, 0.31). Those who had never been pregnant had a Partner History Factor score of 0.20 standard deviations below those who had been pregnant ($\beta=-0.20; 95\% \text{ CI: -0.36, -0.05}$), and those residing in near rural areas had a similarly lower score compared to those residing in urban areas ($\beta=-0.19; 95\% \text{ CI: -0.28, -0.10}$). Dropouts had a slightly increased Partner History Factor score as the number of VCT counsellors in the health facility they were served by increased ($\beta=0.02; 95\% \text{ CI: 0.003, 0.04}$). Those served by private or non-governmental health facilities had a Partner History Factor score of 0.23 standard deviations below those served by a government facility (95% CI: -0.30, -0.15).

Discussion

In both groups, increasing age increased the odds of ever having sex, lower educational achievement was associated with higher Age Factor scores (indicating higher sexual risk), and pregnancy history was associated with condom use and increased Partner History Factor scores (also indicating higher sexual risk). However, the importance of contextual factors differed by strata. For schoolgirls, lower household education was associated with higher odds of ever having sex. Near rural residence was associated with ever having sex, and both near and far rural residence were associated with lower odds of condom use. For dropouts, lower household education was associated with riskier Age Factor scores, near rural residence was associated with ever having sex,
and health facility characteristics were associated with condom use, Partner History Factor scores, and Age Factor scores.

The findings related to formal educational attainment and condom use are supported by other studies conducted in sub-Saharan Africa, highlighted by a recent review on the topic by Zuilkowski & Jukes; consensus on the association between education and other measures of risky sexual behavior (such as sexual debut) is less clear (17). The findings of riskier sexual behavior (lower odds of condom use and higher Partner History Factor scores) among participants who had ever been pregnant partially align with findings of Mugo et al., who found riskier sexual behavior among pregnant women (18). These findings warrant further exploration and may present an opportunity for intervention. While extensive PMTCT efforts have been undertaken in Malawi (19, 20), it is possible women receiving educational benefits from these efforts are largely HIV positive already and are therefore specifically targeted by PMTCT programs. It is critical that sufficient educational programs related to risky sexual behavior and condom use be provided to all pregnant women, not just those that have tested positive for HIV.

Among the dropout stratum, there were seemingly conflicting results related to health facility type. While those served by private/non-governmental health facilities were less likely to use condoms consistently, they had better outcomes on the risky sexual behavior indices: slightly lower scores on the Age and Partner History Factors. This may be due to differences in services and risk communication strategies between the two types of facilities. For example, faith-based facilities may focus more attention on the abstinence and be faithful elements of the ABC (abstinence, be faithful, use condoms).
HIV prevention strategy, while government facilities may focus more attention on promoting condom use (21, 22). While better scores on the risky sexual behavior indices are desirable, they are unlikely to outweigh the close to 50% lower odds of using condoms among those served by private/non-governmental facilities, since condom use represents direct prevention of HIV transmission. On the other hand, different types of communities may give rise to different types of facilities; the differences observed may simply be due community differences rather than facility types. Further research is needed to fully explore these nuanced findings.

Findings related to area of residence were also mixed. While near rural residence was associated with higher odds of ever having sex and lower odds of condom use, within the schoolgirl stratum it was associated with a lower Age Factor score and within the dropout stratum it was associated with lower Partner History Factor scores, indicating lower risk when compared to the referent group of urban residents. The current literature on the association between area of residence and risky sexual behavior is mixed (23, 24). The data presented here suggest that area of residence may impact different aspects of risky sexual behavior; however, exploring the underlying reasons for these differences is beyond the scope of this paper. Future research should seek to understand these associations more extensively.

To the authors’ knowledge, this is one of the only studies to examine the multilevel influence of health facility characteristics on risky sexual behavior in sub-Saharan Africa. Given their potential reach, health facilities provide a unique platform for behavioral interventions. The findings that health facility characteristics were only
associated with risky sexual behavior among the dropout stratum is particularly interesting; health facilities may fill a void when formal education is limited. Associations between services offered and behavioral outcomes warrant exploration in the field. Furthermore, while other studies have utilized multilevel analysis to examine risky sexual behavior in Malawi (25-33), this is the first multilevel study to the authors’ knowledge to utilize indices for assessing risky sexual behavior. There are many aspects of risky sexual behavior that defy measurement by only examining the presence of any sexual activity or the use of condoms. The use of indices represents an attempt to move away from oversimplified constructs of risky sexual behavior.

There are several limitations to this study. First, the risky sexual behavior indices presented here were experimental and require further validation using data from other studies, collected in settings both similar to and different from this study sample. Future studies might use data from sources such as Demographic and Health Surveys to do so. Additionally, it should be noted that pregnancy may be an outcome of RSB, not vice versa. However, given the potential for participation in PMTCT programming to influence HIV awareness, the authors opted to include it in the conceptual framework. As indicated by the 95% CIs, estimates related to pregnancy history and condom use had poor precision; we suspect this was due to limited power, particularly among schoolgirls, because a relatively small proportion of them had ever been pregnant (Table 3-1). Furthermore, there were a relatively low number of health facilities available for analysis (17); low variation of the outcomes across this limited number of facilities may have contributed to the multilevel models not converging. Finally, scores on the risky sexual behavior indices were only estimated for respondents who had complete information on
all components and final models included participants who had complete information on all variables; this may have introduced some bias into the results and limited the precision of estimates.

Conclusions

While age, educational status, and pregnancy history were associated with measures of risky sexual behavior among both the schoolgirl and dropout strata, the types of contextual factors influencing risky sexual behavior varied by strata; dropouts had decreased odds of consistent condom use but less risky Age and Partner History Factor scores if served by private or non-governmental health facilities. Future research is needed to fully elucidate reasons for increased risky sexual behavior among women who have been pregnant and to explore differences in services provided by government and private/non-governmental health facilities.

References


Tables and Figures

Table 3-1. Age and partner history factor loadings, by school enrolment status at baseline of the Schooling, Income, and Health Risk Study, Zomba, Malawi

<table>
<thead>
<tr>
<th></th>
<th>Schoolgirls&lt;sup&gt;b&lt;/sup&gt;</th>
<th></th>
<th>Dropouts&lt;sup&gt;c&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age Factor</td>
<td>Partner History</td>
<td>Age Factor</td>
<td>Partner History</td>
</tr>
<tr>
<td>Girls’ age at sexual debut</td>
<td>0.88</td>
<td>--</td>
<td>0.83</td>
<td>--</td>
</tr>
<tr>
<td>Age when sexual relationship</td>
<td>0.82</td>
<td>--</td>
<td>0.79</td>
<td>--</td>
</tr>
<tr>
<td>with last partner began</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of lifetime partners</td>
<td>--</td>
<td>0.74</td>
<td>--</td>
<td>0.67</td>
</tr>
<tr>
<td>Number of partners in the last year</td>
<td>--</td>
<td>0.64</td>
<td>--</td>
<td>0.58</td>
</tr>
<tr>
<td>Frequency of sexual activity</td>
<td>--</td>
<td>0.54</td>
<td>--</td>
<td>0.44</td>
</tr>
<tr>
<td>with last partner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An age difference with last</td>
<td>--</td>
<td>0.46</td>
<td>--</td>
<td>0.36</td>
</tr>
<tr>
<td>partner of greater than five</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>years</td>
<td></td>
<td></td>
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</tbody>
</table>

<sup>a</sup>Estimated using exploratory factor analysis (EFA) with principal factor analysis and varimax rotation. The number of eigenvalues greater than 1 was used as criteria for determining how many factors to retain. EFA was performed separately for the schoolgirl and dropout strata. Only participants indicating they were sexually active were included in the EFA. 

<sup>b</sup>Eigenvalues: 2.05 and 1.14. 

<sup>c</sup>Eigenvalues: 1.52 and 1.13.
<table>
<thead>
<tr>
<th></th>
<th>Schoolgirls N=1,407</th>
<th>Dropouts N=407</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> - Mean (SD; range)</td>
<td>16.23 (2.34; 12-23)</td>
<td>18.57 (2.36; 13-25)</td>
</tr>
<tr>
<td><strong>Girl's Highest Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>54.09</td>
<td>72.73</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>45.91</td>
<td>27.27</td>
</tr>
<tr>
<td><strong>Ever Pregnant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9.66</td>
<td>58.72</td>
</tr>
<tr>
<td>No</td>
<td>90.34</td>
<td>41.28</td>
</tr>
<tr>
<td><strong>HIV Literacy Score</strong> - Mean (SD; range)</td>
<td>3.69 (0.67; 1-4)</td>
<td>3.67 (0.60; 1-4)</td>
</tr>
<tr>
<td><strong>Risk Perception</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/Low</td>
<td>92.94</td>
<td>89.19</td>
</tr>
<tr>
<td>Medium/High</td>
<td>7.06</td>
<td>10.81</td>
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<tr>
<td><strong>Household's Highest Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>26.98</td>
<td>45.91</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>73.02</td>
<td>54.09</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>34.95</td>
<td>18.67</td>
</tr>
<tr>
<td>Near Rural</td>
<td>55.83</td>
<td>68.55</td>
</tr>
<tr>
<td>Far Rural</td>
<td>9.23</td>
<td>12.78</td>
</tr>
<tr>
<td><strong>Number of VCT Counsellors</strong>- Mean (SD; range)</td>
<td>6.03 (2.86; 0-11)</td>
<td>5.78 (2.32; 0-11)</td>
</tr>
<tr>
<td><strong>Health Care Facility Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>54.77</td>
<td>61.18</td>
</tr>
<tr>
<td>Other</td>
<td>45.23</td>
<td>38.82</td>
</tr>
<tr>
<td><strong>Ever Had Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24.22</td>
<td>78.38</td>
</tr>
<tr>
<td>No</td>
<td>75.78</td>
<td>21.62</td>
</tr>
<tr>
<td><strong>Among those who had ever had sex:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Condom Use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/Sometimes/At the Beginning</td>
<td>65.17</td>
<td>86.14</td>
</tr>
<tr>
<td>Always/Almost Always</td>
<td>34.83</td>
<td>13.86</td>
</tr>
<tr>
<td><strong>Partner History Factor</strong>- Mean (SD; range)</td>
<td>0.02 (0.74; -0.99-2.84)</td>
<td>0.00 (0.62; -1.09-2.10)</td>
</tr>
<tr>
<td><strong>Number of Lifetime Partners</strong> - Mean (SD; range)</td>
<td>1.39 (0.81; 1.00-5.00)</td>
<td>1.76 (0.95; 1.00-6.00)</td>
</tr>
<tr>
<td><strong>Number of Partners in the Last Year</strong> - Mean (SD; range)</td>
<td>0.76 (0.57; 0.00-3.00)</td>
<td>0.67 (0.56; 0.00-3.00)</td>
</tr>
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### Frequency of Sex with Last Partner

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Once or twice only</td>
<td>27.13</td>
<td>9.87</td>
</tr>
<tr>
<td>Less than twice per month</td>
<td>24.00</td>
<td>19.74</td>
</tr>
<tr>
<td>A couple of times per month</td>
<td>18.67</td>
<td>25.66</td>
</tr>
<tr>
<td>1-3 times per week</td>
<td>23.99</td>
<td>36.18</td>
</tr>
<tr>
<td>4 or more times per week</td>
<td>6.23</td>
<td>8.55</td>
</tr>
</tbody>
</table>

### Had an Age Difference with Last Partner of Greater than Five Years

<table>
<thead>
<tr>
<th>Age Factor</th>
<th>Mean (SD; range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Factor</td>
<td>0.05 (0.99; -3.17-3.83)</td>
</tr>
<tr>
<td>Age at Sexual Debut</td>
<td>15.69 (2.07; 1.00-22.00)</td>
</tr>
<tr>
<td>Age when Sexual Relationship with</td>
<td>16.34 (1.98; 11.00-22.00)</td>
</tr>
<tr>
<td>Last Partner Began</td>
<td>22.00</td>
</tr>
</tbody>
</table>

SD = Standard Deviation. VCT = Voluntary Counselling and Testing.

\(^a\)Weights were used to account for the sampling design of the Schooling, Income, and Health Risk study.
Table 3-3. Associations between multilevel factors and risky sexual behavior outcomes among young women in the schoolgirl stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi

<table>
<thead>
<tr>
<th></th>
<th>Ever Had Sex(^{a,b})</th>
<th>Condom Use(^{a,d})</th>
<th>Age Factor(^{c,d})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=1,373</td>
<td>N=346</td>
<td>N=341</td>
</tr>
<tr>
<td></td>
<td>Adjusted OR (95% CI)</td>
<td>Adjusted OR (95% CI)</td>
<td>(\beta) (95% CI)</td>
</tr>
<tr>
<td>Age</td>
<td>1.74 (1.55, 1.95)</td>
<td>0.85 (0.75, 0.97)</td>
<td>--</td>
</tr>
<tr>
<td>Girl's Highest Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.38 (0.97, 1.96)</td>
<td>0.55 (0.23, 1.35)</td>
<td>0.46 (0.26, 0.67)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Ever Pregnant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>No</td>
<td>--</td>
<td>16.93 (6.79, 42.26)</td>
<td>0.06 (-0.17, 0.29)</td>
</tr>
<tr>
<td>HIV Literacy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/Low</td>
<td>0.75 (0.51, 1.10)</td>
<td>1.26 (0.73, 2.03)</td>
<td>0.27 (-0.05, 0.59)</td>
</tr>
<tr>
<td>Medium/High</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Risk Perception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/Low</td>
<td>1.19 (0.93, 1.53)</td>
<td>1.11 (0.68, 1.82)</td>
<td>0.03 (-0.09, 0.15)</td>
</tr>
<tr>
<td>Medium/High</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Household's Highest Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.48 (1.06, 2.07)</td>
<td>0.68 (0.41, 1.12)</td>
<td>0.16 (-0.07, 0.39)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Near Rural</td>
<td>1.52 (1.19, 1.94)</td>
<td>0.47 (0.28, 0.78)</td>
<td>-0.36 (-0.56, -0.16)</td>
</tr>
<tr>
<td>Far Rural</td>
<td>1.35 (0.84, 2.17)</td>
<td>0.27 (0.11, 0.65)</td>
<td>-0.24 (-0.60, 0.13)</td>
</tr>
<tr>
<td>Number of VCT Counsellors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>0.96 (0.88, 1.06)</td>
<td>1.04 (0.94, 1.14)</td>
<td>0.01 (-0.04, 0.06)</td>
</tr>
<tr>
<td>Other</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Health Care Facility Type(^e)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>0.98 (0.66, 1.45)</td>
<td>0.98 (0.48, 1.98)</td>
<td>-0.18 (-0.40, 0.05)</td>
</tr>
</tbody>
</table>

OR=Odds Ratio. CI=Confidence Interval. VCT=Voluntary Counselling and Testing.

\(^a\)Model estimated using logistic regression with cluster-robust standard errors. \(^b\)34 observations were dropped from the final model due to incomplete information on the variables included. \(^c\)Model estimated using linear regression with cluster-robust standard errors. \(^d\)A total of 393 respondents indicated they had ever had sex. A complete case analysis was completed; observations were dropped from the models if they had incomplete information on the variables included. \(^e\)If a participant was served by more than one health facility with differing numbers of VCT counsellors, data on facility type from the facility with the highest number of VCT counsellors was used. If a participant was served by two health facilities that employed the same number of VCT counsellors, the government facility was used. A sensitivity analysis using private facilities as the tie-breaker was conducted. Only four observations were affected, and there were virtually no changes in the estimates.
Table 3-4. Associations between multilevel factors and Partner History Factor score among young women in the schoolgirl stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi

<table>
<thead>
<tr>
<th></th>
<th>Model 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Model 2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Model 3&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β (95% CI)</td>
<td>β (95% CI)</td>
<td>β (95% CI)</td>
</tr>
<tr>
<td>Age</td>
<td>-</td>
<td>0.02 (-0.02, 0.06)</td>
<td>0.02 (-0.02, 0.06)</td>
</tr>
<tr>
<td>Girl's Highest Education</td>
<td>-</td>
<td>0.14 (-0.04, 0.31)</td>
<td>0.14 (-0.04, 0.31)</td>
</tr>
<tr>
<td>Primary</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Ever Pregnant</td>
<td>-</td>
<td>-0.49 (-0.63, -0.36)</td>
<td>-0.49 (-0.63, -0.36)</td>
</tr>
<tr>
<td>Yes</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>No</td>
<td>--</td>
<td>-0.49 (-0.63, -0.36)</td>
<td>-0.49 (-0.63, -0.36)</td>
</tr>
<tr>
<td>HIV Literacy</td>
<td>-</td>
<td>0.04 (-0.09, 0.16)</td>
<td>0.04 (-0.09, 0.16)</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-</td>
<td>-0.01 (-0.23, 0.21)</td>
<td>-0.01 (-0.23, 0.21)</td>
</tr>
<tr>
<td>None/Low</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Medium/High</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Household's Highest</td>
<td>-</td>
<td>-0.05 (-0.24, 0.14)</td>
<td>-0.05 (-0.24, 0.14)</td>
</tr>
<tr>
<td>Education Level</td>
<td>-</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Primary</td>
<td>--</td>
<td>-0.05 (-0.24, 0.14)</td>
<td>-0.05 (-0.24, 0.14)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Residence</td>
<td>-</td>
<td>-0.13 (-0.30, 0.05)</td>
<td>-0.11 (-0.29, 0.06)</td>
</tr>
<tr>
<td>Urban</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Near rural</td>
<td>--</td>
<td>-0.11 (-0.43, 0.11)</td>
<td>-0.16 (-0.43, 0.11)</td>
</tr>
<tr>
<td>Far Rural</td>
<td>--</td>
<td>0.01 (-0.03, 0.04)</td>
<td>0.01 (-0.03, 0.04)</td>
</tr>
<tr>
<td>Number of VCT Counsellors</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Facility Type&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Government</td>
<td>--</td>
<td>--</td>
<td>Ref</td>
</tr>
<tr>
<td>Other</td>
<td>--</td>
<td>--</td>
<td>0.01 (-0.20, 0.21)</td>
</tr>
</tbody>
</table>

Random Effects

<table>
<thead>
<tr>
<th>Individual-Level</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance</td>
<td>0.545 (p&lt;0.001)</td>
<td>0.459 (p&lt;0.001)</td>
<td>0.459 (p&lt;0.001)</td>
</tr>
<tr>
<td>HF Variance</td>
<td>0.001 (p=0.441)</td>
<td>0.003 (p=0.327)</td>
<td>0.002 (p=0.391)</td>
</tr>
</tbody>
</table>

CI=Confidence Interval. VCT=Voluntary Counselling and Testing.

- Empty model. ICC=0.008. Random intercepts model with individual covariates.
- Random intercepts model with both individual and health facility covariates. Estimates of fixed effects were generally consistent with estimates from linear regression with cluster-robust standard errors; confidence intervals varied slightly but statistical significance did not change. In the final model, N=342. A total of 393 respondents indicated they had ever had sex. A complete case analysis was completed; observations were dropped from the models if they had incomplete information on the variables included.
- If a participant was served by more than one health facility with differing numbers of VCT counsellors, data on facility type from the facility with the highest number of VCT counsellors was used. If a participant was served by two health facilities that employed the same number of VCT counsellors, the government facility was used. A sensitivity analysis using private facilities as the tie-breaker was conducted. Only four observations were affected, and there were virtually no changes in the estimates.
Table 3-5. Associations between multilevel factors and risky sexual behavior outcomes among young women in the school dropout stratum of the Schooling, Income, and Health Risk Study, Zomba district, Malawi

<table>
<thead>
<tr>
<th></th>
<th>Ever Had Sex(^a)</th>
<th>Condom Use(^a,c)</th>
<th>Age Factor(^b,c)</th>
<th>Partner History Factor(^b,c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=403</td>
<td>N=300</td>
<td>N=300</td>
<td>N=300</td>
</tr>
<tr>
<td></td>
<td>Adjusted OR (95% CI)</td>
<td>Adjusted OR (95% CI)</td>
<td>β (95% CI)</td>
<td>β (95% CI)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.70 (1.42, 2.04)</td>
<td>1.02 (0.81, 1.28)</td>
<td>--</td>
<td>0.03 (0.00, 0.06)</td>
</tr>
<tr>
<td>Girl's Highest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.41 (0.55, 3.62)</td>
<td>0.34 (0.11, 1.05)</td>
<td>0.47 (0.19, 0.76)</td>
<td>0.17 (0.04, 0.31)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Ever Pregnant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>--</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>No</td>
<td>--</td>
<td>4.62 (2.25, 9.48)</td>
<td>-0.08 (-0.33, 0.17)</td>
<td>-0.20 (-0.36, -0.05)</td>
</tr>
<tr>
<td>HIV Literacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/Low</td>
<td>1.27 (0.79, 2.03)</td>
<td>1.93 (1.11, 3.35)</td>
<td>-0.12 (-0.30, 0.06)</td>
<td>-0.08 (-0.18, 0.02)</td>
</tr>
<tr>
<td>Medium/High</td>
<td>0.59 (0.28, 1.23)</td>
<td>0.35 (0.24, 0.53)</td>
<td>-0.02 (-0.31, 0.27)</td>
<td>-0.08 (-0.42, 0.25)</td>
</tr>
<tr>
<td>Risk Perception</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household's Highest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.24 (0.62, 2.44)</td>
<td>0.78 (0.17, 3.71)</td>
<td>0.31 (0.05, 0.58)</td>
<td>0.08 (-0.09, 0.25)</td>
</tr>
<tr>
<td>Secondary or Higher</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Near Rural</td>
<td>1.88 (1.35, 2.62)</td>
<td>0.87 (0.59, 1.27)</td>
<td>0.01 (-0.27, 0.29)</td>
<td>-0.19 (-0.28, -0.10)</td>
</tr>
<tr>
<td>Far Rural</td>
<td>1.23 (0.48, 3.18)</td>
<td>0.43 (0.18, 1.00)</td>
<td>-0.05 (-0.37, 0.28)</td>
<td>-0.02 (-0.12, 0.09)</td>
</tr>
<tr>
<td>Number of VCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counsellors</td>
<td>1.02 (0.91, 1.13)</td>
<td>1.15 (1.03, 1.29)</td>
<td>0.02 (-0.01, 0.05)</td>
<td>0.02 (0.003, 0.04)</td>
</tr>
<tr>
<td>Facility Type(^d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Government</td>
<td>Ref</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Other</td>
<td>1.05 (0.62, 1.79)</td>
<td>0.51 (0.39, 0.67)</td>
<td>-0.30 (-0.52 , -0.09)</td>
<td>-0.23 (-0.30, -0.15)</td>
</tr>
</tbody>
</table>

OR=Odds Ratio. CI=Confidence Interval. VCT=Voluntary Counselling and Testing.

aModel estimated using logistic regression with cluster-robust standard errors.
bModel estimated using linear regression with cluster-robust standard errors.
cA total of 319 respondents indicated they had ever had sex. A complete case analysis was completed; observations were dropped from the models if they had incomplete information on the variables included.
dIf a participant was served by more than one health facility with differing numbers of VCT counsellors, data on facility type from the facility with the highest number of VCT counsellors was used. If a participant was served by two health facilities that employed the same number of VCT counsellors, the government facility was used. A sensitivity analysis using private facilities as the tie-breaker was conducted. Only four observations were affected, and there were virtually no changes in the estimates.
Figure 3-1. Conceptual framework of the multilevel factors contributing to knowledge and awareness around risky sexual behavior and HIV status

Adapted from work by Barnett and Whiteside as well as Sweat and Denison (11,12).
CONCLUSIONS

Quantitatively, multilevel statistical models are utilized to examine the role of contextual factors in relation to health outcomes and to compare contextual factors to compositional, or individual-level, factors (1-6). Montgomery and Hewitt suggested the utility of such models has not been fully explored in developing nations (7). A systematic literature review was undertaken to describe their use in sub-Saharan Africa. Furthermore, data that were collected from the control group of the Schooling, Income and Health Risk study in Zomba District, Malawi, were analyzed from a multilevel perspective to assess the influence of contextual factors on risky sexual behavior (8).

To the author’s knowledge, the systematic review presented in Manuscript 1 is the first to describe the use of multilevel models in evaluating the influence of contextual factors on HIV/AIDS, sexually transmitted infections, and risky sexual behavior in sub-Saharan Africa. The results of the studies included indicate numerous contextual factors, such as community-level poverty and education, are associated with a number of outcomes related to HIV/AIDS and risky sexual behavior. Nearly all studies consisted of a cross-sectional design, and most represented secondary data analysis, with Demographic and Health Surveys being the most frequently utilized data source. Only five of 118 included studies evaluated the impact of a contextual-level intervention for HIV/AIDS, representing the lack of evidence related to the causal mechanisms underlying associations between contextual factors and HIV/AIDS. Findings also highlighted the lack of standardized reporting guidelines for multilevel models and their potential value.
The results of the systematic review also revealed a lack of research evaluating indices of risky sexual behavior within the context of Malawi. Manuscript 2 set out to do so by examining as outcomes two indices measuring age during sexual activity and partner history, in addition to whether participants had ever had sex or regularly used condoms. The exposures of interest were measures of economic resources and women’s empowerment at both individual and community levels. While various factors were associated with risky sexual behavior, the most consistent variables associated with risky sexual behavior were those related to education, including the girl’s level of education and the highest level of education of her household of origin, and the community percentage of girls enrolled in school.

Manuscript 3 examined the same four measures of risky sexual behavior in relation to health facility characteristics and other factors related to HIV awareness. Age, educational status, and pregnancy history were associated with measures of risky sexual behavior among both schoolgirl and dropout strata. However, the types of contextual factors influencing risky sexual behavior varied by strata, with health facility characteristics being associated with risky behavior among the dropouts.

The use of indices related to age during sexual activity and partner history represent an attempt to move away from oversimplified constructs of risky sexual behavior. Findings from Malawi suggest that interventions and programs seeking to reduce risky sexual behavior among young women, thereby reducing their risk of HIV infection, should continue to focus on improving access to education at multiple levels. Further research is needed to fully elucidate reasons for increased risky sexual behavior.
among women who have been pregnant and to explore differences in services provided by government and private/non-governmental health facilities. Given the recent focus on structural interventions to prevent HIV infection among adolescent women in sub-Saharan Africa, future studies utilizing multilevel statistical models should focus on contextual-level interventions in order to strengthen the evidence base for causality.

References


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SELECTED PUBLICATIONS


