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Monica K. Fleming Date

Gender, Age, and Equity in Mass Drug Administrations for the Control and Elimination of Neglected Tropical Diseases: A Cross-Sectional Study of Coverage in Burkina Faso, Malawi, and Uganda

By

Monica K. Fleming

Master of Public Health

Global Epidemiology

Julie Gazmararian, PhD, MPH

Committee Chair

Katherine Gass, PhD, MPH

Committee Member

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By

Monica K. Fleming

Bachelor of Science in Biology

Florida State University

2014

Thesis Committee Chair: Julie Gazmararian, PhD, MPH

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Abstract

Gender, Age, and Equity in Mass Drug Administrations for the Control and Elimination of Neglected Tropical Diseases: A Cross-Sectional Study of Coverage in Burkina Faso, Malawi, and Uganda

By Monica K. Fleming

Background: Neglected tropical diseases (NTDs) are diseases that cause illness and impose significant burden in over one billion people in the poorest communities in the world. Preventive chemotherapy, through mass drug administration (MDA), remains one of the most cost-effective strategies for NTD control and elimination. Achieving uniformly high treatment coverage in every MDA round is critical to ensure reservoirs of infection don't remain among sub-groups of the population.

Objective: To assess whether MDA treatment is equitable across sub-groups of the population and understand the underlying factors contributing to disparities in treatment.

Methods: This study pooled data from coverage surveys that were conducted from 2014-2015 in selected lymphatic filariasis endemic districts in Burkina Faso, Malawi, and Uganda, four to six months after MDAs occurred. The outcomes of interest were program coverage by gender and age, and reasons for non-participation. Data were collected on individuals in household interviews. Households were sampled, and all individuals who were present at the time of the last MDA were surveyed. The data were used to calculate frequencies and proportions and chi-square test was used to indicate the difference in proportions among males and females in each age category.

Results: Program coverage differed by gender, and this relationship changed with age. Females reported higher coverage than males in all three countries. Coverage among females was approximately 1% higher in Burkina Faso, 7% higher in Malawi and 1% higher in Uganda. The difference was statistically significant in Burkina Faso ($p = 0.04$) and Malawi ($p < .0001$). Males and Females met coverage targets in Burkina Faso and Malawi overall; however, our assessment of coverage by gender and age identified sub-groups in Malawi, specifically adult males that did not meet the target threshold for coverage (80%). Coverage among males 30-39 years was 74% and 50+ years was 75%. Males accounted for the majority of non-participants overall and reported being away at the time of MDA as the most common reason for missing MDA.

Conclusions: Addressing reasons for non-participation among these sub-groups is critical for programs to achieve uniformly high treatment coverage necessary for NTD control and elimination goals.

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Chapter I – Background

I. Background

A. Overview of Neglected Tropical Disease

Neglected tropical diseases (NTDs) are a group of communicable diseases that cause illness and impose a significant burden in over one billion people in the poorest and most marginalized communities in the world (1, 2). They cause disfiguring, debilitating impacts, contributing to both physical and emotional suffering, that can at times lead to death (3). Infection with one of these diseases can hinder a person's ability to work, go to school and contribute to their community (1, 2). NTDs are a huge contributing factor to the cycle of poverty, limiting economic opportunity for adults, and impeding the development of already vulnerable children (4).

B. Treatment and Prevention

Treatment and prevention of NTDs is crucial to increasing people's productivity and quality of life, improving school attendance and cognitive development, increasing economic opportunity, and reducing vulnerability to other diseases (4, 5). In recent years, the World Health Organization (WHO) has produced evidence for interventions that can effectively control, eliminate, and even eradicate the burden caused by NTDs (6). As such, the WHO began to focus on strategic interventions to combat NTDs, through strategies that stop the spread of infection, and alleviate the suffering of affected populations.

In 2012, the WHO published the 2020 road map for implementation, 'accelerating work to overcome the global impact of neglected tropical diseases' (6, 7). This road map inspired new goals for elimination and control of ten of the highest burden NTDs by the year 2020. These goals resulted in many philanthropic organizations, pharmaceutical companies, and government and international agencies pledging commitments, including funding, resources, and treatment to intensify control and elimination efforts (8). In the London Declaration on Neglected Tropical Diseases in 2012, partners committed to working together to help eradicate Guinea worm disease, eliminate lymphatic filariasis, leprosy, sleeping sickness (human African trypanosomiasis), and trachoma and assist in the control of schistosomiasis, soil-transmitted helminths, Chagas disease, visceral leishmaniasis, and onchocerciasis (9). Specific control and elimination strategies vary by NTD, however most strategies use preventive chemotherapy, innovative and intensified disease management, or a more complex combination of care and prevention (1).

C. **Preventive Chemotherapy**

Preventive chemotherapy (PC) is one of the WHO recommended intervention strategies, comprised of regular administration of safe, oral medications. Delivery of PC most commonly occurs through mass drug administrations (MDAs) (10). MDAs are large-scale campaigns that administer PC to entire populations infected, or at risk of infection in an endemic area without individual diagnosis (11, 12). PC through MDA remains one of the most cost-effective strategies for the control and elimination of five NTDs, also known as

PC-NTDs: lymphatic filariasis, onchocerciasis, schistosomiasis, trachoma and soil-transmitted helminths (hookworm, ascariasis and trichiasis) (1, 2) . Only four drugs are needed to treat all five diseases. These drugs include albendazole (ALB), Zithromax (ZITH), ivermectin (IVM) or diethylcarbamazine (DEC) and praziquantel (PZQ) (14).

These four drugs can be administered alone or in combination, depending on MDA program objectives (6). MDAs can target a single disease or multiple diseases at once. Integrated MDAs are a common strategy that distribute a combination of drugs, targeting control and elimination goals of multiple diseases at one time (10). Frequency of MDAs is generally annually or biannually, depending on the specific level of infection of disease in a population (5). More than seven billion treatments have been delivered since 2006, with over 700 million people being treated annually (15).

D. **Drug Coverage**

After each MDA round, national programs report drug coverage, the most important indicator in determining success of MDA (16). Coverage is the proportion of individuals in the targeted population who swallowed the drug during MDA, reported as a percentage (10). Drug coverage is commonly reported in four forms: program coverage (proportion of the eligible population that is treated), epidemiologic coverage (proportion of the entire target population treated, regardless of eligibility), geographical coverage (proportion of the endemic districts that received treatment) and national coverage (proportion of the at-risk population that was treated). Reported drug coverage is usually

calculated by aggregating data from volunteer drug distributors (numerator) and dividing by population estimates reported by census data (denominator) (10).

While it would be ideal to reach 100% drug coverage of the eligible population, current MDA performance indicators, set by World Health Organization, define success of an MDA by reported drug coverage exceeding a disease-specific target threshold (17). Coverage targets vary by disease, remain the same across countries and regions, and are independent of the level of disease present. Disease specific coverage targets are found in Table 1 (18).

Table 1: Preventive chemotherapy coverage targets for the control and elimination of neglected tropical diseases.

Disease	Drugs	Coverage target	2020 Goal
Lymphatic Filariasis	Albendazole + Ivermectin	65% epidemiologic coverage 80% program coverage[a]	Elimination
Onchocerciasis	Ivermectin	80% epidemiologic coverage, 95-100% program coverage[b]	Elimination
Schistosomiasis	Praziquantel	75% school-aged children 5-14	Control
Trachoma	Zithromax	80% of epidemiologic coverage	Elimination
Soil-transmitted helminths	Albendazole	75% school-aged children 5-14	Control

[a] 65% is the official WHO epidemiologic coverage target, it is generally accepted that it correlates with an 80% program coverage. [b] 80% is the official WHO epidemiologic coverage target, it is generally accepted that it correlates with a 95-100% program coverage.

E. **Coverage Surveys**

Coverage surveys, conducted post-MDA, are population-based, probability surveys designed to validate reported drug coverage, and assess if coverage has exceeded the target threshold (19). Coverage surveys also provide an opportunity to assess other valuable information not collected by routine MDA reporting. This

can include gathering information on demographics (gender and age), reasons for non-participation, adverse effects, distribution strategies, and health education activities (20). Coverage surveys have been identified and recommended by the WHO and drug donation programs as a necessary means of program monitoring to ensure MDAs are achieving and maintaining adequate drug coverage (20). While conducting coverage surveys can be costly and timely, they are essential to track progress of program goals, evaluate program performance, and allow for further research to be conducted (19).

F. **Threat to Control/Elimination Goals: Non-participants**

Coverage targets assume treatments are administered randomly throughout the population (21, 22). However, they may not reflect true coverage as treatments may not occur randomly in real world situations but follow a systematic pattern (21, 23). In many cases, the same sub-groups of people may not receive the drugs in multiple rounds of MDAs, also known as systematic non-participants. For the purposes of this paper, systematic non-participants refer to those who are eligible for treatment, yet untreated across consecutive MDA treatment rounds, regardless of the reason untreated. Simulations have illustrated that reservoirs of infection could remain in the population due to sub-groups who systematically do not participate and do not receive MDA treatment over multiple rounds (21). This places populations at risk of new infections and could hurt progress towards elimination goals (8, 24). In some cases, systematic non-participation could prevent the program from achieving elimination (25).

Identifying and characterizing sub-groups of non-participants is the first step to addressing gaps in achieving uniformly high treatment coverage in every treatment round. Demographics, such as gender and age, have been identified as possible predictors for participation with MDAs. In previous studies, gender has been found to be associated with MDA participation with females having lower rates of participation as pregnancy was often cited as a reason for non-participation (13, 26). Age has also been associated with MDA participation in some studies, with the youngest age group (less than five years) being associated with non-participation due to parents' fear of how treatment might affect their children (26).

Once sub-groups have been identified for being less likely to participate, the next step is identifying the underlying factors contributing to non-participation among these sub-groups of the population. Many studies have identified reasons for non-participation, from program level issues (delivery, drug availability) to individual characteristics (knowledge and awareness, perceived benefits and risks, personal situations) (8). However, assessing how these factors affect different sub-groups of the population is still lacking and other studies have suggested further research is necessary. This information will help programs tailor MDAs to equitably reach all populations (8).

G. **Goal/Objectives/Significance:**

The overall goal of this study was to assess whether MDA treatment is equitable across sub-groups of the population and understand the underlying factors contributing to disparities in MDA treatment among sub-groups of the

population. Specific objectives included: (1) estimating the percent drug coverage for ALB + IVM in Burkina Faso and Malawi, and percent drug coverage of ALB, IVM, PZQ and ZITH in Uganda by gender and age; (2) evaluating whether sub-groups of the population (by gender and age) are disproportionately treated in MDAs; and (3) examining reasons for non-participation, and how they may affect sub-groups disproportionately.

Reaching NTD control and elimination targets depend on achieving uniformly high treatment coverage in every MDA treatment round. Evaluation of gender and age equity of MDA programs and underlying factors contributing to gender and age disparities can help in identifying and characterizing sub-groups of non-participants. Identifying non-participants and factors contributing to non-participation is a crucial step for programs to identify barriers that still exist in reaching uniformly high coverage.

Chapter II – Manuscript

II. Manuscript

A. Introduction

Neglected tropical diseases (NTDs) are a group of communicable diseases that cause illness and impose a significant burden in over one billion people in the poorest and most marginalized communities in the world (1, 2). They cause disfiguring, and debilitating impacts, and are a huge contributing factor to the cycle of poverty (4).

In recent years, the World Health Organization (WHO) has produced evidence for interventions that can effectively control, eliminate and even eradicate the burden caused by NTDs (6). Preventive chemotherapy (PC) through mass drug administration (MDA) is one of the WHO recommended intervention strategies. Comprised of regular administration of safe, oral medications, PC through MDA remains one of the most cost-effective strategies for the control and elimination of five NTDs: lymphatic filariasis, onchocerciasis, schistosomiasis, trachoma and soil-transmitted helminths (hookworm, ascariasis and trichiasis) (1, 2, 10).

MDA performance indicators, set by the World Health Organization, define success of an MDA by reported drug coverage exceeding a disease-specific target threshold (17). Drug coverage is the proportion of individuals in the targeted population who swallowed the drug during MDA, reported as a percentage (10). After each MDA round, national programs report drug coverage, which is widely considered the most important indicator in determining success of MDA (16).

Coverage targets assume treatments are administered randomly throughout the population (21, 22). However, they may not reflect true coverage as treatments may not occur randomly in real world situations, but instead, follow a systematic pattern (21, 23). In many cases, the same sub-groups of people may not receive the drugs in multiple rounds of MDAs, also known as systematic non-participants. For the purposes of this paper, systematic non-participants refer to those who are eligible for treatment, yet untreated across consecutive MDA treatment rounds, regardless of the reason untreated. Simulations have illustrated that reservoirs of infection could remain in the population due to sub-groups who systematically do not participate and do not receive MDA treatment over multiple rounds (21). This places populations at risk of new infections and could hurt progress towards elimination goals (8, 24). In some cases, systematic non-participation could prevent the program from achieving elimination (25).

Identifying and characterizing sub-groups of non-participants, and factors contributing to non-participation is a crucial step for programs to identify barriers that still exist in reaching uniform coverage. In previous studies, demographics, such as gender and age, have been identified as possible predictors for participation with MDAs (13, 26). However, gender and age disaggregated data is relatively sparse in peer-review literature (27). Reporting of gender and age disaggregated data has only recently been encouraged by the WHO, as a standard practice, and only 13% of countries provided gender disaggregated data in 2015 lymphatic filariasis MDA reports (28). The need for country programs to collect and analyze gender and age disaggregated data has been identified as an

important step to research factors underlying gender disparities, to better inform policies and programs (27).

Evaluation of gender and age equity of MDA programs and underlying factors contributing to gender and age disparities can help in identifying and characterizing sub-groups of non-participants. The overall goal of this study was to assess whether MDA treatment is equitable across sub-groups of the population and understand the underlying factors contributing to disparities in MDA treatment. Specific objectives included: (1) estimating the percent drug coverage for ALB + IVM in Burkina Faso and Malawi, and percent drug coverage of ALB, IVM, PZQ and ZITH in Uganda, by gender and age; (2) evaluating whether sub-groups of the population (by gender and age) are disproportionately treated in MDAs; and (3) examining reasons for non-participation, and how they may affect sub-groups disproportionately.

B. Methods

1. Study Setting

This study took place in three lymphatic filariasis (LF) endemic countries: Burkina Faso, Malawi and Uganda, six months following MDAs that occurred in each country between 2013 – 2014. In 2013, Burkina Faso's total population requiring MDA was 17,322,796 people and 11,664,010 were targeted for MDA. In Malawi, 14,989,401 people required MDA and all were targeted for treatment. In Uganda, 14,875,650 people required treatment, and 11,277,331 were targeted (30). By 2014, Malawi had become the second country in the region to move into the post-MDA surveillance

phase after distributing treatment in all implementing units (IU) and reaching coverage targets. Burkina Faso and Uganda continued to require MDA. Burkina Faso was one of 22 countries that reached 100% geographical coverage and was on track to eliminate LF as a public health problem by 2020. However, Uganda reported meeting 89% geographical coverage, and remained one of 23 countries that did not reach 100% geographical coverage and was not on track for elimination by 2020 (31).

2. Study Population

The population targeted for the LF MDA was of interest for this study. For LF, the target population included every (eligible) individual living in the district at the time of the last MDA. Data used for this study was collected as part of a multi-country study comparing coverage survey evaluation methods, and therefore three sampling techniques were used in each country to select households for coverage survey interviews. All individuals in the household at the time of the last MDA were included in the survey (regardless of MDA eligibility). If a person was missing at the time of the survey, someone in the household responded for the missing individual, as a proxy response (32).

a. Sampling Techniques

Data from a multi-country study comparing coverage survey sampling methods was used for this study. Coverage surveys were conducted from 2014-2015 in three lymphatic filariasis (LF) endemic districts in Burkina Faso, three LF endemic districts in Malawi and

one LF endemic district in Uganda. One sampling method was used per district in Burkina Faso and Malawi, and all three sampling methods were used in one district in Uganda. The three sampling method techniques that were used, are specified below.

i. Expanded Program on Immunization's 30 cluster survey (EPI) is a non-probability method believed to produce results that are generally representative (33, 34). Enumeration Areas (EA), the smallest areas for which census results are available, were determined and 30 were selected amongst all the EAs in the district using probability proportional to estimated size. Approximately 60 people were interviewed per EA. Survey teams went household to household in each EA until 60 individuals had been surveyed. To choose the first house, the survey team found the approximate center of the area, then used a 'spin the bottle' approach to identify a random direction. All households in that direction were enumerated, and one was chosen randomly to serve as the starting house (32).
ii. Lot Quality Assurance Sampling (LQAS): a stratified random sampling method, in which a small sample of individuals were used to determine if coverage threshold has been reached for the district. Each district was divided into five supervision areas (SA), within each SA, 19

individuals were sampled for a total of 95 individuals. Selection of EAs within each SA were chosen using probability proportional to estimated size. Within each of the selected EAs, the starting house was chosen at random from a list of all the households. All individuals who were living in the household at the time of MDA were enumerated, but only one person was randomly chosen for interview (32).

iii. Probability Sampling with Segmentation (PSS): a segmented sampling approach that offered equal probability sampling. EAs were selected using probability proportional to estimated size. Each EA was divided into a variable number of segments with approximately the same number of households per segment. One segment was randomly chosen in each EA, and a subset of households within that segment was included in the survey, using a systematic sampling interval (32).

b. Inclusion/Exclusion Criteria

All individuals in each household were surveyed regardless of MDA eligibility. For this study however, only individuals eligible for MDA were included. Individuals who were reportedly ineligible (too young, pregnant/lactating, or severely ill) at the time of MDA were excluded from the analysis. Observations for children under five

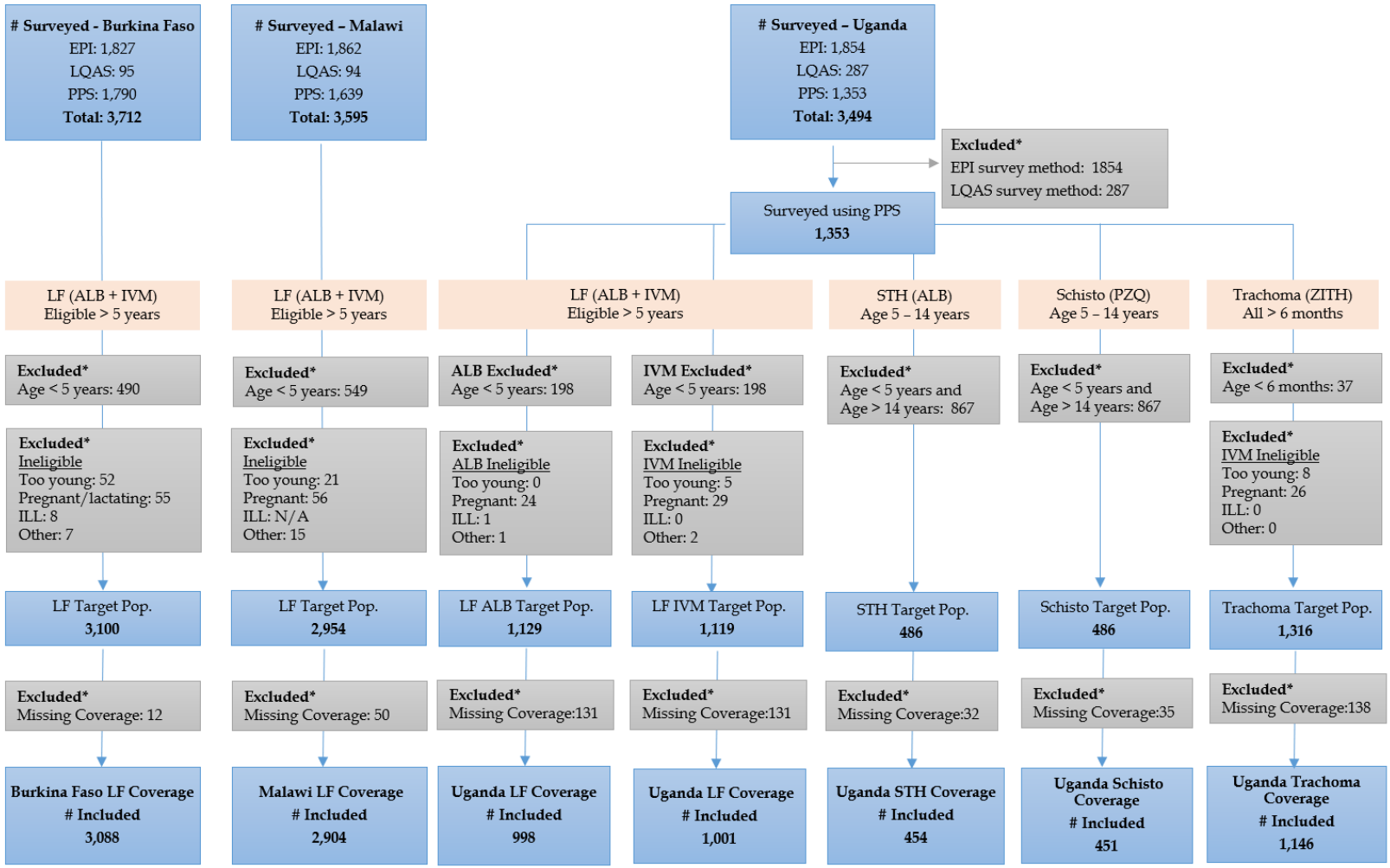
years of age were also excluded for ALB, IVM and PZQ drug types, and children less than six months of age were excluded for ZITH. While children over two years were eligible for ALB, children under five years were ineligible for IVM, and the two drugs were administered in combination during the LF MDAs (children under five were likely skipped over for both drug types).

Additional exclusions included those missing a coverage response, and observations collected using EPI and LQAS survey methods in Uganda. Data collected using the EPI and LQAS survey methods in Uganda were excluded to control for possible duplications due to surveys being conducted in the same district.

Figure 1 displays the inclusion criteria and final sample sizes by country and drug type for this study. In Burkina Faso, 3,712 individuals were surveyed, 624 were excluded from this study for not meeting inclusion criteria. The final study sample size for Burkina Faso was 3,088 individuals. In Malawi, 3,595 individuals were surveyed, 549 individuals were excluded from the study, and so the final study sample size was 2,904 individuals. In Uganda, 3,949 individuals were surveyed, 1,854 were excluded due to being sampled by the EPI sampling method, and 287 were excluded due to being sampled by the LQAS sampling method. Individuals surveyed using PPS (n=1,353) were included. In Uganda, target populations varied by drug type and targeted disease. After exclusions, the

sample size for ALB and IVM targeting LF was 998 and 1,001 respectively. Target population for ALB targeting soil-transmitted helminths (STH) and PZQ targeting schistosomiasis included school aged children five to fourteen years of age. After age restrictions and exclusions, the target population for treating STH with ALB included 454 school-aged children and the target population for treating schistosomiasis with PZQ included 451 children. The target population for Zithromax targeting trachoma was larger than the previous target populations due to children over six months being eligible. After exclusions, 1,146 individuals were included in the final sample size for Zithromax targeting trachoma.

Figure 1: Study inclusion/exclusion criteria by country and targeted NTD.



3. Data Sources

Data from a multi-country study comparing coverage survey evaluation methods was used for this study. Coverage surveys were conducted in 2014-2015 in three LF endemic districts in Burkina Faso, three LF endemic districts in Malawi and one LF endemic district in Uganda. The surveys collected coverage of ALB and IVM among all ages in Burkina Faso, Malawi and Uganda approximately six months after an MDA occurred in each country. In Uganda, the coverage surveys also assessed the coverage of PZQ and ZITH, approximately four months after MDA occurred. The data were collected on android forms using the LINKS system and computed in Microsoft Excel.

a. Country Specific Surveys

i. Burkina Faso: three teams consisting of two surveyors and a driver were deployed to conduct coverage surveys in each of the three selected districts, with each team employing a different sampling method, from February – March 2015. All three survey teams conducted a 19-question survey, which collected demographic information, coverage, Knowledge, Attitudes and Practices (KAPs) questions, and reasons for poor coverage.

ii. Malawi: three teams consisting of three surveyors and one driver were deployed in February 2014 to conduct coverage

surveys in each of the three selected districts, with each team employing a different sampling method. Survey teams conducted a short ten question survey to collect demographic and coverage information. KAP questions were not included in this survey.

iii. Uganda: a single team consisting of two surveyors and one driver conducted all three surveys, using three survey methods in a single district in Uganda. The team conducted these surveys from October – November 2014. Surveys using PPS survey method were conducted first, followed by the EPI survey method, and LQAS survey method was conducted last. Uganda had the most extensive coverage survey of the three countries, consisting of 40 questions.

4. Study Measures

The outcomes of interest were program coverage by gender and age, and other factors contributing to disparities in MDA treatment among sub-groups of the population (reasons for non-participation, drug distribution location and source of MDA information). While the specific questions within each coverage survey varied by country, all collected gender, age, drug coverage and reasons for non-participation. Other variables of interest included the source of MDA information (how people were informed of MDA) in the Burkina Faso coverage survey, and drug distribution location (location people received MDA) measured in the Uganda coverage survey.

Drug coverage was measured for ALB and IVM among all ages in Burkina Faso, Malawi and Uganda approximately six months after an MDA occurred in each country and drug coverage was measured for PZQ and ZITH in Uganda approximately four months after MDA occurred. Program coverage (proportion of the eligible population that is treated) was calculated by including surveyed individuals that were treated in MDA in the numerator and including surveyed individuals who were eligible for the drug at the time of MDA in the denominator (individuals who reported ineligible for receiving the drug at the time of MDA were excluded).

5. Analysis

Frequencies and proportions of program coverage of the target population were calculated separately by country, drug type, age category and gender. The target population varied slightly by drug type and disease targeted. Program coverage of ALB and IVM targeting LF was calculated for eligible individuals five years of age and older. Program coverage was calculated for ALB targeting STH and PZQ targeting schistosomiasis among school aged children (age five to fourteen) and program coverage for ZITH targeting trachoma was calculated for eligible individuals over six months of age. Chi-square test was used to determine significant differences in proportions among males and females in each age category using SAS v9.4. A P value <0.05 was considered statistically significant.

Frequencies and proportions of reasons for non-participation among reported non-participants were calculated separately by country, drug type,

and gender. From the Uganda data, proportions and frequencies were calculated for sources of MDA information among surveyed responses and examined the relationship between being informed of MDA and program coverage. Lastly, from the Malawi data, the proportion and frequencies of reported drug distribution locations among surveyed responses from Burkina Faso was examined, as well as the relationship between drug distribution location and coverage.

C. Results

The differences in demographics of study participants by country and drug type are displayed in Table 2. Surveyed individuals in Burkina Faso were more slightly more likely to be female (50%), and the proportion of surveyed individuals by age category varied, with participants most likely to be five to nine years of age (21%), and least likely to be 40-49 years of age (9%). Surveyed individuals in Malawi were significantly more likely to be female (53%), and the proportion of surveyed individuals by age category also varied, with participants most likely to be five to nine years of age (21%), and least likely to be 40-49 years of age (7%). In Uganda, surveyed individuals were interviewed for coverage of all four drug types. The number of participants per drug type are not independent from one another, however due to variation in the number of ineligibles and those missing coverage data for each drug type, the number of included responses varied. In Uganda, there was not a significant difference in surveyed individuals by gender. However, the proportion of surveyed individuals by age category

varied across all drug types. Surveyed participants were most likely to be school-aged children (5 – 14 years) and least likely to be 40-49 years.

Table 2: Demographic characteristics of the study population by country and drug type, Burkina Faso, Malawi and Uganda, 2014-2015.

	Burkina Faso	Malawi	Uganda[a]			
	ALB + IVM (N = 3,088) n (%)	ALB + IVM (N= 2,904) n (%)	ALB (N= 998) n (%)	IVM (N= 1,001) n (%)	PZQ (N= 1,005) n (%)	ZITH (N= 1,144) n (%)
Gender						
Female	1,556 (50)	1,524 (53)[b]	501 (50)	499 (50)	512 (51)	562 (49)
Male	1,578 (50)	1,380 (48)	497 (50)	502 (50)	493 (49)	582 (51)
Age (years)						
1-4						150 (13)
5-9	642 (21)	614 (21)	228 (23)	223 (22)	223 (22)	228 (20)
10-14	536 (17)	564 (19)	226 (23)	230 (23)	222 (22)	226 (20)
15-19	348 (11)	297 (10)	116 (12)	116 (12)	123 (12)	116 (10)
20-29	411 (13)	529 (18)	141 (14)	140 (14)	142 (14)	138 (12)
30-39	378 (12)	423 (15)	121 (12)	124 (12)	130 (13)	122 (11)
40-49	288 (9)	206 (7)	79 (8)	79 (8)	79 (8)	79 (7)
50+	484 (16)	271 (9)	87 (9)	89 (9)	86 (9)	85 (7)

[a] Individuals surveyed for the Uganda coverage survey were the same across drug type, but the number of responses varied based on exclusion criteria [b] The number of surveyed individuals varied significantly by gender in Malawi ($p < .01$)

1. Coverage

Program coverage of ALB and IVM by gender and age, in Burkina Faso, Malawi and Uganda is represented in Table 3. Burkina Faso and Malawi met LF coverage targets of 80% program coverage overall, and by gender, while Uganda did not meet the coverage target of 80% program coverage overall or by gender. Females reported higher coverage than males in all three countries with a statistically significant difference in Burkina Faso ($p = 0.04$) and Malawi ($p <.0001$). Despite Malawi meeting an 80% program coverage overall, sub-groups in Malawi, specifically adult males (30-39 years and 50+ years of age), did meet the target threshold for coverage.

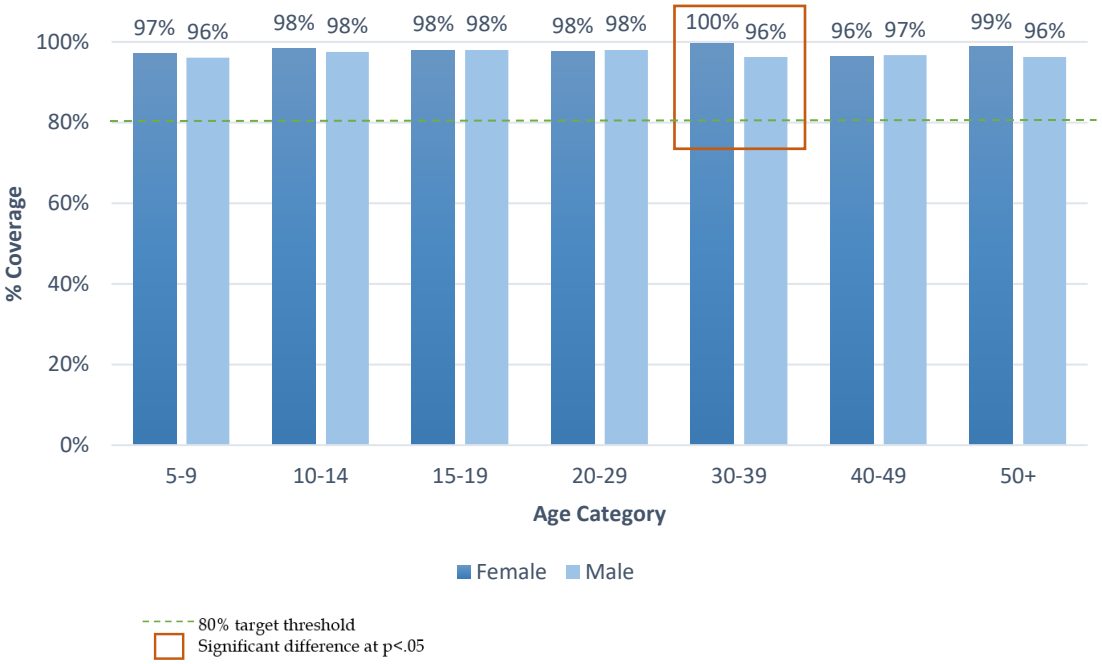
Table 3: Surveyed program coverage (%) of albendazole and ivermectin by gender and age, in Burkina Faso, Malawi and Uganda, 2014-2015.

		Burkina Faso ALB + IVM		Malawi ALB + IVM		Uganda IVM		Uganda ALB	
Age (years)	**Gender**	**N**	**n (%)**	**N**	**n (%)**	**N**	**n (%)**	**N**	**n (%)**
5-9	**Female**	**287**	279 (97)	**297**	287 (97)	**111**	65 (59)	**113**	63 (56)
	Male	**355**	341 (96)	**317**	302 (95)	**112**	61 (55)	**115**	56 (49)
10-14	**Female**	**253**	249 (98)	**293**	275 (94)	**112**	74 (66)	**111**	58 (52)
	Male	**283**	276 (98)	**271**	256 (95)	**118**	68 (58)	**115**	53 (46)
15-19	**Female**	**149**	146 (98)	**146**	137 (94)	**47**	31 (66)	**49**	26 (53)
	Male	**199**	195 (98)	**151**	135 (89)	**69**	42 (61)	**67**	30 (45)
20-29	**Female**	**213**	208 (98)	**318**	295 (93)**	**67**	43 (64)	**69**	40 (58)
	Male	**198**	194 (98)	**211**	177 (84)	**73**	52 (71)	**72**	36 (50)
30-39	**Female**	**219**	218 (100)*	**216**	197 (91)***	**67**	38 (57)	**66**	33 (50)
	Male	**159**	153 (96)	**207**	153 (74)	**57**	40 (70)	**55**	32 (58)
40-49	**Female**	**166**	160 (96)	**101**	91 (90)*	**43**	26 (61)	**43**	18 (42)
	Male	**122**	118 (97)	**105**	84 (80)	**36**	24 (67)	**36**	21 (58)
50+	**Female**	**269**	266 (99)	**153**	139 (91)***	**52**	37 (71)	**50**	22 (44)
	Male	**215**	207 (96)	**118**	88 (75)	**37**	25 (68)	**37**	18 (49)
Total	**Female**	**1556**	**1526 (98.1)***	**1524**	**1421 (93)*****	**499**	**314 (63)**	**501**	**260 (52)**
	Male	**1531**	**1484 (96.9)**	**1380**	**1195 (87)**	**502**	**312 (62)**	**497**	**246 (50)**

* Significant at the 0.05 probability level.
** Significant at the 0.01 probability level.
*** Significant at the 0.001 probability level.

Figure 2 indicates that all age and gender sub-groups were above the 80% LF program coverage target (displayed as the dashed line in the figure) in Burkina Faso. The lowest coverage was reported in males 5-9 years old (96%). The highest coverage was reported in females aged 30 – 39 years (100%). There was significantly higher coverage among 30-39-year-old females compared to males, indicated inside the orange box (p=0.02).

Figure 2: Program coverage (%) of albendazole and ivermectin by gender and age, Burkina Faso.



Most sub-groups in Malawi met the 80% coverage target (represented by the dashed green line), with the exception of males aged 30-39 years and males 50+ years, who reported the lowest coverage (Figure 3). The highest coverage was seen among males and females 5-9 years of age (>95%). In Malawi, there was higher coverage among females in all age categories with the exception of the 10-14 age category. Females had significantly higher coverage than adult males 20-29 years ($p = .0013$), 30-39 years ($p < .0001$), 40-49 years ($p=0.04$) and 50+ years ($p = 0.0003$) of age.

Figure 3: Program coverage (%) of albendazole and ivermectin by gender and age, Malawi.

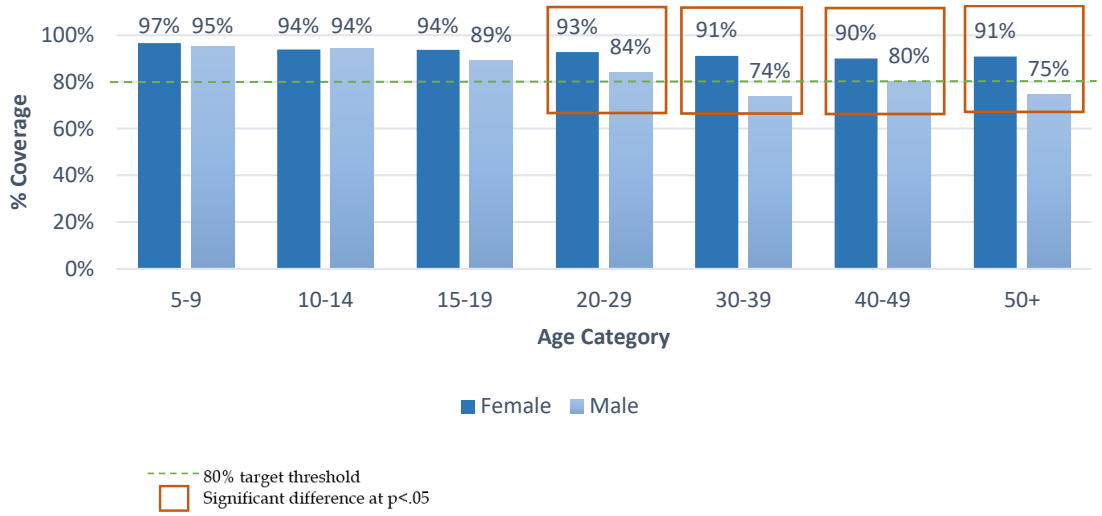


Figure 4 shows that coverage targets for ALB (80%, as indicated by the dashed green line in the figure) were not met for any sub-group in Uganda. Females had slightly higher coverage than males overall for ALB, however there were no statistically significant differences between males and females in any sub-group.

Figure 4: Program coverage (%) of albendazole by gender, age, and drug type, Uganda, 2014.

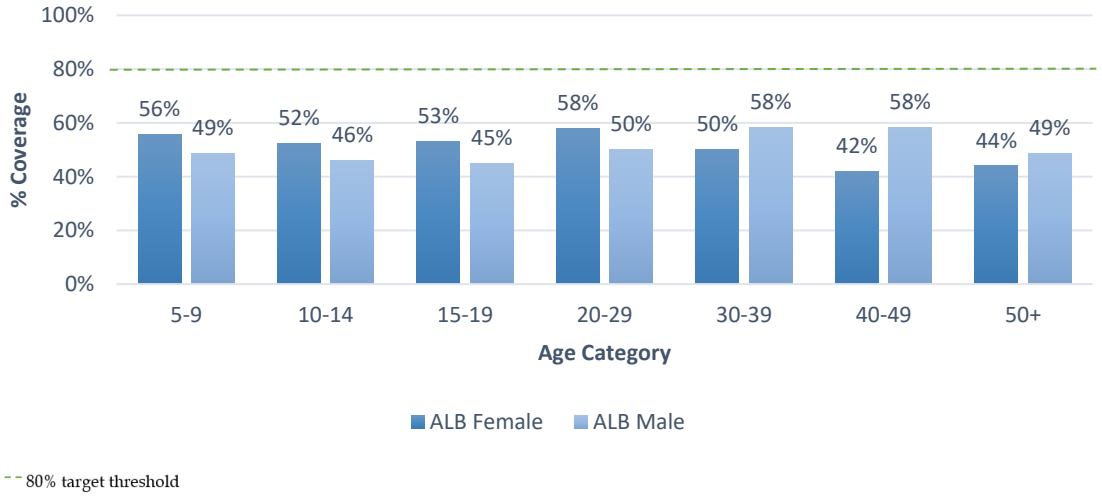
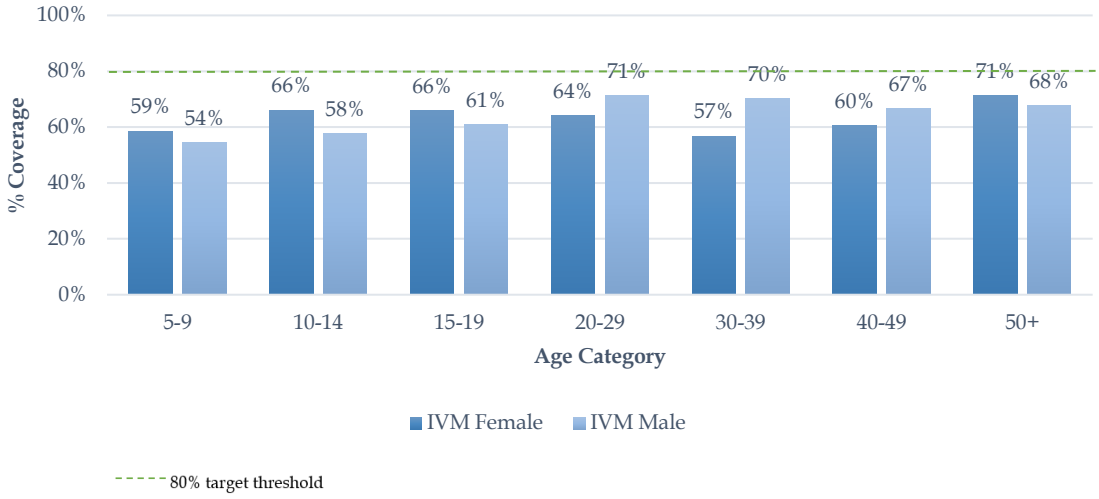


Figure 5 shows that coverage targets for IVM (80%, as indicated by the dashed green line in the figure) were not met for any sub-group in Uganda. Females had slightly higher coverage than males overall for IVM, however there were no statistically significant differences between males and females in any sub-group.

Figure 5: Program coverage (%) of ivermectin by gender, age, and drug type, Uganda, 2014.



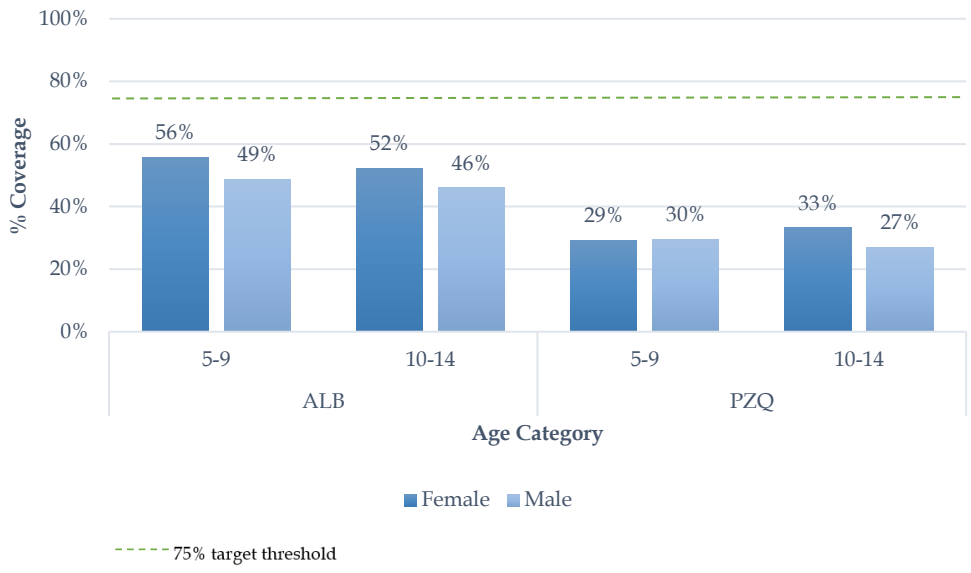
Coverage of ALB and PZQ in Uganda did not meet the 75% coverage target for school-aged children 5-14 years of age for schistosomiasis or STH (Table 4). Coverage for ALB was reported overall to be 51% among school-aged children, while IVM overall coverage among school-aged children was 30%. Coverage targets were not met for any sub-group, and while coverage among females was universally higher among school-aged children, the difference was not statistically significant (Table 4).

Table 4: Surveyed program coverage (%) of albendazole and praziquantel among school-aged children (5-14 years) by gender and age in Uganda, 2014.

		ALB		PZQ	
Age (years)	**Gender**	**N**	**n (%)**	**N**	**n (%)**
5-9	**Female**	**113**	63 (56)	**113**	33 (29)
	Male	**115**	56 (49)	**115**	34 (30)
10-14	**Female**	**111**	58 (52)	**108**	36 (33)
	Male	**115**	53 (46)	**115**	31 (27)
Total	**Female**	**224**	121 (54)	**221**	69 (31)
	Male	**230**	109 (47)	**230**	65 (28)

No sub-groups in the ALB and PZQ target populations in Uganda met the 75% coverage target (Figure 6). Females had slightly higher coverage of ALB, but there was no significant difference.

Figure 6: Program coverage (%) of albendazole and praziquantel for school-aged children (5-14 years), Uganda, 2014.



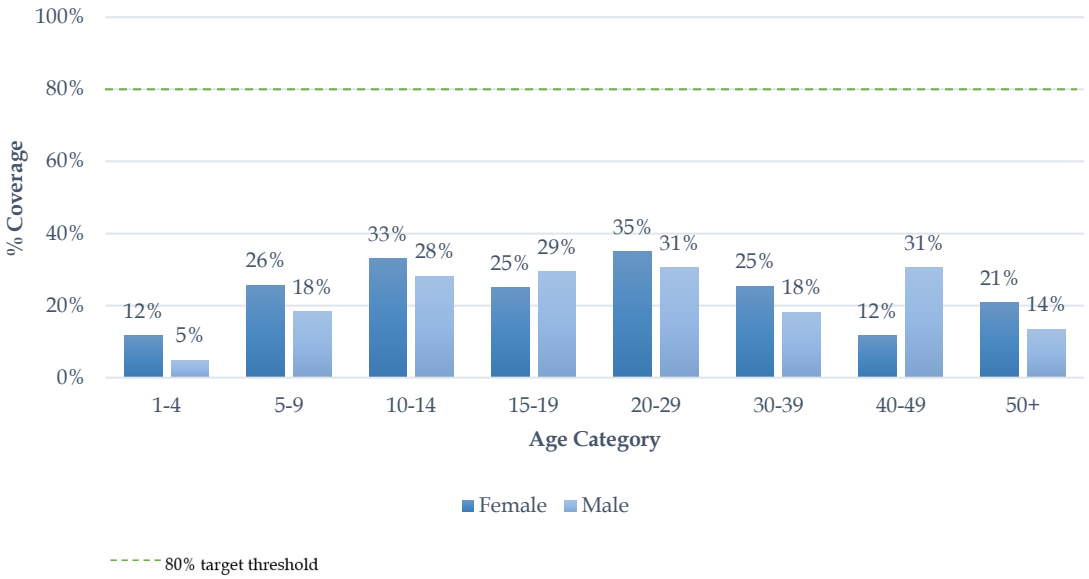
Coverage of Zithromax in Uganda was also low and did not meet the 80% coverage target for Trachoma (Table 5). Overall coverage reported was 23%. Lowest coverage was 5% among 1-4-year-old males. The highest coverage reported was 35% among 20- 29-year-old females. There was slightly higher coverage for females overall, but the difference was not significant.

Table 5: Surveyed program coverage (%) of Zithromax by gender and age in Uganda, 2014.

		ZITH	
Age (years)	**Gender**	**N**	**n (%)**
1-4	**Female**	**68**	8 (12)
	Male	**82**	4 (5)
5-9	**Female**	**113**	29 (26)
	Male	**115**	21 (18)
10-14	**Female**	**109**	36 (33)
	Male	**117**	33 (28)
15-19	**Female**	**48**	12 (25)
	Male	**68**	20 (29)
20-29	**Female**	**66**	23 (35)
	Male	**72**	22 (31)
30-39	**Female**	**67**	17 (25)
	Male	**55**	10 (18)
40-49	**Female**	**43**	5 (12)
	Male	**36**	11 (31)
50+	**Female**	**48**	10 (21)
	Male	**37**	5 (14)
Total	**Female**	**562**	140 (25)
	Male	**582**	126 (22)

Coverage target for Zithromax (80%) was not met for any sub-groups by gender and age in Uganda (Figure 7). Females had slightly higher coverage for all age categories except for ages 10-15 and 40-49 years of age. The differences in coverage by gender were not significant.

Figure 7: Program coverage (%) of Zithromax by gender and age, Uganda, 2014.

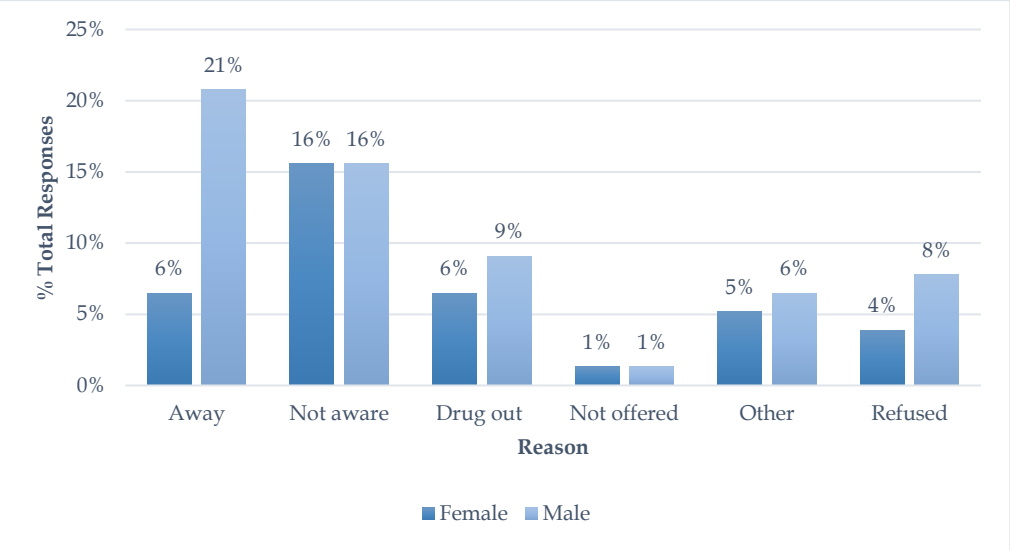


2. Reasons for Non-participation

Out of the 3,088-people surveyed in Burkina Faso, 77 (3%) people reported not participating in MDA (Appendix 1). Of non-participants, 61% were male. As Figure 8 displays, the most reported reason for non-participation overall, among males and females was not being aware of MDA (31%), but by gender, the most common reason was among males who reported being away at the time of MDA (21%). Drug supply running out was the third most common reason among both males (9%) and females

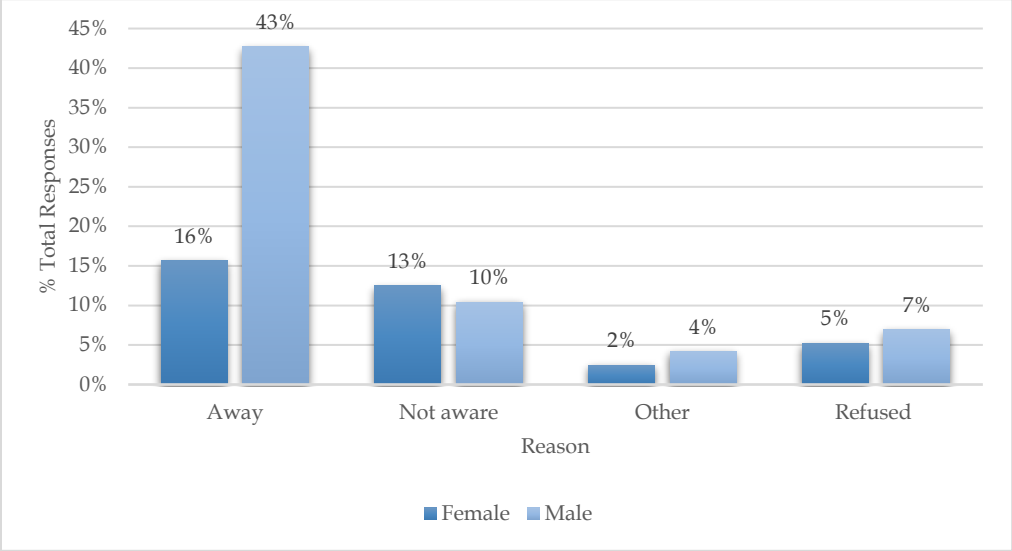
(7%), followed by refusal of the drug, other reasons, and not being offered the drug by a distributor.

Figure 8: Reported reasons for not participating in MDA among non-participants, Burkina Faso, 2015.



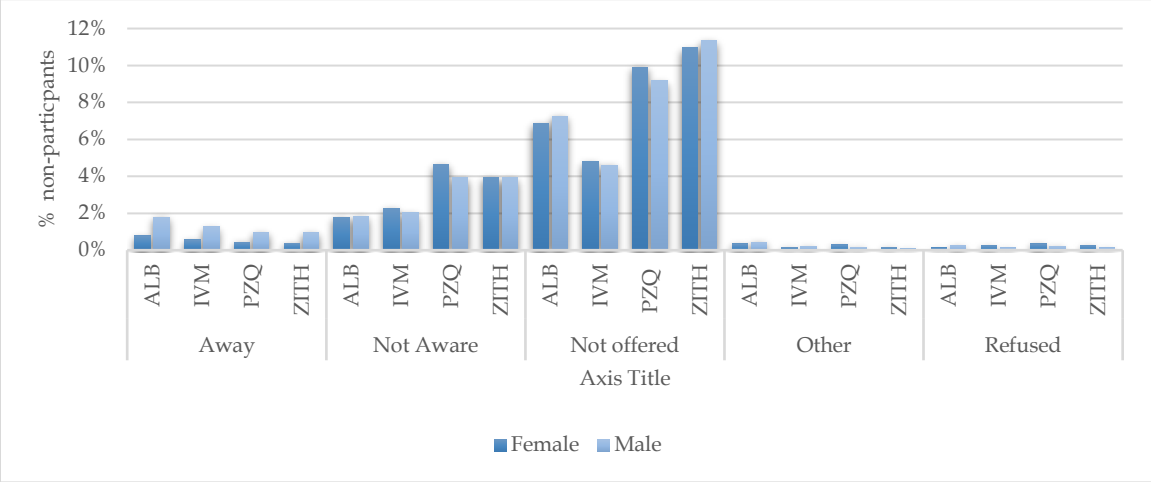
Out of the 2,904-people surveyed in Malawi, 288 people (10%) reported not participating in the MDA (Appendix 2). Of non-participants, 64% were male. As displayed in Figure 9, the most common reason for non-participation for both males and females was being away at the time of the MDA; however, males accounted for a much larger proportion of the non-participants. The second most common reason reported for non-participation was not being aware of the MDA, accounting for 23% of total responses. Refusal of the drugs accounted for 12% of reasons, and other reasons accounted for the remaining 10% of reasons.

Figure 9: Reported reasons for not participating in MDA among non-participants, Malawi, 2014.



As displayed in Figure 10, among non-participants in Uganda, the most common reason for non-participation was not being offered the drug, for all drug types. The proportion of males and females reporting not being offered the drug was similar. Not being aware of the MDA was the second most common reason for non-participation for both males and females across all drug types. Being away at the time of the MDA as a reason for non-participation was the third most common reason reported for both males and females, however the proportion of males that reported being away (5%) was over twice the proportion of females (2%). Other reasons reported and refusal of the drugs, each accounted for 2% of reasons. A breakdown of reason for non-participation by gender and age is also provided in Appendix 3.

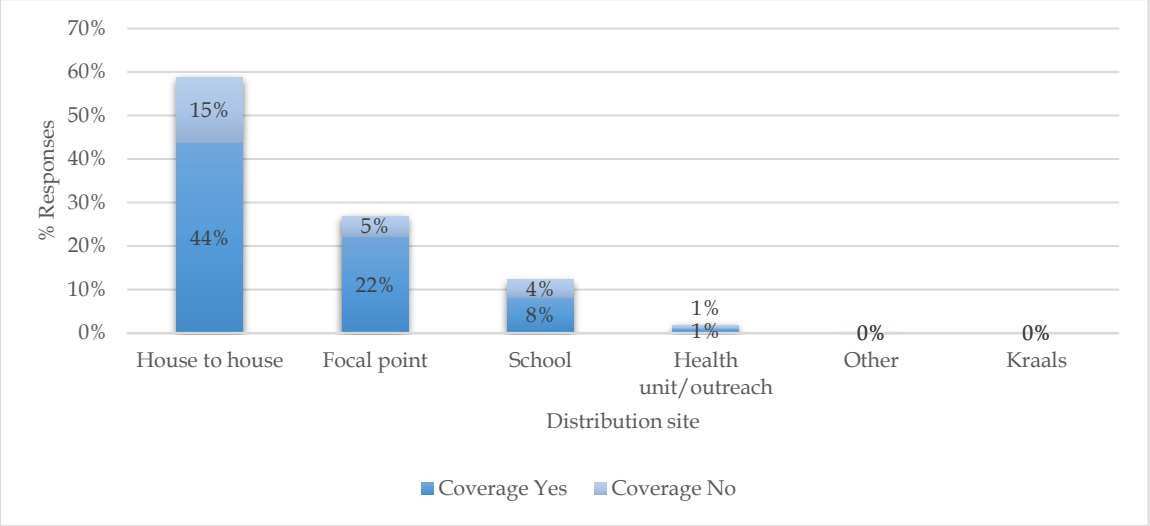
Figure 10: Reported reasons for not participating in MDA among non-participants, by drug type, Uganda, 2014.



3. Drug Distribution Location, Uganda

Out of all individuals surveyed in Uganda, 895 reported (89%) the distribution method used by the drug distributor to reach them in the MDA. Figure 11 displays the proportion of responses per distribution site by drug coverage. House-to-house distribution was the most common (59%), with focal point being the second most common distribution (27%). Coverage was reported highest among focal point distribution (81%) with house to house being the second most effective (72%). Schools were also a common distribution point (12%) with a 63% coverage reported from school distributions. Health unit/outreach site was the third most common place for MDA distribution but accounted for less than 2% overall.

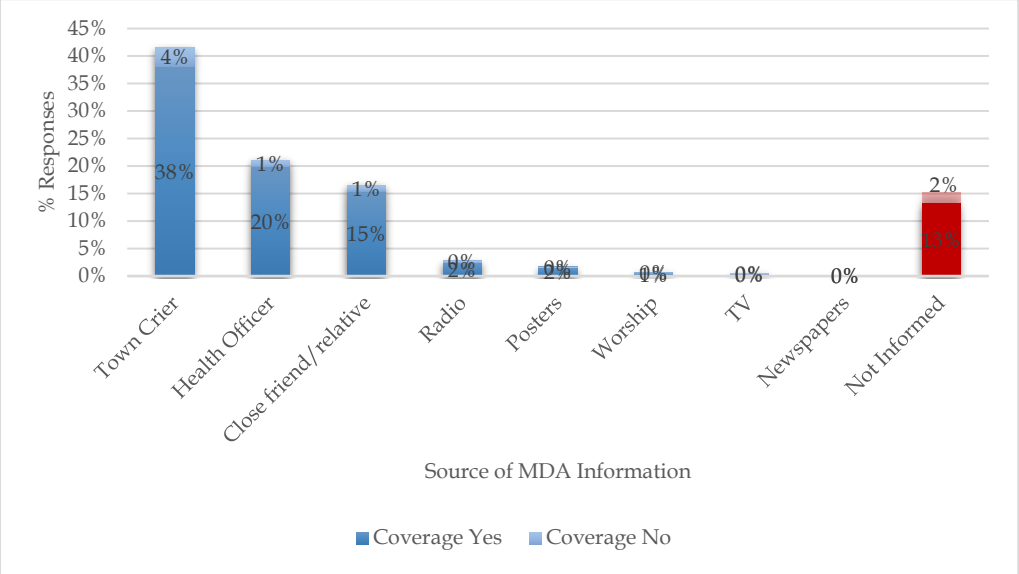
Figure 11: Surveyed coverage by drug distribution method (%), reported among survey responses, Uganda, 2014.



4. Source of MDA information, Burkina Faso

Out of 898 people that provided information on if and how they were informed of the MDA, 761 (85%) reported having been informed. Coverage among those who reported receiving information from any source was higher (92%) compared to those who reported not being informed (85%). Displayed in Figure 12, the most common source of information reported was by a town crier (42%), with health officer (21%) being the second most common reported source of information. A close friend/relative was the third most commonly reported source of information (17%). Radio, TV, posters and places of worship, each accounted for less than 5% of the total reported sources.

Figure 12: Sources of MDA information (%) reported among survey responses, by coverage, Burkina Faso, 2015.



D. Discussion

The results of this study found that program coverage was associated with both gender and age. Females reported higher coverage than males in all three countries, and gender differences were more common among adults.

In Malawi, our assessment of coverage by gender and age identified sub-groups, specifically adult males (30-39 years and 50+ years), that did not meet the target threshold for coverage (80%). This highlights the importance of assessing coverage by gender and age, as sub-groups that do not meet target thresholds could otherwise go unnoticed, acting as reservoirs of infection, risking elimination goals.

For Burkina Faso and Uganda, the results of this study showed a limited difference of MDA treatment by gender and age, suggesting that treatment is equitable across sub-groups of the population. However, the reasons why people

did not receive the drug(s) in the MDA differed among sub-groups. This demonstrates that treatment may not be as equitable as it appears, and that factors do exist that contribute to disparities in MDA treatment among groups of the population.

Assessing factors contributing to non-participation is necessary to identify barriers that still exist in reaching uniform coverage. In both Burkina Faso and Malawi, the majority of reasons reported for non-participation was among males due to being away at the time of drug distribution. This may suggest why males had significantly lower coverage in these two countries. In Uganda, the number one reason for non-participation was that people were not offered the drug by the distributor during the MDA. Suggesting that the MDA failed to distribute the drug to the entire target population. Our findings for non-participation were similar to findings by Krentel et al., in a systematic review, who also found that the absence of eligible recipients during the MDA was a commonly reported issue for coverage, and that reaching everyone in the MDA was a common barrier due to not enough time being allotted to reach all populations (35-46).

The reasons for non-participation reported in this study and other studies, identifies program-level issues that still need to be addressed to increase coverage in MDAs across sub-groups. In determining end-game strategies, the focus must shift on the gaps that can be filled. Reaching those that are away, not offered the drug, and were not aware of the MDA, are issues that must be tackled.

The results of the Uganda data indicated that the distribution location does have an effect on coverage. House-to-house distribution was the most commonly reported distribution in the MDA, but the second most effective when it came to coverage, while focal point was the second most common distribution reported but was highest among coverage.

Results from the Burkina Faso data found that being informed of the MDA also has a meaningful impact on coverage and also showed what methods were most impactful for disseminating MDA information. Coverage among those who reported being informed about the MDA was higher compared to those who reported not being informed. This result was also found in studies from India, Sri Lanka, the Philippines, Sierra Leone and Vanuatu, which found one of the most prominent factors associated with participation was advance knowledge of the MDA (17, 26, 37, 41, 47). In our study, we also found that people were more likely to participate when they hear about MDA from face-to-face interaction compared to other means of distributing information which included radio, tv, posters and places of worship.

1. Strengths/Limitations

This study had at least three strengths. First, it had a large and representative sample across three countries, and findings could be generalizable and used to inform NTD programs in many countries. Second, the coverage surveys served as useful tools for capturing age, gender and coverage data, as well as other factors that had an impact on MDA participation. This allowed the study to meet our objectives of

estimating the percent drug coverage by gender and age, evaluating whether sub-groups of the population (by gender and age) are disproportionately treated in MDAs, and examine the reasons for non-participation, and how they may affect sub-groups disproportionately. Third, this study was a multi-country study which provided the opportunity to assess the similarities and differences in coverage and barriers to MDA participation among three countries, identifying common and context specific issues.

Despite these strengths, there were at least three limitations. First, this was a cross-sectional study, and we were unable to assess the issue of systematic non-participation, and causality could not be assessed. Systematic non-participation, or non-participation of the same sub-groups of people over multiple treatment rounds, has been identified as an issue that could be detrimental to programs trying to reach control and elimination targets. Second, there was heavy reliance on proxy responses for a large portion of responses across all three countries' coverage surveys. This raises a few issues. Proxy responses were found to likely be biased, reporting higher coverage than self reports (appendices 4,5). The same sub-groups of people being reported by a proxy response (adult males) were also reported being away at the time of the MDA, as the number one reason they missed MDA. By conducting coverage surveys at households and relying on proxy responses for individuals not present at the time of the interview, information on high-risk sub-groups of the population has

questionable validity. Third, was the brevity of the survey questions, as it would have been beneficial to capture more detailed information.

2. Conclusions

Reaching NTD control and elimination targets depend on achieving uniformly high treatment coverage in every MDA treatment round. While national programs report drug coverage as the most important indicator in determining success of MDA, research has found that reaching coverage targets at the national and subnational levels may not be enough. Reservoirs of infection could remain in the population if sub-groups of systematic non-participants exist and harbor infection.

This study found sub-groups of the population in Malawi who failed to reach coverage targets, despite meeting national and sub-national targets. This study also found that the reasons why people did not receive the drug(s) in the MDA differed among sub-groups, and treatment may not be as equitable as it appears.

The results of this study and previous research in a number of other countries have highlighted the unique differences that exist between countries. The most effective strategies for informing and reaching populations depend on addressing context specific barriers that remain. It is important to tailor strategies appropriately. As such, it is important for every program to continue to monitor and evaluate their programs to reach NTD control and elimination goals.

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Chapter III – Implications and Future Directions

III. Implications and Future Directions

Reaching NTD control and elimination targets depend on achieving uniformly high treatment coverage in every MDA treatment round. While national programs report drug coverage as the most important indicator in determining success of MDA, research has found that reaching coverage targets at the national and subnational levels may not be enough. Reservoirs of infection could remain in the population if sub-groups of systematic non-participants exist and harbor infection.

Reported drug coverage can be plagued with bias and errors, and rarely are gender and age disaggregated data reported. Conducting post-MDA coverage surveys can be costly and timely, but they are essential to track progress of program goals and evaluate program performance. Coverage surveys provide an opportunity to assess information not otherwise collected by MDA reporting.

In this study, coverage surveys served as useful tools for capturing coverage data by age and gender, as well as other factors that had an impact on MDA participation. This allowed the study to identify sub-groups of the population (by gender and age) that are disproportionately treated in MDAs and examine reasons for non-participation.

The results of this study found sub-groups of the population in Malawi that did not meet coverage targets, specifically adult males, despite the population meeting coverage targets overall. Without the use of the coverage survey, and analyzing

coverage by gender and age, it may have been assumed that non-participation occurred randomly. However, in identifying sub-groups that were more likely to not participate in MDA, the following three actions must take place.

First, this study found that males who did not reach coverage targets were most likely 'away' at the time of MDA. However, limited information was provided to where or why males may have been away, which would be essential information in making programmatic recommendations for the future MDAs. While adding additional questions to the coverage survey may cause the interview to be too long and time consuming for both interviews and interviewees, programs could benefit from conducting follow-up interviews and focus group discussions, to gather more in-depth information on the coverage survey responses, targeting the most critical sub-groups of the population.

Second, males were also more likely to have a proxy response, meaning they weren't present for the coverage survey. By conducting coverage surveys at households and relying on proxy responses for individuals not present at the time of the interview, first-hand information on high-risk sub-groups of the population is missed. Both coverage surveys and MDAs are difficult to conduct, time consuming and costly. However, it could be detrimental to a program's progress, if they are not conducted inclusively, reaching all target populations. Future MDAs and coverage survey teams should plan ways to reach populations that are not present at the household during the distribution or survey.

Third, this study was only able to identify sub-groups that were non-participants in one round of MDA and were not able to identify if sub-groups of non-participants were systematic non-participants. Simulations have illustrated that reservoirs of infection could remain in the population due to sub-groups who systematically do not participate and do not receive MDA treatment over multiple rounds, and in some cases and conditions, could be as detrimental as leading to no chance of elimination. Longitudinal surveys need to be conducted over multiple rounds of MDA capturing coverage of the same individuals to identify if systematic non-participants exist.

This study also found that distribution location and prior knowledge of MDA also had an effect on coverage. In planning future MDAs, providing advanced notice through town criers, health officers, and close friends is recommended. Distribution through focal point is also recommended. However, best practices for MDAs likely vary by country.

The results of this study and previous research in a number of other countries have highlighted the unique differences that exist between countries. The most effective strategies for informing and reaching populations depend on addressing context specific barriers that remain. It is important to tailor strategies appropriately. As such, it is important for every program to continue to monitor and evaluate their programs. Countries must make an investment to conduct effective coverage surveys, to identify gaps and best practices for end-game strategies.

Appendices

Appendix 1: Reasons for not participating in MDA among non-participants by gender and age, Burkina Faso, 2015.

Age (years)	Gender	Away n (%)	Not Aware n (%)	Drug out n (%)	Not Offered n (%)	Other n (%)	Refused n (%)
5-9	**Female**	0 (0)	1 (1)	4 (5)	0 (0)	3 (4)	0 (0)
	Male	1 (1)	4 (5)	6 (8)	0 (0)	3 (4)	0 (0)
10-14	**Female**	0 (0)	4 (5)	0 (0)	0 (0)	0 (0)	0 (0)
	Male	3 (4)	3 (4)	0 (0)	0 (0)	0 (0)	1 (1)
15-19	**Female**	0 (0)	2 (3)	1 (1)	0 (0)	0 (0)	0 (0)
	Male	3 (4)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
20-29	**Female**	1 (1)	1 (1)	0 (0)	1 (1)	1 (1)	1 (1)
	Male	2 (3)	1 (1)	0 (0)	0 (0)	1 (1)	0 (0)
30-39	**Female**	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
	Male	3 (4)	0 (0)	0 (0)	1 (1)	0 (0)	2 (3)
40-49	**Female**	2 (3)	2 (3)	0 (0)	0 (0)	0 (0)	2 (3)
	Male	2 (2)	1 (1)	0 (0)	0 (0)	1 (1)	0 (0)
50+	**Female**	2 (3)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
	Male	2 (3)	2 (3)	1 (1)	0 (0)	0 (0)	3 (4)
Total	**Female**	5 (6)	12 (16)	5 (6)	1 (1)	4 (5)	3 (4)
	Male	16 (21)	12 (16)	7 (9)	1 (1)	5 (6)	6 (8)

Appendix 2: Reasons for not participating in MDA among non-participants by gender and age, Malawi, 2014.

Age (years)	Gender	Away n	Not Aware n	Other n	Refused n
5-9	**Female**	3	4	1	2
	Male	13	2	0	0
10-14	**Female**	9	6	2	1
	Male	7	4	3	1
15-19	**Female**	2	3	3	1
	Male	11	1	1	3
20-29	**Female**	13	9	0	1
	Male	28	2	2	2
30-39	**Female**	9	2	1	7
	Male	36	6	4	8
40-49	**Female**	4	4	0	2
	Male	15	4	0	2
50+	**Female**	5	8	0	1
	Male	13	11	2	4
Total	**Female**	45	36	7	15
	Male	123	30	12	20

Appendix 3: Reasons for not participating MDA among non-participants by gender, age and drug type, Uganda, 2014.

		Away				Not aware				Not offered				Other				Refused			
		ALB	IVM	PZQ	ZITH	ALB	IVM	PZQ	ZITH	ALB	IVM	PZQ	ZITH	ALB	IVM	PZQ	ZITH	ALB	IVM	PZQ	ZITH
Age (years)	**Gender**	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
5-9	**Female**	1	0	0	0	10	15	24	24	39	31	54	60	0	0	0	0	0	0	0	0
	Male	4	5	3	5	7	13	23	24	47	33	51	64	1	0	1	1	0	0	0	0
10-14	**Female**	1	0	0	0	7	12	18	11	43	25	50	60	2	0	1	0	0	1	2	2
	Male	5	4	7	5	10	12	22	19	45	32	51	59	1	1	1	0	1	1	3	1
15-19	**Female**	3	2	2	2	4	3	9	8	14	10	26	25	2	1	2	1	0	0	1	0
	Male	7	6	2	2	1	6	5	6	28	12	32	39	0	2	1	0	1	1	1	1
20-29	**Female**	2	3	2	2	7	7	22	15	17	11	26	22	3	1	2	3	0	2	1	1
	Male	6	7	5	5	9	7	15	15	20	7	25	30	1	0	0	0	0	0	0	0
30-39	**Female**	3	3	3	2	3	9	15	14	25	12	30	32	0	2	2	0	2	3	3	2
	Male	4	4	3	3	3	2	13	11	14	9	21	30	2	1	0	0	0	1	1	1
40-49	**Female**	3	4	2	3	2	2	10	8	20	11	21	27	0	0	0	0	0	0	0	0
	Male	2	2	1	1	1	3	5	6	11	6	13	18	1	1	0	0	0	0	0	0
50+	**Female**	5	1	1	0	8	4	9	11	0	10	21	26	1	0	0	0	1	0	1	1
	Male	13	1	1	1	11	4	7	9	2	7	18	21	4	0	1	1	4	0	0	0
Total	**Female**	18	13	10	9	41	52	107	91	158	110	228	252	8	4	7	4	3	6	8	6
	Male	41	29	22	22	42	47	90	90	167	106	211	261	10	5	4	2	6	3	5	3

Appendix 4: Proxy responses (%) of total coverage survey responses by country, Burkina Faso, Malawi and Uganda, 2014-2015.

		Burkina Faso		Malawi		Uganda	
Age (years)	**Gender**	**N**	**n (%)**	**N**	**n (%)**	**N**	**n (%)**
5-9	**Female**	**308**	63 (20)	**310**	297 (96)	**120**	28 (23)
	Male	**389**	87 (22)	**332**	322 (97)	**121**	38 (31)
10-14	**Female**	**254**	84 (33)	**298**	181 (61)	**117**	47 (40)
	Male	**285**	109 (38)	**276**	178 (64)	**128**	39 (30)
15-19	**Female**	**159**	97 (61) **	**156**	42 (27)***	**67**	20 (30)
	Male	**200**	158 (79)	**158**	79 (50)	**81**	35 (43)
20-29	**Female**	**247**	131 (53)**	**355**	23 (6)***	**85**	19 (22)
	Male	**201**	141 (70)	**222**	106 (48)	**90**	31 (34)
30-39	**Female**	**233**	106 (45)*	**233**	22 (9)***	**79**	12 (15)**
	Male	**161**	91 (56)	**214**	82 (38)	**71**	27 (38)
40-49	**Female**	**169**	69 (41)	**103**	15 (15)***	**52**	9 (17)
	Male	**124**	61 (49)	**110**	45 (41)	**47**	14 (30)
50+	**Female**	**274**	119 (43)	**157**	19 (12)**	**53**	7 (13)*
	Male	**218**	93 (43)	**122**	33 (27)	**44**	14 (32)
Total	**Female**	**1644**	669 (41)**	**1612**	599 (37)***	**573**	142 (25)***
	Male	**1578**	740 (47)	**1434**	845 (59)	**582**	198 (34)

Data doesnot follow inclusion criteria and contains all observations except children <5 years

* Significant at the 0.05 probability level.

** Significant at the 0.01 probability level.

*** Significant at the 0.001 probability level.

Appendix 5: Coverage (%) by proxy Response, by country and gender, Burkina Faso, Malawi and Uganda, 2014-2015.

Country	Gender	Proxy	N	Coverage		
				Yes	No	Ineligible
				n (%)	n (%)	n (%)
Burkina Faso	**Female**	**Yes**	**666**	640 (96)	6 (1)	20 (3)***
		No	**973**	886 (91)	24 (3)	63 (7)
	Male	**Yes**	**734**	712 (97)	12 (2)	10 (1)***
		No	**837**	773 (92)	35 (4)	29 (4)
Malawi	**Female**	**Yes**	**590**	550 (93)	26 (4)	14 (2)***
		No	**1010**	871 (86)	77 (8)	62 (6)
	Male	**Yes**	**808**	715 (89)	78 (10)	15 (2)***
		No	**588**	480 (82)	107 (18)	1 (0)
Uganda	**Female**	**Yes**	**131**	97 (74)	32 (24)	2 (2)***
		No	**400**	217 (54)	153 (38)	30 (8)
	Male	**Yes**	**177**	121 (68)	55 (31)	1 (1)*
		No	**329**	191 (58)	135 (41)	3 (1)
Total		**Yes**	**3,106**	2,835 (91)	209 (7)	62 (2)***
		No	**4,137**	3,418 (83)	531 (13)	188 (5)

Data does not follow same inclusion criteria and contains all observations except children <5 years

* Significant at the 0.05 probability level.

** Significant at the 0.01 probability level.

*** Significant at the 0.001 probability level.