

The Kenya AIDS Indicator Survey 2012: Rationale, Methods, Description of Participants, and Response Rates

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Background: Cross-sectional population-based surveys are essential surveillance tools for tracking changes in HIV epidemics. In 2007, Kenya implemented the first AIDS Indicator Survey [Kenya AIDS Indicator Survey (KAIS 2007)], a nationally representative, population-based survey that collected demographic and behavioral data and blood specimens from individuals aged 15–64 years. Kenya's second AIDS Indicator Survey (KAIS 2012) was conducted to monitor changes in the epidemic, evaluate HIV prevention, care, and treatment initiatives, and plan for an efficient and effective response to the HIV epidemic.

Methods: KAIS 2012 was a cross-sectional 2-stage cluster sampling design, household-based HIV serologic survey that collected information on households as well as demographic and behavioral data from Kenyans aged 18 months to 64 years.

Participants also provided blood samples for HIV serology and other related tests at the National HIV Reference Laboratory.

Results: Among 9300 households sampled, 9189 (98.8%) were eligible for the survey. Of the eligible households, 8035 (87.4%) completed household-level questionnaires. Of 16,383 eligible individuals aged 15–64 years and emancipated minors aged less than 15 years in these households, 13,720 (83.7%) completed interviews; 11,626 (84.7%) of the interviewees provided a blood specimen. Of 6302 eligible children aged 18 months to 14 years, 4340 (68.9%) provided a blood specimen. Of the 2094 eligible children aged 10–14 years, 1661 (79.3%) completed interviews.

Conclusions: KAIS 2012 provided representative data to inform a strategic response to the HIV epidemic in the country.

Key Words: HIV, Kenya, AIDS Indicator Survey, surveillance

(*J Acquir Immune Defic Syndr* 2014;66:S3–S12)

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Kenya AIDS Indicator Survey (KAIS) 2012 was supported by the National AIDS and STI Control Programme (NAS COP), Kenya National Bureau of Statistics (KNBS), National Public Health Laboratory Services (NP HLS), National AIDS Control Council (NACC), National Council for Population and Development (NCPD), Kenya Medical Research Institute (KEMRI), US Centers for Disease Control and Prevention (CDC/Kenya, CDC/Atlanta), United States Agency for International Development (USAID/Kenya), University of California, San Francisco (UCSF), Joint United Nations Team on HIV/AIDS, Japan International Cooperation Agency (JICA), Elizabeth Glaser Paediatric AIDS Foundation (EGPAF), Liverpool Voluntary Counselling and Testing (LVCT), African Medical and Research Foundation (AMREF), World Bank, and Global Fund. This publication was made possible by support from the US President's Emergency Plan for AIDS Relief through cooperative agreements (PS001805, GH000069, and PS001814) from the US Centers for Disease Control and Prevention, Division of Global HIV/AIDS. This work was also funded in part by support from the Global Fund, World Bank, and the Joint United Nations Team for HIV/AIDS.

The authors have no conflicts of interest to disclose.

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the US Centers for Disease Control and Prevention and the Government of Kenya.

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INTRODUCTION

In 2011, an estimated 1.6 million people were living with HIV in Kenya, representing 6.8% of the HIV burden in sub-Saharan Africa.¹ The adult prevalence of HIV in Kenya has remained stable over the past 5 years at approximately 6%.² To monitor the epidemic, assess the impact of HIV prevention, care, and treatment programs, and to plan interventions, the country uses findings from Demographic and Health Surveys, AIDS Indicator Surveys, HIV sentinel surveillance in antenatal clinics, behavioral surveys in high-risk populations, and HIV estimates and projections from mathematical modeling. However, continuous improvement on the collection of detailed information on the HIV-infected, at-risk groups, and the general population is needed for the Government of Kenya to plan for and evaluate its HIV prevention, care, and treatment programs adequately.

In 2007, Kenya conducted its first national comprehensive, population-based HIV serologic survey, the Kenya AIDS Indicator Survey (KAIS 2007), among persons aged 15–64 years. KAIS 2007 found that adult HIV prevalence was 7.1% (95% confidence interval: 6.5 to 7.7); married or cohabitating partners were at high risk for HIV transmission compared with those who had never married or cohabitated^{3,4}; uncircumcised men were more likely to be infected with HIV compared with circumcised men⁵; the vast majority of

HIV-infected individuals were unaware of their infection^{6,7}; and there was unmet need for HIV-related care, including antiretroviral therapy (ART).³ Also, for the first time, HIV prevalence among older adults (aged 50–64 years) was measured. In response to these findings, the government increased opportunities for voluntary medical male circumcision and expanded HIV testing strategies, programs to prevent perinatal HIV transmission, and HIV treatment and care services throughout the country.⁸

Although Kenya has made great strides in its national response to the HIV epidemic, information gaps in critical populations remain. For example, while there is evidence of unmet need for HIV medical care among children, no nationally representative data exist to confirm the prevalence of HIV infection among children.¹ Additionally, surveys conducted among select high-risk groups such as female sex workers, men who have sex with men, and persons who inject drugs have been conducted, but estimates on the size of these key populations have not been well validated.⁹

The second Kenya AIDS Indicator Survey (KAIS 2012), conducted between October 29, 2012 and February 5, 2013, enabled the Government of Kenya to monitor progress on indicators collected in KAIS 2007 and also collected new indicators to address information gaps. KAIS 2012 included children aged 18 months to 14 years and persons aged 15 to 64 years. In addition, the survey also provided home-based testing and counseling (HBTC), and for persons found to be HIV-positive in HBTC, in-home measurement of CD4⁺ T-cell counts. Data from KAIS 2012 allowed for analysis of trends in HIV prevalence, risk behaviors, and coverage of and unmet need for HIV prevention, care, and treatment services in both the general population and key populations at high-risk of HIV infection. We describe the design and methods of the survey, results of the household and participant recruitment, and respondent characteristics.

METHODS

Sample Size and Study Design

The survey sample size was calculated to estimate HIV prevalence for men and women aged 15 to 64 years and children aged 18 months to 14 years for the main geographic domains of interest: urban, rural, regional, and national. For children, the domain of interest was the national-level only. It was estimated that a sample of 9300 households within 372 clusters would provide a representative sample of women and men aged 15 to 64 years and children aged 18 months to 14 years.

The survey used a 2-stage stratified cluster sampling design. The first stage involved selection of 372 of a total of 5360 clusters from the Kenya National Bureau of Statistics household-based sampling frame (NASSEP V) using a systematic random sampling method.¹⁰ The NASSEP V frame was developed using the 47 counties and further stratified into residential areas (urban and rural) within clusters. In the second stage, a sample of 25 households was selected in each cluster using equal probability systematic sampling methods. Because half of the households were required for the child sample, we selected

every other household after random selection of the first household to recruit children.

Community Mobilization

To gain support and awareness for the survey at the cluster, regional, and national levels, we undertook a series of activities that included a high-level national launch targeting national and regional leaders and development of print, radio, and television materials that described the survey. During data collection, we focused on district and cluster-level mobilization, where field staff worked directly with local leaders and key organizations to gain access and acceptability in the sampled clusters and disseminated information on the survey before the arrival of field teams into those clusters.

Eligibility Criteria, Recruitment, and Consent Procedures

The survey population was persons aged 18 months to 64 years who were usual household residents or persons who had been present in the household on the night before the survey. We excluded adults or children with cognitive or hearing disabilities that would prohibit them from effectively participating in the survey. Emancipated minors aged 17 years or younger were included in the survey and completed adult questionnaires. KAIS 2012 defined an emancipated minor as a person aged less than 18 years who was married, pregnant, or a parent and allowed these individuals to provide consent for survey participation.

The head of household, defined as an adult aged 18 years or older who was a resident of the household and recognized as a decision maker by other household members, provided verbal consent for his or her household to participate in the survey and subsequently completed the household interview. In the absence of an adult household member, an emancipated minor living in the home was selected as the household head for the purposes of the survey. Enumeration of household members was obtained through the household interview. If a household was contacted and a head of household was not available or it was not convenient for household members to be interviewed, the survey team would reschedule a maximum of 3 return visits while proceeding to the next selected household.

Eligible adults aged 18 years and above or emancipated minors provided verbal consent for interview, collection of a blood specimen for biologic testing at the National HIV Reference Laboratory (NHRL), storage of blood samples at the NHRL, and future testing that would include recent HIV infection and other unspecified tests. Verbal consent from parents or parents or guardians was required for minors aged 17 years and below to participate; we also obtained verbal assent from children aged 10–17 years whose parents or guardians had consented to their participation. Participants could also consent or assent to HBTC in their homes and for those testing HIV-positive through HBTC, a point-of-care (POC) CD4⁺ T-cell count test was offered.

Survey Instruments

Trained interviewers conducted face-to-face interviews in a private area in the participants' home. Names of

participants were collected to facilitate interviews; however, these were not retained in the survey data set. Data were captured on netbook computers (Mirus innovations, Mississauga, Ontario, Canada) using a data entry software application that was programmed with automated skip patterns and recognition of invalid responses.¹¹ In addition to providing information on eligible participants, the household questionnaire collected information regarding support of orphans and vulnerable children within the household, the physical and sanitary condition of the home, and household possessions. Based on household characteristics (water source, sanitation facilities, and household construction material) and household possessions, a wealth score was calculated for each household and used to divide households into quintiles that represented a wealth index of the poorest to the wealthiest households.¹² The household questionnaire also collected data using a validated Household Hunger Scale to measure food security at the household level.¹³ The Household Hunger Scale was used to tabulate a score for each household based on responses about the occurrence and frequency of food insecurity and intake. Based on the scores, we derived 3 household hunger categories: little to no household hunger, moderate household hunger, and severe household hunger.

Interviewers administered questionnaires to persons aged 15–64 years and emancipated minors that collected information on demographic characteristics, reproductive and children's health (for households with children aged 18 months to 14 years), sexual behavior, HIV-related knowledge and attitudes, HIV testing, exposure to blood transfusions and medical injections, tuberculosis and other health issues, male circumcision, health service utilization, nonprescription drug use, and migration. New elements in KAIS 2012 included an expansion of questions pertaining to programs that prevent perinatal HIV transmission, HIV care and treatment modules that asked comprehensive questions around entry into HIV care, retention in care, use of cotrimoxazole and ART, and adherence to treatment, questions to describe sexual concurrency, and prevalence of high-risk behaviors such as anal sex, transactional sex, and injecting drug use. The children's questionnaire was administered to respondents aged 10–14 years and collected information on demographics, HIV-related knowledge and attitudes, HIV risk perception, exposure to HIV prevention interventions, male circumcision, HIV testing, social norms about sex, alcohol and drug use, and HIV stigma. Information on sexual behavior in the children's questionnaire was limited to respondents aged 12–14 years to correspond with the age of sex education in Kenyan schools.

Sample Collection

Laboratory technicians collected venous blood from participants in CD4 stabilization tubes (Becton Dickinson Vacutainer Systems, Franklin Lakes, NJ). If a participant was willing to be interviewed but refused to provide a venous blood sample, a dried capillary blood spot (DBS) sample from a finger prick was requested. DBS samples were also collected in cases where venipuncture was not feasible or unsuccessful. Laboratory technicians prepared up to 4 S&S 903 DBS cards (Schleicher & Schuell Bioscience Inc., Keene, NH) for every participant at the end of each day using venous

blood samples. DBS cards were labeled with study identification numbers that matched their corresponding venous blood tube. DBS cards were dried overnight in the field laboratory and packaged for transport to the NHRL for biologic testing and storage. Field teams shipped participant blood tubes and DBS cards to the NHRL at room temperature through ground courier several times a week.

HIV Home-Based Testing and Counseling and Point-of-Care CD4⁺ T-Cell Count Testing

Eligible survey participants who completed the survey were given the opportunity to receive their HIV test results within their home using rapid HIV tests based on the national HIV testing algorithm.¹⁴ Blood specimens were tested in a parallel testing algorithm with Determine HIV-1/2 (Inverness Medical, Waltham, MA) and Unigold (Trinity Biotech PLC, Bray, Ireland) rapid test kits. Specimens that tested positive on both test kits were reported positive as the final result. Specimens testing negative on both test kits were reported negative as the final result. Specimens that tested positive on 1 kit and negative on the other were determined to be discrepant and reported indeterminate as the final result. Participants with indeterminate results were referred to a health facility for re-testing. CD4⁺ T-cell count testing was performed within the home using the PIMA CD4 Analyzer (Alere Inc., Waltham, MA) for participants with HIV-positive test results.

Adults were offered the opportunity to receive their HIV test results as an individual or as a couple. The parents or guardians of children aged 18 months to 9 years received the results on the child's behalf and were counseled by the HBTC service provider on how to disclose results to the child. Children aged 10–14 years received results in the presence of their parent or guardian, whereas children aged 15–17 years could receive their results without a parent or guardian present, provided the parent or guardian consented to this. All HIV-positive participants were provided with a KAIS 2012 referral card and referred for care.

Central Laboratory Procedures and Specimen Repository

At the NHRL, specimens were tested for HIV antibody using the Vironostika HIV-1/2 UNIF II Plus O Enzyme Immunoassay (bioMérieux, Marcy d'Etoile, France). HIV antibody-positive results were confirmed using the Murex HIV.1.2.O HIV Enzyme Immunoassay (DiaSorin, SpA, Saluggia, Italy). Repeat testing was performed for discordant results, and if results remained discordant, final results were obtained using polymerase chain reaction (Cobas Amplicor HIV-1 Monitor Test, version 1.5, Roche Molecular Diagnostics, Pleasanton, CA). We measured CD4⁺ T-cell counts and percentages (for children aged less than 5 years) using BD FACSCalibur flow cytometer (Becton Dickinson Biosciences, San Jose, CA). To quantify CD4⁺ T-cell count reference values, we measured CD4⁺ T-cell counts from a 10% random sample of HIV-negative specimens. All confirmed HIV-positive blood specimens were measured for HIV RNA concentration (Abbott M2000 Real-Time HIV-1 Assay, Abbott Laboratories, Abbott Park, IL). Specimens with HIV

RNA concentrations of under 1000 copies per milliliter were classified as clinically suppressed; specimens with HIV RNA concentrations of less than 550 copies per milliliter, the minimum concentration detectable on the assay, were classified as virologically suppressed.^{15,16} Samples remaining after HIV, CD4, and viral load testing were completed were stored at -70°C for future tests for recent HIV infection and other unspecified biologic testing.

Data Management, Weighting, and Statistical Analysis

Survey data were transmitted from field teams on a daily basis to the KAIS 2012 central server using a secure virtual private network. Where wireless networks were not available,

national-level survey supervisors would visit the teams on a monthly basis, collect the data, and upload the data to the central server in Nairobi. Because the KAIS 2012 design was not self-weighted, sampling weights were computed to take into account the sampling probability and survey nonresponse. Design weights included the probability of selection of the 372 KAIS 2012 clusters in the NASSEP V sampling frame. Weights were adjusted for household nonresponse (both for the adult and child sample) and individual nonresponse (both for the interview and blood draw). Because of overrepresentation of females in the sample, a poststratification adjustment was applied to the weights to reflect the expected distribution of sex across geographic regions based on the projected 2012 population distribution in the 2009 Kenya Population and Housing Census.¹⁷ In each cluster,

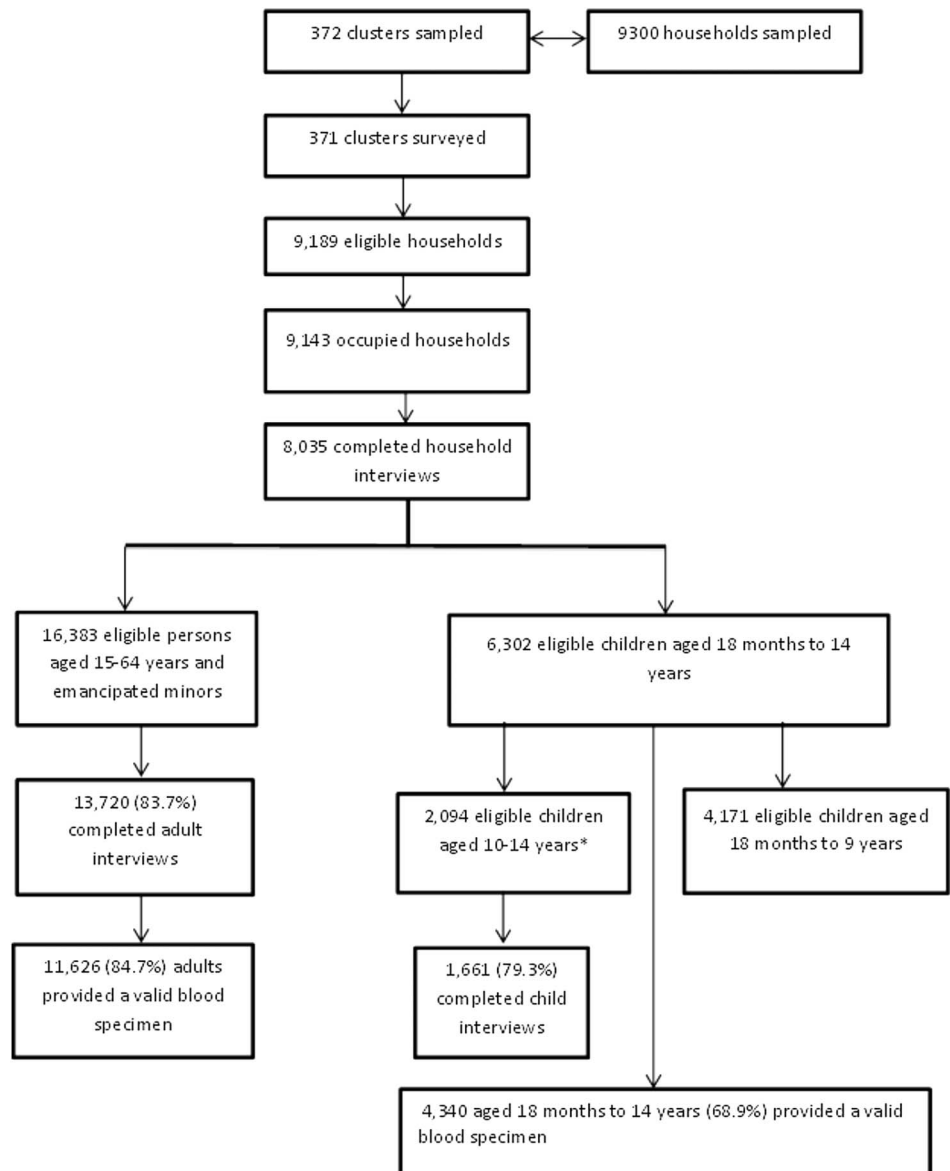


FIGURE 1. Clusters, households, and individuals in the Kenya AIDS Indicator Survey 2012.

*2131 children aged 10–14 years were eligible at the household level for children’s interview; however 37 were found to be ineligible based on their self-reported age during the interview.

TABLE 1. Interview and Blood Response Rates Among Households and Individuals Aged 15–64 Years and Emancipated Minors, KAIS 2012

	Total Eligible, N	Interviewed, N	Interview Response Rate, %	P	Provided Blood Sample, N	Blood Response Rate, %	P
Households	N = 9189	N = 8035				N/A	
Rural	5506	4915	89.3		—	—	—
Urban	3683	3120	84.7	<0.0001	—	—	—
Individuals aged 15–64 years and emancipated minors	N = 16,383	N = 13,720			N = 11,626		
Sex							
Men	7452	5766	77.4		4836	83.9	
Women	8931	7954	89.1	<0.0001	6790	85.4	0.0200
Age group, yrs*							
15–24	5708	4546	79.6		3828	84.2	
25–34	4519	3863	85.5		3228	83.6	
35–44	3021	2590	85.7		2211	85.4	
45–54	1929	1684	87.3		1446	85.9	
55–64	1139	1037	91.0	<0.0001	913	88.0	0.0030
Residence							
Rural	10,290	8638	84.0		7501	86.8	
Urban	6093	5082	83.4	0.3700	4125	81.2	<0.0001
Region							
Central	1757	1580	89.9		1423	90.1	
Coast	1971	1712	86.9		1462	85.4	
Eastern	3381	2684	79.4		2321	86.5	
Nairobi	2098	1745	83.2		1314	75.3	
Nyanza	2146	1834	85.5		1631	88.9	
Rift Valley	3109	2484	79.9		2067	83.2	
Western	1921	1681	87.5	<0.0001	1408	83.8	<0.0001
Wealth index							
Poorest	3570	2850	79.8		2434	85.4	
Second	3358	2857	85.1		2497	87.4	
Middle	3091	2675	86.5		2318	86.7	
Fourth	3056	2580	84.4		2177	84.4	
Richest	3308	2758	83.3	<0.0001	2200	79.8	<0.0001

*Excludes 67 eligible emancipated minors younger than aged 15 years who were not interviewed.

separate weights were calculated for the type of interview or blood draw conducted, including household interview, adult interview, child interview, parent or guardian’s pediatric interview, adult blood draw, and child blood draw. When reporting proportions and mean values, weights were normalized to the survey’s sample size and had a mean of 1.0. When reporting regional and national estimates of the total number of adults and children with select characteristics in the population, non-normalized weights based on the 2012 projected population data in the 2009 Kenya Population and Housing Census were applied.¹⁷ We performed data cleaning and anal-

yses using STATA version 12.0 (STATA Corporation, College Station, TX) and SAS version 9.3 (SAS Institute Inc., Cary, NC).

Ethical Approval

The KAIS 2012 protocol was reviewed and approved by the Ethical Review Board of the Kenya Medical Research Institute, the Institutional Review Board of the US Centers for Disease Control and Prevention, and the Committee on Human Research of the University of California, San Francisco.

TABLE 2. Interview and Blood Response Rates Among Children Aged 18 Months to 14 Years, KAIS 2012

	Total Eligible	Boy	Girl	P	Rural	Urban	P
Number eligible for blood draw (18 months to 14 years)	6302	3196	3106	—	1682	4620	—
Blood draw response rate (%) (18 months to 14 years)	68.9	69.1	68.6	0.6600	62.8	71.1	<0.0001
Number eligible for interview (10–14 yrs)	2094	1037	1057	—	543	1551	—
Interview response rate (%) (10–14 yrs)	79.3	79.2	79.3	0.3100	79.2	79.7	0.5000

TABLE 3. Demographic Characteristics of Individuals* Aged 15–64 Years and Emancipated Minors, KAIS 2007 and KAIS 2012

Characteristic	KAIS 2012					
	Men (N = 5766) Unweighted, n	Weighted % (95% CI)	Women (N = 7954) Unweighted, n	Weighted % (95% CI)	Total (N = 13,720) Unweighted, n	Weighted % (95% CI)
Age group, yrs						
15–19	1073	18.2 (16.8 to 19.7)	1220	15.3 (14.2 to 16.5)	2293	16.8 (15.8 to 17.7)
20–24	846	14.9 (13.7 to 16.0)	1403	17.6 (16.5 to 18.7)	2249	16.3 (15.4 to 17.1)
25–29	828	14.6 (13.5 to 15.8)	1313	16.6 (15.6 to 17.6)	2141	15.6 (14.8 to 16.4)
30–34	716	12.2 (11.3 to 13.2)	981	12.4 (11.5 to 13.4)	1697	12.3 (11.7 to 13.0)
35–39	583	10.4 (9.6 to 11.3)	833	10.4 (9.6 to 11.2)	1416	10.4 (9.8 to 11.0)
40–44	493	8.6 (7.8 to 9.4)	669	8.4 (7.7 to 9.0)	1162	8.5 (8.0 to 9.0)
45–49	357	6.1 (5.5 to 6.8)	492	6.3 (5.7 to 7.0)	849	6.2 (5.8 to 6.7)
50–54	372	6.4 (5.7 to 7.0)	473	5.9 (5.3 to 6.5)	845	6.1 (5.7 to 6.6)
55–59	277	4.7 (4.0 to 5.3)	320	4.0 (3.5 to 4.5)	597	4.3 (3.9 to 4.8)
60–64	221	3.8 (3.2 to 4.4)	250	3.1 (2.6 to 3.5)	471	3.4 (3.0 to 3.8)
15–24	1919	33.1 (31.5 to 34.8)	2622	32.9 (31.7 to 34.2)	4541	33.0 (32.0 to 34.1)
15–49	4896	85.1 (84.0 to 86.3)	6910	87.1 (86.1 to 88.0)	11,806	86.1 (85.2 to 87.0)
50–64	870	14.9 (13.7 to 16.0)	1043	12.9 (12.0 to 13.9)	1913	13.9 (13.0 to 14.7)
Highest educational attainment						
No primary	381	3.8 (2.9 to 4.8)	1197	10.6 (8.8 to 12.4)	1578	7.3 (6.0 to 8.6)
Incomplete primary	450	6.7 (5.4 to 7.9)	710	8.4 (7.3 to 9.5)	1160	7.6 (6.7 to 8.4)
Complete primary	1893	32.5 (30.6 to 34.4)	2423	32.1 (30.3 to 33.9)	4316	32.3 (30.9 to 33.7)
Secondary or higher	3042	57.0 (54.6 to 59.3)	3624	48.9 (46.8 to 50.9)	6666	52.8 (51.1 to 54.6)
Marital status						
Never married/never cohabited	2256	38.7 (37.0 to 40.4)	2015	25.5 (24.1 to 26.9)	4271	32.0 (30.7 to 33.2)
Ever widowed	49	0.8 (0.5 to 1.1)	561	7.0 (6.3 to 7.7)	610	4.0 (3.6 to 4.3)
Separated/divorced	219	3.8 (3.2 to 4.4)	439	5.4 (4.8 to 6.0)	658	4.7 (4.2 to 5.1)
Married/cohabiting- polygamous	239	3.8 (3.1 to 4.5)	691	8.2 (7.1 to 9.3)	930	6.0 (5.2 to 6.8)
Married/cohabiting- monogamous	2999	52.8 (51.1 to 54.4)	4242	53.8 (52.3 to 55.4)	7241	53.3 (52.1 to 54.6)
Living with partner/spouse						
Yes	2780	85.7 (83.6 to 87.9)	3818	78.0 (76.3 to 79.8)	6598	81.6 (80.1 to 83.1)
Residence						
Rural	3531	61.4 (58.5 to 64.2)	5107	64.5 (62.1 to 66.8)	8638	62.9 (60.5 to 65.4)
Urban	2235	38.6 (35.8 to 41.5)	2847	35.5 (33.2 to 37.9)	5082	37.1 (34.6 to 39.5)
Region						
Nairobi	796	11.6 (10.3 to 13.0)	949	10.3 (9.2 to 11.4)	1745	11.0 (9.9 to 12.0)
Central	654	13.2 (11.1 to 15.3)	926	13.2 (11.7 to 14.7)	1580	13.2 (11.5 to 14.9)
Coast	714	9.4 (8.0 to 10.9)	998	9.1 (7.6 to 10.7)	1712	9.3 (7.9 to 10.7)
Eastern	1089	15.2 (13.1 to 17.3)	1595	15.6 (14.0 to 17.2)	2684	15.4 (13.7 to 17.1)
Nyanza	774	13.4 (11.5 to 15.2)	1060	14.7 (13.0 to 16.3)	1834	14.0 (12.4 to 15.7)
Rift Valley	1058	26.7 (23.6 to 29.9)	1426	25.7 (23.1 to 28.4)	2484	26.2 (23.5 to 29.0)
Western	681	10.4 (8.9 to 11.9)	1000	11.3 (9.9 to 12.7)	1681	10.9 (9.5 to 12.2)
Employment						
Employed in last week	3331	59.0 (56.7 to 61.4)	2836	37.9 (35.9 to 39.9)	6167	48.2 (46.4 to 50.1)
Wealth index						
Poorest	1131	18.1 (15.4 to 20.9)	1719	20.2 (17.5 to 23.0)	2850	19.2 (16.6 to 21.8)
Second	1162	20.2 (18.1 to 22.2)	1695	21.4 (19.5 to 23.4)	2857	20.8 (18.9 to 22.7)
Middle	1135	20.0 (17.9 to 22.0)	1540	19.7 (17.8 to 21.6)	2675	19.8 (17.9 to 21.7)
Fourth	1195	21.1 (18.7 to 23.5)	1385	17.6 (15.6 to 19.6)	2580	19.3 (17.2 to 21.4)
Richest	1143	20.6 (17.8 to 23.5)	1615	21.0 (18.3 to 23.8)	2758	20.8 (18.1 to 23.6)
Religion						
Roman Catholic	1318	24.2 (21.9 to 26.4)	1733	23.0 (20.8 to 25.3)	3051	23.6 (21.6 to 25.6)
Protestant/other Christian	3487	64.4 (61.9 to 67.0)	5088	68.4 (65.8 to 71.0)	8575	66.5 (64.1 to 68.8)
Muslim	610	5.8 (4.2 to 7.4)	835	5.5 (3.8 to 7.3)	1445	5.6 (4.0 to 7.3)

TABLE 3. (Continued) Demographic Characteristics of Individuals* Aged 15–64 Years and Emancipated Minors, KAIS 2007 and KAIS 2012

Characteristic	KAIS 2012					
	Men (N = 5766) Unweighted, n	Weighted % (95% CI)	Women (N = 7954) Unweighted, n	Weighted % (95% CI)	Total (N = 13,720) Unweighted, n	Weighted % (95% CI)
No religion	240	4.5 (3.3 to 5.6)	182	2.0 (1.2 to 2.8)	422	3.2 (2.5 to 4.0)
Other	110	1.2 (0.4 to 1.9)	113	1.0 (0.6 to 1.4)	223	1.1 (0.6 to 1.6)
Nationality						
Kenyan	5729	99.4 (99.2 to 99.7)	7898	99.4 (99.2 to 99.6)	13,627	99.4 (99.3 to 99.6)
Non-Kenyan	37	0.6 (0.3 to 0.8)	56	0.6 (0.4 to 0.8)	93	0.6 (0.4 to 0.7)

Characteristic	KAIS 2007		
	Men (N = 7701) Weighted % (95% CI)	Women (N = 10,239) Weighted % (95% CI)	Total (N = 17,940) Weighted % (95% CI)
Age group, yrs			
15–19	18.6 (17.3 to 19.8)	15.5 (14.7 to 16.3)	16.8 (16.1 to 17.6)
20–24	15.7 (14.7 to 16.6)	17.8 (16.9 to 18.8)	16.9 (16.1 to 17.7)
25–29	12.6 (11.7 to 13.6)	15.0 (14.2 to 15.9)	14.0 (13.3 to 14.7)
30–34	11.3 (10.4 to 12.1)	12.3 (11.5 to 13.1)	11.9 (11.2 to 12.5)
35–39	10.1 (9.4 to 10.9)	10.7 (10.0 to 11.4)	10.5 (9.9 to 11.0)
40–44	8.2 (7.4 to 8.9)	8.2 (7.5 to 8.8)	8.2 (7.6 to 8.7)
45–49	7.7 (7.1 to 8.4)	7.9 (7.3 to 8.5)	7.8 (7.4 to 8.3)
50–54	5.5 (5.0 to 6.1)	5.2 (4.7 to 5.7)	5.3 (4.9 to 5.7)
55–59	5.6 (5.0 to 6.2)	4.7 (4.1 to 5.2)	5.1 (4.7 to 5.5)
60–64	4.7 (4.2 to 5.3)	2.7 (2.3 to 3.0)	3.5 (3.2 to 3.9)
15–24	34.2 (32.8 to 35.7)	33.4 (32.4 to 34.4)	33.7 (32.8 to 34.7)
15–49	84.1 (83.2 to 85.1)	87.5 (86.6 to 88.3)	86.1 (85.4 to 86.8)
50–64	15.9 (14.9 to 16.8)	12.5 (11.7 to 13.4)	13.9 (13.2 to 14.6)
Highest educational attainment			
No primary	6.5 (5.5 to 7.5)	15.0 (13.6 to 16.4)	11.4 (10.3 to 12.5)
Incomplete primary	29.3 (27.5 to 31.2)	29.6 (28.1 to 31.2)	29.5 (28.0 to 31.0)
Complete primary	24.5 (23.1 to 25.8)	24.8 (23.6 to 25.9)	24.6 (23.6 to 25.6)
Secondary or higher	39.7 (37.5 to 42.0)	30.5 (28.5 to 32.6)	34.5 (32.5 to 36.4)
Marital status			
Never married/never cohabited	37.1 (35.5 to 38.6)	23.1 (21.8 to 24.4)	29.1 (27.9 to 30.2)
Ever widowed	1.4 (1.0 to 1.7)	7.4 (6.8 to 8.0)	4.8 (4.4 to 5.2)
Separated/divorced	4.2 (3.7 to 4.8)	6.8 (6.0 to 7.5)	5.7 (5.2 to 6.2)
Married/cohabiting-polygamous	4.6 (4.0 to 5.2)	8.3 (7.5 to 9.2)	6.7 (6.1 to 7.4)
Married/cohabiting-monogamous	52.7 (51.2 to 54.2)	54.4 (52.8 to 55.9)	53.7 (52.4 to 54.9)
Living with partner/spouse	83.5 (81.4 to 85.6)	72.7 (71.1 to 74.2)	77.1 (75.7 to 78.5)
Residence			
Rural	77.6 (74.9 to 80.3)	76.1 (72.8 to 79.5)	76.8 (73.8 to 79.7)
Urban	22.4 (19.7 to 25.1)	23.9 (20.5 to 27.2)	23.2 (20.3 to 26.2)
Region			
Nairobi	9.3 (7.8 to 10.8)	9.8 (8.5 to 11.2)	9.6 (8.4 to 10.9)
Central	14.5 (13.1 to 16.0)	14.4 (12.9 to 15.8)	14.4 (13.1 to 15.8)
Coast	7.6 (6.5 to 8.8)	8.1 (6.7 to 9.5)	7.9 (6.7 to 9.1)
Eastern	18.5 (16.2 to 20.9)	17.4 (15.7 to 19.2)	17.9 (16.0 to 19.8)
Nyanza	15.5 (13.7 to 17.4)	15.7 (14.1 to 17.3)	15.6 (14.0 to 17.3)
Rift Valley	22.5 (20.1 to 24.8)	22.6 (19.4 to 25.7)	22.5 (19.8 to 25.3)
Western	12.0 (10.5 to 13.5)	12.0 (10.6 to 13.4)	12.0 (10.7 to 13.3)
Employment			
Employed in last week	80.8 (79.5 to 82.1)	63.3 (61.9 to 64.8)	70.8 (69.7 to 71.9)

(continued on next page)

TABLE 3. (Continued) Demographic Characteristics of Individuals* Aged 15–64 Years and Emancipated Minors, KAIS 2007 and KAIS 2012

Characteristic	KAIS 2007		
	Men (N = 7701) Weighted % (95% CI)	Women (N = 10,239) Weighted % (95% CI)	Total (N = 17,940) Weighted % (95% CI)
Wealth index			
Poorest	15.4 (13.3 to 17.4)	15.6 (13.8 to 17.4)	15.5 (13.7 to 17.3)
Second	17.8 (16.1 to 19.5)	17.6 (16.1 to 19.2)	17.7 (16.1 to 19.3)
Middle	19.9 (18.3 to 21.5)	19.6 (18.2 to 21.1)	19.7 (18.3 to 21.2)
Fourth	21.3 (19.3 to 23.3)	21.5 (19.8 to 23.3)	21.4 (19.7 to 23.2)
Richest	25.6 (22.9 to 28.4)	25.6 (22.7 to 28.5)	25.6 (22.9 to 28.3)
Religion			
Roman Catholic	28.0 (25.8 to 30.2)	24.8 (22.9 to 26.7)	26.1 (24.2 to 28.0)
Protestant/other Christian	60.7 (58.3 to 63.0)	65.8 (63.8 to 67.9)	63.6 (61.6 to 65.7)
Muslim	6.5 (5.6 to 7.5)	7.1 (6.1 to 8.1)	6.9 (5.9 to 7.8)
No religion	4.1 (3.3 to 4.8)	1.7 (1.2 to 2.2)	2.7 (2.2 to 3.2)
Other	0.7 (0.4 to 1.1)	0.6 (0.2 to 1.1)	0.7 (0.4 to 1.0)
Nationality			
Kenyan	—	—	—
Non-Kenyan	—	—	—

*The sums for individual variables may not add up to the totals in the column headings because of missing data.
CI, confidence interval.

RESULTS

Survey Response Rates

Because of regional insecurity, the North Eastern region was not included in the NASSEP V from which KAIS 2012

TABLE 4. Demographic Characteristics of Children Aged 10–14 Years, KAIS 2012

Characteristic	Crude, n	Weighted % (95% CI)
Total	1661	
Median age (yrs)	12	—
Sex		
Boy	822	50.3 (47.5 to 53.1)
Girl	839	49.7 (46.9 to 52.5)
Residence		
Rural	1236	75.6 (71.8 to 79.5)
Urban	425	24.4 (20.5 to 28.2)
Region		
Nairobi	111	6.1 (4.8 to 7.3)
Central	181	10.5 (8.7 to 12.3)
Coast	227	9.4 (7.0 to 11.7)
Eastern	349	16.1 (12.5 to 19.7)
Nyanza	231	14.9 (12.3 to 17.5)
Rift Valley	306	29.9 (24.7 to 35.1)
Western	256	13.1 (10.9 to 15.4)
Wealth index		
Poorest	453	28.2 (22.3 to 34.1)
Second	419	25.5 (22.0 to 29.0)
Middle	366	22.2 (18.8 to 25.6)
Fourth	237	13.3 (10.6 to 16.1)
Richest	186	10.8 (8.5 to 13.1)

CI, confidence interval.

clusters were sampled. The North Eastern region contributes to approximately 6% of Kenya's total population, and HIV prevalence in North Eastern region was 0.8% in 2007 accounting for 0.4% of the overall HIV burden in the country.^{3,17} A total of 372 clusters were sampled for KAIS 2012; however, 1 cluster in Tana River region was excluded because of security issues during the survey period. The final number of surveyed clusters was 371. Of the 9300 households sampled, 9189 (98.8%) were eligible for the survey and 9143 (98.3%) were occupied by household members at the time of the survey (Fig. 1). Of the eligible households, 8035 (87.4%) completed a household interview. Of 16,383 eligible individuals aged 15–64 years and emancipated minors in these households, 13,720 (83.7%) completed individual interviews, and 11,626 (84.7%) provided a blood specimen. There were a total of 6302 children aged 18 months to 14 years who were eligible for the blood draw, and of these 4340 (68.9%) provided a blood specimen. There were a total of 2094 children aged 10–14 years eligible for interview, and of these, 1661 (79.3%) completed child interviews.

Rural households had higher household interview response rates (89.3%) compared to urban households (84.7%, $P < 0.0001$) (Table 1). Response rates for adult interviews (respondents aged 15–64 years) were higher among women (89.1%) than men (77.4%; $P < 0.0001$) and similar between urban (83.4%) and rural (84.0%) residents. A greater proportion of women (85.4%) than men (83.9%, $P = 0.0200$) provided blood specimens. Participants who were aged younger than 35 years ($P = 0.0030$), residing in urban areas ($P < 0.0001$) and in the highest wealth index ($P < 0.0001$) were less likely to provide a blood sample than their older, rural, and poorer counterparts. Among children aged 10–14 years, interview response rates were similar among girls and boys (79.3% vs. 79.2%, $P = 0.3100$) and among urban and rural residents

(79.7% vs. 79.2%, $P = 0.5000$) (Table 2). The overall blood response rate among all children aged 18 months to 14 years was 68.9%.

Among participants aged 15–64 years and emancipated minors who completed an interview, more than half were women, and close to half were persons aged 15–29 years (Table 3). Married or cohabiting participants accounted for almost 60% of survey respondents. The majority of participants resided in rural areas with Rift Valley region having the highest representation of all respondents. About half of the subjects were currently employed and two-thirds were Protestant Christian. The distribution of sociodemographic characteristics among KAIS 2007 and KAIS 2012 survey respondents was similar with respect to age, sex, marital status, and regional distribution.

The median age of surveyed children aged 10–14 years was 12 years (Table 4). Sex was equally distributed among interviewed children, with 49.7% girls compared with 50.3% boys. Most children were rural residents (75.6%) and were surveyed in the Rift Valley region (29.9%).

A total of 16,807 DBS specimens and 14,993 venous blood specimens were received at the NHRL. Of the venous blood specimens received, 1254 were not suitable for CD4⁺ T-cell testing primarily because of hemolysis of the blood during transport. Furthermore, of 15,979 participants who gave a blood sample, 1135 provided a DBS only (as opposed to venous sample) from which we could not measure CD4⁺ T-cell counts. Because of this, less than half (46.2%) of HIV antibody-positive specimens had a valid CD4⁺ T-cell test result from the national laboratory.

DBS specimens that were not used for primary testing at NHRL were stored for future anticipated testing for recent HIV infection and other unspecified biologic testing. Overall, HBTC services were requested by 72% of survey participants.¹⁸ Among participants who had an HBTC HIV test result and a central laboratory HIV test result, the overall agreement of results was 99% (data not shown).

DISCUSSION

KAIS 2012 provided data for monitoring HIV prevalence and HIV-related behaviors among the general population. Although KAIS 2007 had a larger sample size, the distribution and sociodemographic characteristics of respondents in the 2 surveys were similar.

KAIS 2012 included several new elements to enhance the utility of data collected from a national HIV serologic survey to inform Kenya's national strategy for prevention, care, and treatment. Data from KAIS 2012 permitted analysis of sexual concurrency in relationships, HIV testing patterns within sexual partnerships, and same sex partnerships; previously, these had not been examined. The survey collected information to calculate national size estimates for populations at high risk for HIV infection. Behavioral and clinical data on HIV-infected persons, including knowledge of HIV infection, use of ART, CD4⁺ T-cell count, and viral load, enabled us to construct a clinical cascade describing the continuum of care among HIV-infected

persons in the country, following persons from HIV infection to diagnosis, entry and retention in care, use of and adherence to ART, and virologic suppression.

For the first time, a national household survey in Kenya included an assessment of HIV prevalence, correlates of HIV infection, sociodemographic characteristics, sexual norms, HIV risk perception, and HIV-related stigma among children. Another innovation was the pairing of HBTC services with POC CD4 testing, allowing study participants to receive their CD4⁺ T-cell counts at the time of testing within their homes. This also provided data for comparison of POC results to CD4 test results from the national laboratory. KAIS 2012 used up-to-date technology for data collection and transmission, allowing for real-time monitoring of survey progress and response rates, maximizing data quality and minimizing time for data entry and data cleaning, thereby facilitating rapid dissemination of key findings.

KAIS 2012 had several limitations. The survey response rate was lower than expected for both interview and blood draw response rates, which we had a priori estimated to be 90% based on results from KAIS 2007. The household interview, individual interview, and blood draw response rates were lower than documented in KAIS 2007, where the household and individual interview rates were above 90% and blood draw response rate was 88%.³ Lower participation in the blood draw could introduce selection bias if participation was associated with knowledge of HIV infection, potentially leading to an underestimate of national HIV prevalence.¹⁹ Participation of children aged 10–14 years was lower than expected because many were away at school during the survey. Infants younger than 18 months of age were excluded because of logistical difficulties in conducting polymerase chain reaction tests in the field and returning these results back to participants. Consequently, KAIS 2012 data excluded potential cases of HIV infection in this age group, underscoring an important gap in the ability to provide a comprehensive assessment of HIV infection and need for services for all children in Kenya. In addition, we were unable to survey North Eastern region because of regional security concerns. In KAIS 2007, North Eastern region had the fewest number of participants and the lowest HIV prevalence.³ Therefore, it is unlikely that omission of North Eastern region contributed to underestimation of national HIV prevalence in KAIS 2012. Finally, approximately half of HIV-positive samples did not have corresponding CD4⁺ T-cell count data, limiting our ability to comprehensively estimate eligibility for ART and ART coverage among treatment eligible persons. To limit bias, we weighted our estimates of ART need and coverage to account for missing CD4⁺ T-cell count data among HIV-positive persons.

Despite this the overall sample sizes for adults and children were large enough to provide adequately robust regional and national estimates of HIV prevalence. Findings from this survey will be used to validate and calibrate existing surveillance data and guide the country's HIV programs in strengthening prevention, treatment, care, and surveillance initiatives. Kenya's recent transition into a devolved government system also necessitates that these data be sufficiently detailed to assist planning, budgeting, and programming up to regional and subregional levels.

In generalized epidemics, population-based surveys of the general population are critical for obtaining information for monitoring epidemic trends, guiding programmatic responses, and evaluating key initiatives.^{8,20} Data from KAIS 2007 had substantial influence in determining and refining Kenya's response to HIV/AIDS over the past 5 years.⁸ As the new Kenya National AIDS Strategic Plan is being formed, important political and programmatic impact is expected from the results of KAIS 2012.

ACKNOWLEDGMENTS

The authors thank the fieldworkers and supervisors for their excellent work during KAIS 2012 data collection. They also gratefully acknowledge all the children and families who participated in this national survey. The authors would like to thank George Rutherford, Kevin DeCock, Janet Lee, and Joy Mirjahangir for reviewing and providing input on the article; Ray Shiraiishi, Eddas Bennett, and Paul Stupp for their input on weighting of the data set; and the KAIS 2012 Study Group for their contribution to the design of the survey and collection of the data set: Willis Akhwale, Sehin Birhanu, John Bore, Angela Broad, Robert Buluma, Thomas Gachuki, Jennifer Galbraith, Anthony Gichangi, Beth Gikonyo, Margaret Gitau, Joshua Gitonga, Mike Grasso, Malayah Harper, Andrew Imbwaga, Muthoni Junghae, Mutua Kakinyi, Samuel Mwangi Kamiru, Nicholas Owenje Kandege, Lucy Kanyara, Yasuyo Kawamura, Timothy Kellogg, George Kichamu, Andrea Kim, Lucy Kimondo, Davies Kimanga, Elija Kinyanjui, Stephen Kipkerich, Danson Kimutai Koske, Boniface O. K'Oyugi, Veronica Lee, Serenita Lewis, William Maina, Ernest Makokha, Agneta Mbithi, Joy Mirjahangir, Ibrahim Mohamed, Rex Mpazanje, Nicolas Muraguri, Patrick Murithi, Lilly Muthoni, James Muttunga, Jane Mwangi, Mary Mwangi, Sophie Mwanyumba, Silas Mulwa, Francis Ndichu, Anne Ng'ang'a, James Ng'ang'a, John Gitahi Ng'ang'a, Lucy Ng'ang'a, Carol Ngare, Bernadette Ng'eno, Inviolata Njeri, David Njogu, Bernard Obasi, Macdonald Obudho, Edwin Ochieng, Linus Odawo, Jacob Odhiambo, Caleb Ogada, Samuel Ogola, David Ojaka, James Kwach Ojwang, George Okumu, Patricia Oluoch, Tom Oluoch, Kenneth Ochieng Omondi, Osborn Otieno, Yakubu Owolabi, Bharat Parekh, George Rutherford, Sandra Schwarcz, Shahnaaz Sharrif, Victor Ssempiijja, Lydia Tabuke, Yuko Takanaoka, Mamo Umuro, Brian Eugene Wakhutu, Celia Wandera, John Wanyungu, Wanjiru Waruiru, Anthony Waruru, Paul Waweru, Larry Westerman, and Kelly Winter.

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