Liberia - Malaria Indicator Survey 2011

National Malaria Control Program - Ministry of Health and Social Welfare, Liberia Institute for Statistics and Geo-Information Services

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Sampling

Sampling Procedure

The 2011 Liberia Malaria Indicator Survey (2011 LMIS) is the third of its kind following the ones conducted in 2005 (2005 LMIS) and 2009 (2009 LMIS). The 2011 LMIS repeats the 2009 survey using the same sampled clusters but with independent household selection to strengthen the capability of measuring trends in key indicators between the two surveys. The survey is a nationwide survey, calling for a nationally representative sample of approximately 4,500 households, which was expected to yield approximately 4,400 completed interviews of women age 15-49 and 3,800 children under age 5. It is designed to provide information on key malaria control indictors, such as the proportion of households having at least one insecticide-treated net (ITN); the proportion of children under 5 who slept under an ITN the previous night; the proportion of pregnant women who slept under an ITN the previous night, the proportion of pregnant women who received intermittent preventive treatment (IPT) for malaria during their last pregnancy; and the malaria prevalence estimate among children under age 5, based on on-site malaria testing and laboratory testing.

In Liberia, there are 15 counties. Each county consists of districts, and each district consists of clans. The counties are grouped to form five geographical regions and each region consists of three counties. The survey estimates are reported for the country as a whole, for the capital city of Greater Monrovia, for the other urban areas, for all the rural areas, and for each of the five geographical regions. In total, there are eight report domains, with domain composition as follows:
- The capital city of Liberia: Greater Monrovia
- The other urban areas of Liberia
- The rural areas of Liberia
- North Western: Bomi, Grand Cape Mount, Gbarpolu
- South Central: Montserrado (without Monrovia), Margibi, Grand Bassa
- North Central: Bong, Nimba, Lofa
- South Eastern A: River Cess, Sinoe, Grand Gedeh
- South Eastern B: River Gee, Grand Kru, Maryland

The sampling frame used for the 2009 LMIS, and therefore for the 2011 LMIS, is the National Population and Housing Census conducted in March 2008 (NPHC 2008). A total of 7,021 enumeration areas (EAs) were constructed for the census to have complete coverage of the country. A list of EAs is available from the Liberia Institute of Statistics and Geo-Information Service (LISGIS). In this list, each EA contains its identification information and the number of households and male and female population from the summary sheets of the census. So the frame was the preliminary frame of the NPHC 2008.

The sample for the 2011 LMIS is a stratified sample selected in two stages. First, 150 EAs had been selected with a stratified probability proportional to size (PPS) sampling from the sampling frame. The EA size is the number of residential households residing in the EA recorded in the census. Stratification was achieved by separating every county into urban and rural areas. The urban areas in each county mainly consist of the county capital. Therefore the 15 counties plus Greater Monrovia, which has only urban areas, were stratified into 31 sampling strata: 15 rural strata and 16 urban strata. Samples were selected independently in every stratum, with a predetermined number of EAs to be selected as given in Table A.3. Implicit stratification should have been achieved in each explicit sampling stratum by sorting the sampling frame according to districts and clan within each sampling stratum and by using the probability proportional to size selection procedure.

A household listing operation was carried out in all of the selected clusters before the main survey. The household listing operation consisted of visiting each of the 150 selected EAs; to draw a location map and a detailed sketch map; and to record on the household listing forms all residential households found in the EA with the address and the name of the head of the households. The resulting list of households was served as the sampling frame for the selection of households in the second stage.

At the second stage, a fixed number of 30 households was selected from the newly established household listing for each selected EA. Household selection was performed in a central office prior to the main survey. The survey interviewers were asked to interview only the pre-selected households. No replacements and no changes of the pre-selected households were allowed in the implementing stages in order to prevent bias. All women age 15-49 and their young children under 5 years of age in the selected households were eligible for the interview.

The sampling procedures are fully described in Appendix A of " Liberia Malaria Indicator Survey 2011 - Final Report" pp.63-66.

Response Rate

Of the 4,492 households selected in the sample, 4,237 were found occupied at the time of the fieldwork. The shortfall is due to households with members who were away for an extended period of time, dwellings that could not be found in the field, and dwellings that were found to be vacant or destroyed. Of the existing households, 4,162 were successfully interviewed, yielding a household response rate of 98 percent.

In the households interviewed in the survey, a total of 4,014 eligible women were identified, of whom 3,939 were successfully interviewed, yielding a response rate of 98 percent. The households' and women's response rates are slightly lower in urban areas than in the rural areas. The principal reason for nonresponse among eligible women was the failure to find them at home despite repeated visits to the household.

Weighting

Because of the nonproportional allocation of the sample to the different reporting domains, sampling weights are required for any analysis using 2011 LMIS data to ensure the actual representativeness of the sample. Because the 2011 LMIS sample is a two-stage stratified cluster sample, sampling weights will be calculated based on sampling probabilities, which will be calculated separately for each sampling stage and for each cluster. We use the following notations:

$P1_{hi}$: first stage's sampling probability of the ith cluster in stratum h
$P2_{hi}$: second-stage's sampling probability within the ith cluster (households)
P_{hi}: overall sampling probability of any households of the ith cluster in stratum h

Let a_h be the number of EAs selected in stratum h, M_{hi} the number of households according to the sampling frame in the ith EA, and ΣM_h the total number of households in the stratum h. The probability of selecting the ith EA in stratum h calculated as follows: $P1_h = a_h \times M_h / \Sigma M_h$

Let g_M ($g_M = 30$ for all h and i for 2011 LMIS) be the number of households selected in the ith cluster in stratum h. The second stage's selection probability for each household in the cluster is calculated as follows: $P2_h = g_h / L_h \times b_h$

The overall selection probability of each household in cluster i of stratum h is therefore the production of the selection probabilities:
$P_h = P1_h \times P2_h = a_h \times g_h / \Sigma M_h$

The sampling weight for each household in cluster i of stratum h is the inverse of its selection probability: $W_h = 1 / P_h$

A spreadsheet containing all sampling parameters and selection probabilities was constructed to facilitate the calculation of sampling weights. Household sampling weights and the individual sampling weights are obtained by adjusting the above calculated weight to compensate for household nonresponse and individual nonresponse, respectively. These weights are further normalized at the national level to produce unweighted cases equal to weighted cases for both households and individuals at the national level. The normalized weights are valid for estimation of proportions and means at any aggregation levels, but they are not valid for estimation of totals.

Questionnaires

Overview

Two questionnaires were used in the LMIS: a Household Questionnaire and a Woman's Questionnaire for all women age 15-49 in the selected households. Both instruments were based on the model Malaria Indicator Survey questionnaires developed by the Roll Back Malaria and MEASURE DHS programs, as well as on previous surveys conducted in Liberia, including the 2005 LMIS, 2009 LMIS, and 2007 LDHS. In consultation with the Technical Committee, NMCP and ICF International staff modified the model questionnaires to reflect relevant issues of malaria in Liberia. Given that there are dozens of local languages in Liberia, most of which have no accepted written script and are not taught in the schools, and also given that English is widely spoken, it was decided not to attempt to translate the questionnaires into vernaculars. However, many of the questions were broken down into a simpler form of Liberian English that interviewers could use with respondents. All questionnaires were formally pretested in June 2011 within two clusters: an urban area in Monrovia and a rural area in Bomi County. The clusters selected for the pretest were not included in the main survey sample.

The Household Questionnaire was used to list all the usual members and visitors in the selected households. Some basic information was collected on the characteristics of each person listed, including age, sex, and relationship to the head of the household. The main purpose of the Household Questionnaire was to identify eligible women for the individual interview and children age 6-59 months for anemia and malaria testing. The Household Questionnaire also collected information on characteristics of the household's dwelling unit, such as the source of water, type of toilet facilities, materials used for the floor, roof, and walls of the house, ownership of various durable goods, and ownership and use of mosquito nets. In addition, this questionnaire was also used to record consent to anemia and malaria testing of young children and test results.

The Woman's Questionnaire was used to collect information from all women age 15-49 and covered the following topics:
- Background characteristics (age, education, religion, and dialect)
- Partial reproductive history
- Preventive malaria treatment for most recent birth
- Prevalence and treatment of fever among children under age 5
- Knowledge about malaria (symptoms, causes, ways to avoid, types of medicines, and so on).

Data Collection

Data Collection Dates

Start	End	Cycle
2011-09-20	2011-10-09	Phase One
2011-10-15	2011-11-05	Phase Two
2011-11-14	2011-12-08	Phase Three

Data Collection Mode

Face-to-face [f2f]

DATA COLLECTION NOTES

Training of Field Staff
Eighty-seven individuals were invited to attend a two-week training course from September 5-19, 2011, at the Catholic Archdiocesan Pastoral Center in Monrovia. Training of the interviewer/supervisor candidates consisted of reviewing how to fill out the Household and Woman's Questionnaires, mock interviewing, and sessions covering tips on interviewing, how to locate selected households, and how to code interview results. Trainers included the LMIS team (project director, assistant project director, data manager, field coordinator, and lab supervisors) and three LISGIS staff, with support from two ICF staff. Quizzes were administered daily. Selection for the different positions was strictly based on performance during training. Despite the large candidate pool, many did not qualify on the basis of their quiz scores or because of their interviewing skills. Overall, few were proficient in the major local languages. Of the 87 attendees in the interviewer/supervisor training, 12 were selected as supervisors, and 24 were selected as interviewers.

Among the 87 training participants, NMCP also identified 32 staff with either laboratory or medical experience who were trained in taking blood for the anemia and malaria testing at the same time and place as the interviewer/supervisor candidates. Of these, 24 were selected as health technicians for the biomarker data collection. The health technicians were trained by an ICF biomarker specialist on how to identify children eligible for testing, how to administer informed consent, how to conduct the anemia and malaria rapid tests, and how to make a proper thick blood smear. They were also trained on how to store the blood slides, how to record test results on the questionnaire, and how to provide results to the parents/caretakers of the children tested. Training included how to record children's anemia and malaria results on the anemia and malaria brochure, which was to be left in every household in which children were tested, and on how to fill in the referral slip for any child who was found to be severely anemic or who had reported symptoms indicative of severe malaria. Trainees participated in numerous practice sessions in the classroom.

All trainees participated in four days of field practice exercises in households close to the training site. They also received a lecture on the epidemiology of malaria in Liberia and NMCP malaria prevention programs.

Fieldwork
Twelve teams were organized for the data collection, each comprised of one supervisor, two interviewers, two health technicians, and one driver. Two staff from LISGIS and two from NMCP were designated as field coordinators, and each field coordinator was assigned a number of teams to monitor.

The LMIS fieldwork was implemented in three phases because of Liberia's 2011 general and presidential elections. The first phase of data collection started on September 20, 2011. To allow for maximum supervision in the first few weeks of the survey and also to allow the field teams to familiarize themselves with the task, all 12 teams started work in Monrovia. Phase One of the survey ran through October 9, 2011, and included EAs in Monrovia, as well as in rural Monserrado, Grand Cape Mount, and Gbarpolu counties. The field staff returned to Monrovia to vote after Phase One. Phase Two of the LMIS began on October 15 and continued through November 5, 2011. Phase Two included EAs within Sinoe, River Cess, Grand Bassa, Margibi, Bomi, Bong, and Lofa counties. The field staff took a temporary hiatus from fieldwork during the presidential run-off election. Nimba, Grand Geddeh, Maryland, Grand Kru, and River Gee counties were visited in Phase Three of the LMIS. Phase Three of the LMIS commenced on November 14 and ended on December 8, 2011.

Data Collectors

Name	Abbreviation	Affiliation
National Malaria Control Program	NMCP	Ministry of Health and Social Welfare
Liberia Institute for Statistics and Geo-Information Services	LISGIS	

SUPERVISION

There is one supervisor for each of the 12 data collection teams in the field.

Data Processing

Data Editing

The processing of the LMIS questionnaire data began one week after the fieldwork commenced. Completed questionnaires were returned periodically from the field to the NMCP office in Monrovia, where they were coded by data processing personnel recruited and trained for this task. The data processing staff consisted of a supervisor and an assistant from NMCP, a questionnaire administrator, five data entry operators, and one data editor, all of whom were trained by an ICF data processing specialist. Data were entered using the CSPro computer package. All data were entered twice (100 percent verification). The concurrent processing of the data was a distinct advantage for data quality, since NMCP was able to advise field teams of errors detected during data entry. The data entry and editing phase of the survey was completed in January 2012.

Data Appraisal

Estimates of Sampling Error

The sample of respondents selected in the 2011 LMIS is only one of many samples that could have been selected from the same population, using the same design and expected size. Each of these samples would yield results that differ somewhat from the results of the actual sample selected. Sampling errors are a measure of the variability among all possible samples. Although the degree of variability is not known exactly, it can be estimated from the survey results.

A sampling error is usually measured in terms of the standard error for a particular statistic (mean, percentage, etc.), which is the square root of the variance. The standard error can be used to calculate confidence intervals within which the true value for the population can reasonably be assumed to fall. For example, for any given statistic calculated from a sample survey, the value of that statistic will fall within a range of plus and minus two times the standard error of that statistic in 95 percent of all possible samples of identical size and design.

If the sample of respondents had been selected as a simple random sample, it would have been possible to use straightforward formulas for calculating sampling errors. However, the 2011 LMIS sample is the result of a multi-stage stratified design, and, consequently, it was necessary to use more complex formulae. The computer software used to calculate sampling errors for the 2011 LMIS is an SAS procedure. This procedure used the Taylor linearization method of variance estimation for survey estimates that are means or proportions. The Taylor linearization method treats any percentage or average as a ratio estimate, $r = y/x$, where y represents the total sample value for variable y, and x represents the total number of cases in the group or subgroup under consideration.

The confidence interval, e.g., as calculated for child slept under an ITN last night, can be interpreted as follows: the proportion from the national sample is 0.371 and its standard error is 0.017. Therefore, to obtain the 95 percent confidence limits, one adds and subtracts twice the standard error to the sample estimate, i.e., 0.371±0.017. There is a high probability (95 percent) that the true proportion of children that slept under an ITN last night is between 0.337 and 0.404.

For the total sample, the value of the DEFT, averaged over all variables, is 1.68. This means that, due to multi-stage clustering of the sample, the average standard error for all the indicators is increased by a factor of 1.68 over that in an equivalent simple random sample.

The sampling errors are fully described in Appendix B of " Liberia Malaria Indicator Survey 2011 - Final Report" pp.69-73.

Other forms of Data Appraisal

A series of data quality tables are available to review the quality of the data and include the following:

- Household age distribution
- Age distribution of eligible and interviewed women
- Completeness of reporting

The results of each of these data quality tables are shown in Appendix C of "Liberia Malaria Indicator Survey 2011 - Final Report" pp.75-76.

Related Materials

Questionnaires

Liberia 2011 MIS Questionnaire

Title	Liberia 2011 MIS Questionnaire
Country	Liberia
Language	English
Filename	LBR_2011_MIS_Questionnaire_EN.pdf

Reports

Liberia 2011 MIS Final Report

Title	Liberia 2011 MIS Final Report
Author(s)	National Malaria Control Program, Ministry of Health and Social Welfare, Liberia Institute of Statistics and Geo-Information Services, Monrovia, Liberia and ICF International, Calverton, Maryland, USA
Date	2012-06-01
Country	Liberia
Language	English
Filename	https://www.dhsprogram.com/pubs/pdf/MIS12/MIS12.pdf

Liberia 2011 MIS Reading MIS tables

Title	Liberia 2011 MIS Reading MIS tables
Author(s)	MEASURE DHS
Date	2012-07-01
Country	Liberia
Language	English
Filename	https://www.dhsprogram.com/pubs/pdf/DM23/DM23.pdf

Liberia 2011 MIS Survey Presentations

Title	Liberia 2011 MIS Survey Presentations
Author(s)	MEASURE DHS
Date	2012-06-01
Country	Liberia
Language	English
Filename	https://www.dhsprogram.com/pubs/pdf/PPT28/PPT28.zip

Technical documents

DHS-V Recode Manual

Title	DHS-V Recode Manual
Author(s)	MEASURE DHS

Language	English
Description	The Recode Manual provides the information necessary to understand these datasets. It describes each data file and contains its associated dictionary and documentation. Each data file and its associated dictionary and documentation are distributed in archived ZIP files, for all available formats (hierarchical and flat). ASCII data and System data files are available for CSPro, SAS, SPSS, and STATA. Users are strongly encouraged to download the DHS recode manual for use with all recode files.
Filename	Recode5DHS.pdf

Liberia 2011 MIS (DHS V) Individual Recode Documentation

Title	Liberia 2011 MIS (DHS V) Individual Recode Documentation
Country	Liberia
Language	English
Filename	LBIR61FL.pdf