



EQUITY OF MATERNAL, NEWBORN AND CHILD HEALTH SERVICES IN RURAL ETHIOPIA

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The Last Ten Kilometers (L10K): What it Takes to Improve Health Outcomes in Rural Ethiopia is implemented by JSI Research & Training Institute, Inc., with grants from the Bill & Melinda Gates Foundation, UNICEF and USAID. The program covers 215 *woredas* (i.e., districts), about 25 million people, in Amhara, Oromia, Tigray, and the Southern Nations, Nationalities and People's (SNNP) regions to strengthen the bridge between households and the primary health care unit (PHCU), which is Ethiopia's basic health service delivery structure at the grassroots, and the community. The aim is to improve high impact maternal, neonatal and child health (MNCH) care practices among the rural households and contribute towards achieving child and maternal health related Millennium Development Goals 4 and 5. (i.e., decrease child and maternal mortality rates, respectively). The PHCU comprises five health posts—each health post staffed by two female health extension workers (HEWs) who are high school graduates with 12 months of pre-service training to provide preventive, promotive and basic curative care to a *kebele* (community) of about 5,000 people—and one health center, staffed with health officers, nurses and midwives who provide technical and supervisory support to the HEWs, and has a referral linkage with a primary hospital. The Bill & Melinda Gates funded activities, initiated in 2008 and will continue until 2015, are implemented by 12 Civil Society Organizations (i.e., L10K grantees) in 115 *woredas*. The L10K platform strategy in the 115 *woredas* enhances the interactions among frontline health workers (i.e., health extension workers [HEWs] and the health development army [HDA] members), households, and communities to achieve more, better, cost-effective and equitable MNCH services provided by the PHCU. A network of five HDA members is responsible for 30 households which extend the reach of the HEWs to provide health education and ensure linkages between the households and the government health services. In selected *woredas*, the *Participatory Community Quality Improvement* and *Referral Solutions* for maternal and newborn critical conditions are added upon the L10K platform strategy to identify enhanced community solutions to reach its objectives. With funds from UNICEF, L10K is providing support to the HEP to implement 1) Community-Case Management (iCCM) of common childhood illnesses in 148 *woredas*; and 2) Community based nutrition (CBN) in 56 *woredas*. With funds from USAID, L10K is 1) supporting HEP to implement iCCM in 38 *woredas*, and 2) supporting 42 PHCUs (in 42 *woredas*) to provide basic emergency obstetrics and newborn care.

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Abstract

Providing equitable maternal, newborn, and child health (MNCH) services is one of the objectives of the Ethiopian rural health system and the L10K program. This study uses the L10K baseline, December 2008, and midterm, December 2010, survey data to assess health disparities (i.e., inequities) in maternal, newborn, and child health (MNCH) outcomes according to women's age, education, wealth, and household's distance from the nearest health facility. Inequities of the MNCH indicators according to women's household wealth were measured by constructing concentration indices—the value of which ranged between -1 and 1; 0 indicating there is equity in the MNCH outcome between the poorest and relatively less poor women; a positive value indicate that the outcome is concentrated among less poorer women while a negative value indicated the opposite. Similarly age, education, and distance from the nearest health facility disparity concentration indices were constructed. Disparities of the MNCH indicators due to education were the most prominent (observed for 16 of the 19 outcomes analyzed), which was followed by age disparity (observed for 13 of the 19 indicators), then wealth disparity (observed for 10 indicators), followed by disparity due to distance from the nearest health facility (observed for 6 indicators). Addressing these inequities in MNCH indicators, especially the disparities by education and wealth, will significantly contribute towards achieving Ethiopia's maternal and child health targets for the Millennium Development Goals. This study concludes by outlining possible HEP strategies to achieve equitable MNCH services and outcomes.

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ACRONYMS

ANC	Antenatal Care
ARI	Acute Respiratory Infection
BEMONC	Basic Emergency Obstetric and Neonatal Care
BMGF	Bill & Melinda Gates Foundation
CHP	Community Health Promoter
CPR	Contraceptive Prevalence Rate
EPI	Expanded Program of Immunization
FMOH	Federal Ministry of Health
HDA	Health Development Army
HEP	Health Extension Program
HEW	Health Extension Worker
HMIS	Health Management Information System
ICCM	Integrated Community Case Management
JSI	JSI Research & Training Institute, Inc.
L10K	Last Ten Kilometers
MDGs	Millennium Development Goals
MF	Model Family
MNCH	Maternal, Newborn and Child Health
M&NH	Maternal and Newborn or Neonatal Health
NGO	Non-Governmental Organization
ORS	Oral Rehydration Salt
ORT	Oral Rehydration Therapy
RHB	Regional Health Bureau
MNCH	Reproductive, Maternal, Neonatal, and Child Health
SNNP	Southern Nations, Nationalities and People's
PHCU	Primary Health Care Unit
PNC	Postnatal Care
TT	Tetanus Toxoid
USAID	United States Agency for International Development
vCHW	volunteer Community Health Workers
WHO	World Health Organization

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The implementation of the surveys would not have been possible without the support of the Regional Health Bureaus (RHBs) of Amhara, Oromia, SNNPR, and Tigray. The involvement of the RHBs during the baseline and midterm surveys, including providing us with staff from the regions to be trained as interviewers and supervisors, has been crucial for maintaining data quality. We thank the interviewers and the supervisors for their hard work, their dedication, and for finishing the field work on schedule.

We are especially grateful to our implementing partners: Amhara Development Association, Bench Maji Development Association, Ethiopian Kale Hiwot Church, Fayyaa Integrated Development Association, Illu Women and Children Integrated Development Association, Kaffa Development Association, Oromiya Development Association, Sheka Peoples' Development Association, Siltie Development Association, Southern Region's Women's Association, Relief Society of Tigray, and Women's Association of Tigray.

We also thank the woreda health bureau staff, health extension workers and the community health promoters for their sincerity and hard work. Their hard work has brought about significant improvements in maternal, newborn and child health care behaviors and practices. We express our gratitude to our implementing partners for providing staff support for survey supervision, as well as logistics support which helped contain survey expenses. The sincere dedication of the supervisors was key to maintaining survey quality and finishing the field work on time.

The contributions of those who worked as consultants during the midterm survey were vital for maintaining survey quality. Dr. Alemayehu Mekonnen provided training for the survey teams in Amhara and SNNP regions; Ato Saail Mohammed and Ato Kasahun Mengistu provided training to the Oromia survey team and coordinated their activities; Ato Dawit Birhanu and Ato Ambanesh Necho coordinated field operations in the Amhara region; Ato Hibret Bireda coordinated field operations in SNNP; Ato Legesse Hadush

coordinated field activities in Tigray; and Dr. Solomon Shiferaw lead the midterm survey database design and management, which was instrumental for maintaining the quality of electronic data capturing, data cleaning and data validation.

The contributions of the central and regional L10K teams at every step of the process have been the foundation of its success. We express our appreciation to the L10K team for their perseverance; hard work, enthusiasm and a can-do mentality made this survey possible.

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Lastly, we would also like to thank the women, including the health extension workers who took their time to respond to the questionnaire and share with us a glimpse of their realities. Their feedback was invaluable not only for L10K but for all partners and stakeholders supporting the Government of Ethiopia's health extension program.

INTRODUCTION

Background

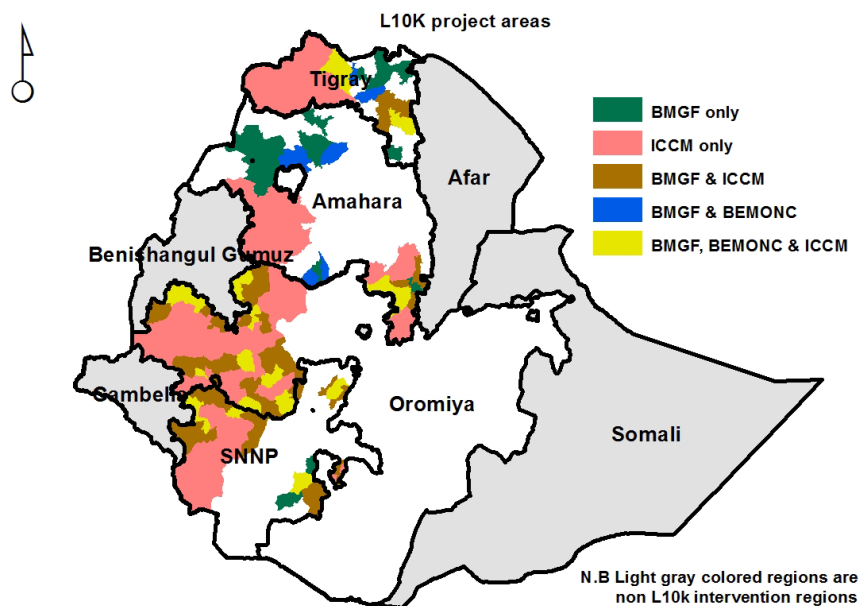
The Countdown to 2015 for maternal, newborn, and child survival, an independent supra-institutional initiative that tracks country and global progress towards achievement of Millennium Development Goals (MDGs) 4 (reduce child mortality) and 5 (improve maternal health), emphasizes the need to address inequities in maternal and child health as a key strategy to improve health and survival (Barros et al. 2012; Bhutta et al. 2010; Boerma et al., 2008).

The Government of Ethiopia (GOE) recognized the need of providing equitable access to promotive, preventive, and selected curative health services to its people, and launched the health extension program (HEP) in 2003. The HEP—a community or *kebele* based service system—is the backbone to reach Ethiopia’s health-related MDGs. The main strategies of the HEP include establishing a health post and training and deploying two female health extension workers (HEWs) in every *kebele* of the country. The package of services provided by the HEWs includes communicable diseases prevention and control, family planning, maternal and child health, immunization, nutrition, adolescent reproductive health, first-aid and emergency measures, hygiene and environmental sanitation, and health education and communication (Assefa Admassie et al. 2009; CNHDE 2008; Temiess 2008; Wakabi 2008). Health centers, staffed with nurses, midwives and health officers, provide administrative, logistical, technical, and referral support to the HEWs. The health centers provide a wide range of mainly curative services and are in the process of being equipped to provide basic emergency obstetric and neonatal care. One health center provides support to five health posts and forms the primary health care unit (PHCU). The PHCU includes a referral linkage with a primary hospital to provide more specialized services including emergency obstetric and newborn care (FMOH 2010).

The HEP has achieved universal coverage by establishing at least one health

post and deploying at least two HEWs in nearly all of the 15 thousand *kebeles* in Ethiopia (FMOH 2011). The HEWs spend 50 percent of their time conducting household visits and community outreach activities; training families to adopt desirable health practices and serve as ‘model families’ in their neighborhood; and, organizing communities to participate in the expansion of HEP services. Community health promoters (CHPs), who are from model family households, have been supporting the HEWs in providing HEP services, with a density of one CHP for every 25 to 30 households (FMOH 2010; Temiess 2008; Wakabi 2008). Recently the Federal Ministry of Health of the GOE (FMOH 2011) implemented a new policy to increase the density of CHPs to one for every five households and now known as the health development army (HDA) members.

Since December 2008, the Bill & Melinda Gates Foundation has funded activities of the Last Ten Kilometers Program (L10K), implemented by JSI Research & Training Institute, Inc., including innovative strategies to engage local communities to participate in and strengthen the health extension program (HEP). The project aims to improve MNCH outcomes in 115 rural *woredas* of Amhara, Oromia, Southern Nations, Nations and Nationalities and People’s



Map 1: Map of Ethiopia showing the *woredas* where L10K program activities according to program strategy. The Bill & Melinda Gates Foundation (BMGF) funded L10K *woredas* are shaded in green, brown, blue and yellow.

(SNNP), and Tigray regions (Map 1), thus contributing towards Ethiopia's MDGs 4 and 5. The L10K project works to ensure that interactions between HEP frontline health workers—i.e., HEWs and HDAs—and households to provide MNCH services will be more frequent, higher quality, cost-effective, and more equitable (see L10K 2012 for further details on the project).

The Ethiopia Demographic and Health Survey (EDHS) 2011 indicated that maternal and child health indicators have improved since the inception of the HEP. Between 2005 and 2011, the contraceptive prevalence rate (CPR) increased from 15 to 29 percent, unmet need for family planning declined from 34 to 25 percent, antenatal care coverage increased from 28 to 44 percent, deliveries assisted by skilled providers increased from six to 10 percent, institutional deliveries increased from four to 10 percent, births protected from neonatal tetanus increased from 32 to 48 percent, measles vaccination coverage increased from 29 to 56 percent, while infant and under-five mortality declined from 77 and 123 deaths per 1,000 live births, respectively to 59 and 88 deaths per 1,000 live births, respectively. Similarly, the L10K baseline, December 2008, and midterm, December 2010, surveys representing the 115 L10K *woredas* documented significant improvements in MNCH care behavior and practices (see L10K 2012). The HEP and the L10K project expected that the MNCH indicators would be equitable. This study uses data from the L10K surveys to assess the equity of these MNCH services in L10K areas and whether there has been any change in equity between the baseline and midterm surveys.

Equitability of MNCH services

In order to provide universal primary health care, all services provided by the HEWs (and CHPs) are free of charge. The epicenter of the PHCUs, i.e., the health centers, have user fees, but MNCH services are either provided free, or user fees are waived for the poor (FMOH 2010). Nevertheless, reducing the gap between the rich and poor in MNCH service utilization by the HEP alone may not be enough to create an equitable health system. By one definition, an equitable health system “treats those with equal need equally and those in greater need ought to be treated in proportion to that greater need” (Culyer 2001: p. 280).

Traditionally, equity in health has been measured by observing the differentials in health care practices according

women's household wealth (Victora et al. 2003, 2005; Boerma et al. 2008)—mainly because improving the health of the poor has been the top priority among international development agencies (DFID 1999; World Bank 1997; and WHO 1999).

Young women are at higher risk for adverse consequences of childbearing, and children of young women are also at higher risk for morbidity and mortality and thus in greater need of MNCH services (Nash 1990; Preston-Whyte 1990, Singh 1998; Zabin and Kiragu 1998). Similarly, uneducated women also have greater need for MNCH services because they are at a higher risk of maternal morbidity and mortality, while the children of uneducated mothers are likewise at higher risk of adverse health outcomes (Bicego and Boerma 1993; McCarthy and Maine 1992). The EDHS 2011 reported that newborn and under-five mortality rate was higher among male children compared to the female children (CSA & ICF International 2012). Furthermore, one HEP strategy for achieving universal coverage of primary health care has been to reduce the distance to service delivery points. Accordingly, the equity of the MNCH outcomes was examined by women's age, education, wealth, and household's distance from the nearest health facility. The newborn and child health indicators were also assessed for differentials due to sex of the child.

METHODS

Study design

Using the L10K midterm survey this study first analyzes whether there is currently any disparity in the MNCH indicators according to women's age, education, household's distance from the nearest health facility, and wealth. Using the L10K baseline and the midterm cross-sectional surveys, this study then examines whether the disparity in the MNCH indicators changed over time.

Data

Two-stage stratified cluster sampling was done to obtain family planning information from women aged 15 to 49 years; maternal, newborn, and infant health and nutrition information from women with children zero to 11 months; and child immunization and childhood illness information from women with children 12 to 23 months. The survey instruments for the three target groups were adapted from Demographic and Health Survey (CSA & ICF International 2012) and Saving Newborn Lives questionnaires, and then translated into the three major local languages (Amharic, Oromifa, and Tigregna). In Southern Nations and Nationalities People's Region (SNNPR), with 11 more languages, the interviewers translated from Amharic while administering the questionnaires. Verbal consent was sought and documented by the interviewer. If the respondent was less than 18 years old then consent was sought from her husband or guardian. Majority of the respondents were not expected to be able to read or write; as such, written consent was not sought.

At the first stage, *kebeles* were selected as clusters with probability proportional to their estimated population sizes, stratified by region during baseline survey and by program strategy and region during the midterm survey. During the baseline survey sampling was not stratified according to program strategy because the intervention areas for the different L10K program strategies areas were not known at that time. At the second stage, the 30 by seven cluster survey strategy was used to obtain information from the three target respondents (Lemeshow & Robinson 1985). In brief, the first household was selected from the middle of the *kebele* and then every fifth household was visited, moving away from the center, and all consenting women aged 15–

49 years were interviewed. From each *kebele*, a quota of 20 interviews with women aged 15–49 years, 12 women with children zero to 11 months, and ten women with children 12–23 months was set during the baseline survey, and a quota of 12 respondents from each of the three target groups was set for the midterm survey. After reaching the quota for women aged 15–49 years in a *kebele* the interviewers only sought to conduct interviews for the other target groups.

The interviewers and supervisors were health professionals from regional health bureaus, who received five days of training, including a day of field practice. They did not interview in the areas under their supervision. Survey supervisors and regional coordinators were trained to monitor and supervise the work and ensure data quality. Each survey, including the training period, took about a month. Data was entered twice and differences resolved with reference to the original forms.

The baseline survey sample for this study included 129 *kebeles* with 3,932 women respondents among which were 2,580 women aged 15–49 years, 1,548 women with children zero to 11 months, and 1,290 women with children 12 to 23 months. The midterm survey sample included 330 *kebeles* with 9,967 women respondents among which were about 3,960 women from each of these three target groups.

Measurements and statistical analysis

The MNCH indicators—i.e., the outcomes of interest—considered were of four categories: 1) exposure to the HEP frontline workers, 2) family planning, 3) maternal and newborn health (M&NH), and 4) child health. Exposure to the HEP frontline workers (i.e., HEWs and CHPs) were measured using four indicators: i) the prevalence of HEW household visits, ii) the prevalence of CHP household visits, iii) the proportion of model family (MF) households, and iv) the proportion of households possessing a family health card. The sample for this analysis included the unique respondents from all three target groups of women (i.e., the sample described in Table 1).

Contraceptive use among women in union (i.e., married or living together) was the only family planning indicator which was obtained from the respondents to the questionnaire for women of reproductive age.

The sample for the analysis of M&NH indicators included the care practices during the most recent pregnancy reported by women with children zero to 11 months. As such, the antenatal period indicators reflect events more-or-less evenly occurring over 20 months preceding the surveys, while the perinatal and postnatal indicators reflect events occurring over the 12 months preceding the surveys. Seven maternal health indicators were considered: i) percentage who visited any health facility for an antenatal check-up (i.e., received any antenatal care [ANC]); ii) percentage who received any iron supplementation during last pregnancy; iii) percentage who received two or more tetanus toxoid injections (TT2+); iv) percentage who took any birth preparedness measure; v) percentage who delivered at an institution; vi) percentage assisted by a health professional (doctor, nurse or midwife) during delivery; and vii) percentage of home deliveries that received any postnatal care visit (any PNC).

In recent years simple community-based preventative maternal and newborn health interventions have proven effective in reducing neonatal mortality rates and significantly contributing towards reducing infant mortality rates (Bhutta et al, 2008; Jokhio et al. 2005; Kumar et al. 2008; Manandhar et al. 2004). The essential newborn health indicators considered were based on newborn interventions suggested by Marsh et al. (2002) and Bhutta et al. (2005). There were three major indicators: i) took thermal care of the newborn: the percent who dried and wrapped baby immediately after birth, delayed bathing the newborn by six hours or more, and always maintained skin-to-skin contact with the baby; ii) took clean cord care: the percent who cut the umbilical cord with a sterile instrument, tied the cut end of the cord with sterile thread, and applied nothing to the cut end of the umbilical cord; and iii) the percent gave baby first milk (colostrums).

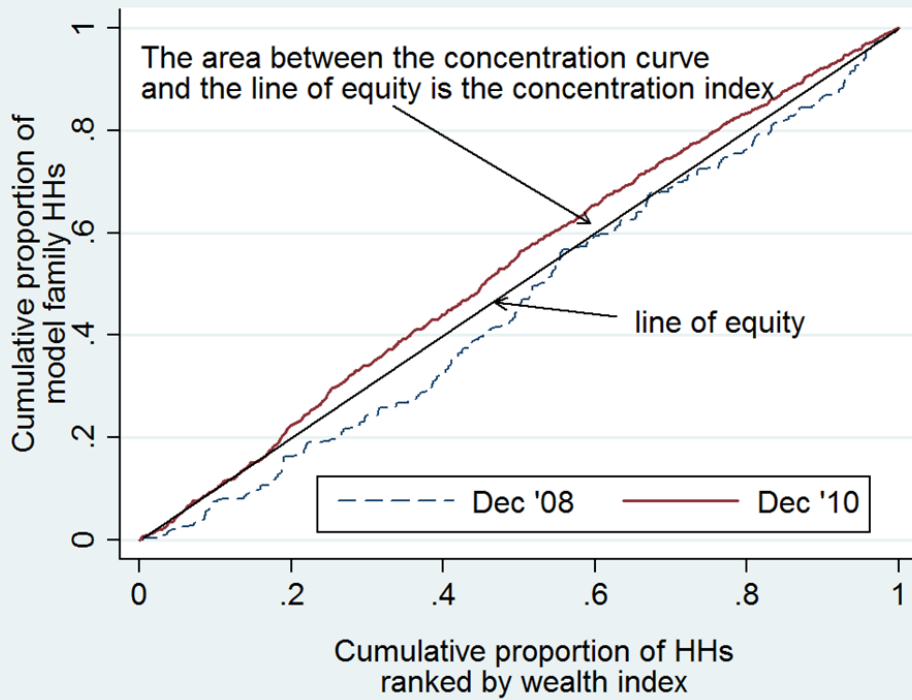
The four child health indicators included were: i) the percentage of women with children zero to 23 months who were visited by any health worker (i.e., HEW or CHP or both) to provide advice on child nutrition; ii) among the children between 0 and 23 months who had an episode of acute respiratory infection (ARI) during the two weeks preceding the survey, the percentage who were taken to any health provider; iii) among the children between 0 and 23 months who had an episode of diarrhea during the two weeks preceding the survey, the percentage who were given oral rehydration therapy (ORT); and iv) the percentage of children between 12 and 23 months who received all vaccines.

The wealth index score, with mean of 0 and standard deviation of 1, was constructed for each household using principal component analysis of household possessions (electricity, watch, radio, television, mobile phone, telephone, refrigerator, table, chair, bed, electric stove, and kerosene lamp), and household characteristics (type of latrine and water source) (Filmer and Pritchett 2001). Households were then ranked according to the wealth score and divided into three terciles (instead of the conventional five quintiles in DHS) indicating poorest, medium, and least poor households, separately for baseline and midterm surveys. The wealth index score is shown to be reasonable proxies for estimating household wealth status in the absence of income or consumption data (McKenzie 2003; Wagstaff and Watanabe 2003; Morris et al. 2007).

Appropriate sampling weights were applied to adjust the point estimates for the differences in sample sizes and sample stratification between the baseline and midterm surveys. The ratio or the difference in the outcome of interest variable between the poorest and the least poor terciles could be used to measure inequity. However, it is possible to get different conclusion between the difference and the ratio measures of equity. Also the ratio or the difference measure of equity does not utilize the information of the indicator of interest among individuals in the middle wealth terciles. Instead, the presence of disparities (or inequities) in an indicator of interest across wealth status were assessed using the wealth disparity concentration index with its standard errors, adjusted for sampling weights and cluster survey design effects (see O'Donnell et al. 2008 for details).

The concentration index can be best described using the *concentration curve*. The concentration curve is obtained by plotting the cumulative proportion of the population ranked by wealth status (i.e., the wealth index⁴) on the x-axis, and the cumulative proportion of the outcome of interest on the y-axis. A 45 degree diagonal line on the graph, from the point where the x-axis meets with the y-axis, indicates perfectly equitable distribution of the indicator across wealth status (Figure 1). A curve above the line of equality indicates that the outcome of interest is higher among the poorer people while a curve below the line indicates the opposite (i.e., the outcome is more common among the rich). The concentration index is defined as twice the area between the observed concentration curve and the diagonal line of equality, and the possible value it can take ranges between positive one and negative one. The concentration index has a negative value if the curve is above the line (indicating the outcome is more favorable for the poor)

Figure 1: Concentration curve for model family households (HHs) in L10K areas, Dec. 2008 & Dec 2010



and a positive value if the curve is below the line (indicating the outcome is favorable for the rich). If the value of the index was significantly ($p < 0.05$) different from 0 (i.e., equity) then it was concluded that wealth inequity or disparity for the indicator is present.

It is likely that the distribution of the health outcome of interest across wealth status may be confounded by education or other socio-demographic characteristics of the respondent. As such, the concentration index is standardized using indirect methods (see O'Donnell et al. 2008 Chapter 8 for details). The confounding variables for which the wealth disparity concentration index was standardized were respondent's age, education, and household's distance from the nearest health facility.

Similar to the wealth disparity concentration index, the age disparity concentration index, the education disparity concentration index, and distance from a health facility disparity concentration index were constructed. Distance was defined as the time required traveling to the nearest health facility using the most common mode of transport. All concentration indices were standardized using the indirect method. A negative value for the age disparity concentration index indicated that the outcome of interest is more

favorable among younger women and a positive value indicated that the indicator was higher among older women. Similarly, a negative value for the education disparity concentration index indicated that the indicator is higher among less educated women and a positive value indicated that the indicator was higher among more educated women.

For the distance from a health facility disparity concentration index the distance from the nearest health facility from the women's household was factored by negative one so that a negative value for the distance from a health facility concentration index indicated that the outcome of interest is concentrated among women who lived further away from a health facility and a positive value indicated that the indicator is concentrated among those women who lived closer to any health facility.

Bivariate analyses were done to compare changes in indicators of interest between the baseline and midterm surveys. Statistically significant changes in proportions between the two surveys were assessed using Pearson's chi-squared statistics adjusted for sampling weights. Statistically significant changes in means were assessed using t-tests with linearized standard errors adjusted for sampling weights. The two-sided alpha error was set at five percent

for the bivariate analyses, and only statistically significant differences are discussed in this report.

Finally, the L10K project and the HEP both expected reductions in health disparities. Changes in measures of health disparities between the baseline and midterm surveys were assessed using t-tests. The standard errors used for the t-tests were adjusted for cluster design and sampling weights.

RESULTS

Sample characteristics

The percentage distributions of baseline and midterm survey respondents by region, age group, marital status, education, number of children, religion, and distance of the respondent's household from nearest health facility are presented in Table 1.

The similar distributions of the baseline and midterm survey respondents in the L10K areas by region reflects the application of the sampling weights that adjusted for the differentials in sample stratification between baseline and midterm survey. The analysis indicates that around 14 to 15 percent of the L10K population was in Tigray, 41 percent in Amhara, 24 to 26 percent in Oromia, and 19 to 20 percent in SNNP regions. The age and parity distribution of the baseline and midterm survey respondents in the L10K areas was similar. About half of the respondents are between the ages 15 to 34 years; while nearly half of the respondents already have four or more children.

The vast majority of the respondents (i.e., 92 percent) were married. There was one percentage-point decrease in the proportion married. A small improvement in women's education was noted. On average, the proportion of the respondents without any education in the L10K areas was 82 percent during baseline which decreased to 78 percent during the midterm; most likely indicating that women's education in rural Ethiopia was improving.

Almost two-thirds of respondents in L10K areas were Orthodox Christian, followed by Muslim (about one-fifth), Protestant (about 14 percent) and other (about one percent). The distribution of the respondents according to their religious background was slightly different between the baseline and midterm surveys. The proportion of the respondents who were Muslims was six percentage-points lower in the midterm survey in comparison to the baseline survey, while the proportion who was Orthodox Christians was four percentage-points higher in the midterm survey in comparison to the baseline survey.

There has been significant change in the access to a health facility in the L10K areas. Between the two survey periods, the proportion of the respondents whose household was within 30 minutes of any health facility increased from 54 to 65 percent, while the proportion of women who were

an hour or more away from any health facility declined from 22 to nine percent.

Exposure of households to the HEP frontline health workers

Table 2 shows the measures of exposure of households to the HEP frontline health workers during the baseline and midterm surveys and the changes during that period according to women's age, education, wealth, and household's distance from the nearest health facility. And Table 3 presents the age, education, wealth, and distance from health facility disparity concentration indices for the indicators in Table 2.

Household visits by HEWs

Table 2 indicates that the proportion of women in L10K areas who reported that a HEW visited or contacted her to discuss her or her children's health during the six months preceding the survey increased from 37 percent in baseline to 50 percent in midterm. The improvements were observed across all age, education, wealth and distance from nearest health facility categories.

The concentration indices in Table 3 indicate that the disparities in household visit by HEWs according to women's age, education and distance from the nearest health facility that was observed during the baseline survey remained unchanged during midterm survey. The positive and statistically significant value of the age disparity concentration index indicates that comparatively older women were more likely to be visited by a HEW. Similarly women who were more educated and women who lived closer to a health facility were more likely to be visited by a HEW. The disparities indicated by the concentration indices in Table 3 can be visualized in Table 2. For example, proportion of household visits by a HEW among women in the ages 35 to 49 years were higher (40 percent during baseline and 58 percent during the midterm) than those among women in the ages 15 to 19 years (30 percent during baseline and 41 percent during midterm).

The negative and statically significant value of the change in wealth disparity concentration index between

Table 1: Background characteristics of the baseline, Dec. 2008, and midterm, Dec. 2010, survey respondents, L10K areas

Background variable	Category	Baseline	Midterm	
Region	Tigray	13.6	14.7	
	Amhara	41.1	41.3	
	Oromia	26.2	24.1	
	SNNP	19.1	19.9	
Age group	15-19	7.1	6.9	
	20-24	24.0	22.3	
	25-34	48.3	49.5	
	35-49	20.7	21.4	
Marital status	Not married	6.5	8.2	**
	Married	93.5	91.8	
Education	None	82.1	78.1	**
	Primary	12.1	13.3	
	Higher	5.9	8.7	
Number of children	0	2.7	3.1	
	1	16.5	17.6	
	2	15.9	16.2	
	3	15.2	15.7	
	4+	49.7	47.3	
Religion	Orthodox	61.8	65.9	**
	Protestant	13.0	15.0	
	Muslim	24.1	17.9	
	Other	1.2	1.2	
Wealth terciles	Poorest	36.1	36.4	
	Medium	38.0	35.9	
	Least poor	25.9	27.7	
Distance to any health facility	<30 min.	54.2	65.3	**
	30 min - <1 hr	23.6	25.6	
	1-<2 hrs	14.5	7.5	
	2+ hrs	7.7	1.7	
No. of respondents		3,932	9,967	

**p<0.05

baseline and midterm surveys (in Table 3) indicates that the change in the wealth disparity favored the poor. Accordingly, the wealth disparity of household visits by a HEW—i.e., poorer households were less likely to be visited by a HEW—that was observed during the baseline was not present during the midterm survey.

Household visits by CHPS

The percentage of women in L10K areas who were contacted by a CHP to discuss their or their children's health during the six months preceding the survey increased by two fold, from 16 percent at baseline to 32 percent during the midterm survey (Table 2). The improvement in the household contact by CHPs was observed across all age, education, wealth and distance from the nearest health facility categories.

Table 2: The interactions of HEP frontline workers with households: Percentage of respondents visited by a HEW during last six months; the percentage of respondents visited by a CHP during last six months; the percentage of respondent from a model family (or working towards it) HH; and the percentage of respondents who have a family health card in their HH, according to age, education, distance to a health facility, and wealth. L10K area, baseline (Dec. 2008) and midterm (Dec. 2010). (For sample sizes see Table A1.1 in Appendix 1)

	Visited by HEW			Visited by CHP			Model family household			Have family health card		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group												
15-19	27.9	41.3	13.5 **	14.3	24.0	9.8 **	5.3	23.8	18.5 **	4.2	28.5	24.3 **
20-34	36.4	49.0	12.7 **	16.0	31.4	15.4 **	9.0	28.1	19.1 **	4.8	36.5	31.7 **
35-49	40.7	57.8	17.1 **	16.1	34.8	18.7 **	12.4	36.3	23.9 **	7.1	35.9	28.8 **
Education												
None	35.5	49.2	13.7 **	14.5	30.2	15.7 **	9.1	28.7	19.6 **	4.6	33.2	28.6 **
Primary	42.0	53.9	11.9 **	20.6	36.1	15.5 **	9.9	33.0	23.1 **	7.1	44.9	37.8 **
Second/higher	41.3	55.4	14.1 **	26.3	37.5	11.1 **	13.2	31.9	18.7 **	10.9	45.3	34.5 **
Wealth												
Poorest	30.1	49.9	19.7 **	18.1	34.1	16.0 **	7.2	33.3	26.1 **	6.9	33.5	26.6 **
Medium	38.6	50.1	11.5 **	14.1	29.4	15.3 **	11.2	29.4	18.2 **	3.9	35.5	31.6 **
Least poor	42.8	51.4	8.6 **	15.5	31.2	15.8 **	10.0	24.8	14.8 **	4.9	39.2	34.4 **
Distance to HF												
<30 min.	41.7	54.0	12.3 **	15.8	31.2	15.4 **	9.5	30.3	20.8 **	4.4	35.9	31.5 **
30 min – <1 hour	33.9	44.4	10.4 **	16.7	33.3	16.6 **	11.7	29.0	17.2 **	6.6	35.5	28.9 **
1+ hour	27.2	41.2	14.0 **	15.4	30.1	14.7 **	6.8	25.8	19.0 **	5.9	36.0	30.1 **
All women	36.6	50.4	13.7 **	15.9	31.6	15.7 **	9.4	29.5	20.1 **	5.3	35.8	30.6 **
No. of women	3,932	9,967		3,932	9,967		3,932	9,967		3,932	9,967	

**p<0.05 for significant changes

Table 3: Age, education, distance to health facility (HF), and wealth disparity concentration indices for HEP frontline workers' interactions with households.

Concentration index	Visited by HEW			Visited by CHP			Model family households			Have family health card		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age Disparity	0.07 (0.03, 0.10)	0.06 (0.04, 0.07)	-0.01 (-0.05, 0.02)	0.05 (0.00, 0.10)	0.06 (0.04, 0.08)	0.01 (-0.04, 0.06)	0.16 (0.04, 0.27)	0.07 (0.04, 0.10)	-0.09 (-0.21, 0.03)	0.08 (-0.03, 0.19)	0.03 (0.01, 0.05)	-0.05 (-0.16, 0.06)
Education disparity	0.12 (0.02, 0.21)	0.05 (0.01, 0.08)	-0.07 (-0.17, 0.03)	0.17 (0.07, 0.26)	0.10 (0.05, 0.15)	-0.07 (-0.17, 0.04)	-0.32 (-0.90, 0.26)	0.14 (0.04, 0.24)	0.46 (-0.12, 1.04)	0.26 (0.00, 0.52)	0.10 (0.06, 0.14)	-0.16 (-0.42, 0.11)
Wealth Disparity	0.09 (0.02, 0.16)	0.01 (-0.03, 0.05)	-0.08 (-0.17, -0.00)	-0.19 (-0.49, 0.10)	-0.08 (-0.18, 0.03)	0.12 (-0.19, 0.43)	0.53 (-1.00, 1.00)	-0.28 (-0.58, 0.02)	-0.81 (-1.00, 1.00)	0.91 (-1.00, 1.00)	0.04 (-0.01, 0.09)	-0.87 (-1.00, 1.00)
Distance to HF disparity	0.31 (0.08, 0.54)	0.09 (0.04, 0.13)	-0.22 (-0.45, 0.01)	0.02 (-0.10, 0.13)	-0.05 (-0.11, 0.01)	-0.07 (-0.19, 0.06)	-0.19 (-1.02, 0.63)	-0.03 (-0.14, 0.07)	0.16 (-0.66, 0.98)	-0.16 (-0.61, 0.29)	-0.01 (-0.06, 0.03)	0.15 (-0.30, 0.59)

95% confidence intervals are given in parenthesis. The shaded cells are statistically significant (p<0.05)

The disparity in household visits by CHPs according to women's age and education observed during the baseline remained more-or-less unchanged (Table 3). At the time of the midterm survey the concentration of household visit by CHPs was comparatively higher among older women and among women with higher education. Reassuringly, there were no disparities of the indicator according to household wealth or according to the distance from the nearest health facility during both the survey periods.

Model family households

The HEWs spend a significant portion of their time interacting with households on training model families. For a household to graduate as a model family, they must have several training sessions and adopt a number of the healthy household practices that are part of the HEP primary health package. Model families should not only change their own behaviors, but also act as role models to influence neighbors and the larger community for improved health outcomes. The percentage of women in L10K areas who were from a model family household or working towards becoming one increased by more than three-fold from nine to 30 percent between the baseline and midterm surveys (Table 2). The increase in model family households was observed across all women's age, education, wealth and distance from the nearest health facility categories.

The disparity in the prevalence of model families according to women's age and education were present during the midterm survey (Table 3). Model family households were concentrated among older women and women with higher education. There were no disparities of the indicator according to household wealth or according to the distance from a health facility during both the survey periods.

Family health cards

Family health cards are distributed by HEWs to all women of reproductive age in a household. The cards are used as a tool to provide health education for promoting MNCH. The card is also used to record the MNCH services provided to the household. The CHPs use the family health cards to reinforce health education messages and to remind households of HEP health services they should receive. The percentage of women with a family health card increased by more than seven-fold from five to 36 percent between the baseline and midterm surveys (Table 2). The increase in the

possession of family health card in a household was observed across all women's age, education, wealth and distance from the nearest health facility categories.

Similar to the model family households, the disparity in the proportion of households possessing a family health card according to women's age and education were observed during the midterm (Table 3). The possession of family health cards concentrated among relatively older women and women with relatively higher education. However, there were no disparities of the indicator according to women's wealth status or distance from the nearest health facility during both the survey periods.

Family planning

Table 4 presents the percentage of the women in reproductive age, who are in union (i.e., married or living together) and currently using a modern method of contraception by women's age, education, wealth, and household's distance from the nearest health facility during baseline and midterm surveys. Correspondingly women's age, education, wealth, and distance from the nearest health facility disparity concentration indices are also given. The percentage of women of reproductive age who were in union and currently using contraception (i.e., the contraceptive prevalence rate [CPR]) in L10K areas increased from 27 to 40 percent between the baseline and midterm surveys. Other than the women in the youngest age group, women with secondary or higher degrees, women in the least poor terciles, and women who lived within 30 minutes to an hour's distance from the nearest health facility, the increase in CPR was observed among all the other age, education, wealth and distance from the nearest health facility categories.

The disparity indices in Table 4 indicate that disparities in CPR were observed during the midterm survey by women's education and distance from the nearest health facility. CPR was more concentrated among women with higher education and among women who were closer to a health facility. Interestingly the wealth disparity of CPR observed at baseline was not present during midterm survey.

Maternal and newborn health

Tables 5, 6 and 7 present the M&NH indicators according

Table 4: Percentage of women in reproductive age who are in union and currently using a family planning method by age, education, distance from any health facility, and wealth; and the age, education, distance from a health facility, and wealth disparity concentration indices, baseline (Dec. 2008) and midterm (Dec. 2010) surveys, L10K area (See Table A1.2 of Appendix 1 for sample sizes)

	Percentage			Concentration index with 95% confidence interval		
	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group				-0.05	0.02	0.07
15-19	26.9	17.8	-9.1	(-0.11, 0.00)	(-0.02, 0.05)	(0.01, 0.14)
20-34	29.0	39.8	10.8 **			
35-49	20.3	37.1	16.8 **			
Education				0.02	0.08	0.06
None	25.1	35.9	10.7 **	(-0.03, 0.07)	(0.03, 0.12)	(-0.01, 0.13)
Primary	31.3	42.4	11.2 **			
Second/higher	39.9	42.4	2.5			
Wealth				0.06	0.02	-0.04
Poorest	20.5	35.2	14.7 **	(0.02, 0.11)	(-0.03, 0.06)	(-0.10, 0.02)
Medium	27.3	36.4	9.1 **			
Least poor	34.2	40.9	6.7			
Distance to HF				0.05	0.07	0.02
<30 min.	29.1	39.7	10.7 **	(0.01, 0.10)	(0.02, 0.12)	(-0.05, 0.09)
30 min – <1 hour	28.5	33.1	4.6			
1+ hour	19.8	29.5	9.7 **			
All women	26.9	37.4	10.5 **			
No. of women	1,897	2,401				

**p<0.05 for significant changes. Shaded cells for the concentration indices are statistically significant (p<0.05)

to women's age, education, wealth, and distance from the nearest health facility and their corresponding concentration indices during baseline and midterm surveys.

Antenatal care

Antenatal care (ANC) coverage is important for measuring progress toward MDG 5. The percentage of women with children zero to 11 months who visited a health facility during their last pregnancy for a check-up (i.e., ANC coverage) increased from 51 to 66 percent during the survey periods (Table 5). However the improvement in ANC coverage was not observed among women in the youngest age group, among women with secondary or higher education, and among women who lived within 30 minutes to an hour's distance from the nearest health facility.

The concentration indices indicate that the disparity ANC coverage by women's education and wealth observed during at baseline survey remained during the midterm. Concentration of ANC coverage was higher among women who have higher education and women who are less poor.

Age disparity in ANC coverage is also observed during the midterm survey. ANC coverage was concentrated among older women. However, it was reassuring to observe that there was no disparity in ANC coverage according to the distance from the nearest health facility.

Tetanus toxoid injection

The percentage of women with children zero to 11 months who received two or more tetanus toxoid injection during their last pregnancy (i.e., TT2+ coverage), increased from 40 percent at baseline to 45 percent during the midterm survey (Table 5). The increase in TT2+ coverage was mainly observed among women in the age group 35 to 49 years, and among women from the middle wealth terciles.

The disparity in TT2+ coverage according to women's education and wealth observed during the baseline remained at midterm survey. Disparity in TT2+ coverage according to women's age was also observed during the midterm survey. However, disparity of the indicator due to the distance from the nearest health facility was not observed during the mid-

Table 5: Percentage of women with children zero to 11 months who during last pregnancy received any ANC, received two or more TT injections, received iron supplementation, and took any birth preparedness measure by women's age, education, distance to a health facility, and wealth; and the age, education, distance from a health facility, and wealth disparity concentration indices, baseline (Dec. 2008) and midterm (Dec. 2010) surveys, L10K area. (sample size in Table A1.3 of Appendix 1)

	Received ANC						Received TT2+ during last pregnancy					
	Percentage			Concentration index with 95% confidence interval			Percentage			Concentration index with 95% confidence interval		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group				-0.01	0.03	0.04				0.01	0.04	0.04
15-19	50.1	60.5	10.4	(-0.05, 0.03)	(0.01, 0.04)	(-0.01, 0.08)	33.7	33.9	0.3	(-0.04, 0.05)	(0.01, 0.08)	(-0.02, 0.10)
20-34	50.8	66.7	15.9**				41.8	46.0	4.2			
35-49	50.9	68.0	17.0**				37.1	48.5	11.5**			
Education				0.11	0.08	-0.03				0.05	0.06	0.01
None	46.7	62.4	15.7**	(0.06, 0.16)	(0.06, 0.11)	(-0.08, 0.03)	39.4	43.6	4.2	(0.00, 0.10)	(0.00, 0.12)	(-0.07, 0.09)
Primary	62.2	76.1	13.9**				42.9	49.9	7.0			
Second/higher	78.4	84.7	6.4				48.6	54.0	5.5			
Wealth				0.08	0.04	-0.04				0.05	0.08	0.03
Poorest	43.0	60.1	17.1**	(0.04, 0.013)	(0.01, 0.08)	(-0.09, 0.02)	37.0	38.5	1.6	((0.01, 0.10)	(0.03, 0.14)	(-0.04, 0.10)
Medium	50.3	66.4	16.1**				39.9	47.8	7.8**			
Least poor	62.0	74.6	12.6**				45.7	51.1	5.4			
Distance to HF				0.05	0.02	-0.02				0.10	0.04	-0.05
<30 min.	51.3	67.8	16.5**	(-0.02, 0.11)	(-0.00, 0.05)	(-0.09, 0.05)	44.5	46.9	2.3	(0.02, 0.17)	(-0.01, 0.10)	(-0.14, 0.04)
30 min - <1 hour	60.0	65.2	5.2				38.7	43.8	5.2			
1+ hour	40.8	61.0	20.2**				32.5	40.5	8.0			
All women	50.8	66.4	15.7**				40.4	45.4	5.0**			
No. of women	1,548	3,959					1,548	3,959				
				Took iron supplement during pregnancy						Took any birth preparedness measure		
Age group				0.01	0.02	0.01				0.01	0.03	0.02
15-19	11.6	27.9	16.3**	(-0.10, 0.12)	(-0.01, 0.05)	(-0.11, 0.13)	65.2	67.1	1.9	(-0.02, 0.03)	(0.01, 0.04)	(-0.00, 0.05)
20-34	10.7	28.4	17.7**				69.1	75.7	6.5**			
35-49	8.1	30.2	22.1**				68.7	76.3	7.6			
Education				0.16	0.11	-0.05				0.04	0.07	0.03
None	8.9	26.1	17.2**	(0.00, 0.33)	(0.06, 0.16)	(-0.22, 0.12)	66.6	71.6	5.0**	(0.01, 0.08)	(0.05, 0.10)	(-0.01, 0.07)
Primary	12.6	33.8	21.2**				72.7	85.4	12.7**			
Second/higher	24.8	42.0	17.2**				87.2	87.7	0.6			
Wealth				0.06	0.00	-0.06				0.04	0.04	-0.01
Poorest	9.4	27.4	18.1**	(-0.08, 0.21)	(-0.07, 0.07)	(-0.22, 0.10)	61.9	69.8	7.9**	(0.01, 0.07)	(0.01, 0.06)	(-0.05, 0.03)
Medium	10.1	27.6	17.5**				71.2	76.3	5.1			
Least poor	12.2	31.6	19.4**				74.7	80.3	5.6			
Distance to HF				0.03	0.04	0.01				0.01	-0.00	-0.01
<30 min.	10.0	29.4	19.5**	(-0.14, 0.19)	(-0.01, 0.09)	(-0.16, 0.18)	70.2	75.0	4.8	(-0.03, 0.05)	(0.03, 0.02)	(-0.06, 0.03)
30 min - <1 hour	13.6	28.0	14.4**				69.6	74.2	4.6			
1+ hour	8.4	25.7	17.3**				64.6	77.9	13.4**			
All women	10.4	28.7	18.3**				68.8	75.1	6.3**			
No. of women	1,548	3,959					1,548	3,959				

**p<0.05 for significant changes. Shaded cells for the concentration indices are statistically significant (p<0.05)

term survey.

Iron supplementation

The percentage of women with children zero to 11 months who took iron supplementation during the last pregnancy increased by nearly three-fold from 10 percent at baseline to 29 percent during the midterm survey (Table 5). The increase in the indicator was observed across women's age, education, wealth, and distance from health facility categories. Disparity in iron supplementation during pregnancy was mainly according to the education status of the women which was observed during both the survey periods. The concentration of the proportion who took iron supplementation during their last pregnancy was among women with higher education.

Birth preparedness

The percentage of women who reported taking any birth preparedness measures during their last pregnancy increased from 69 to 75 percent between the surveys (Table 5). Taking any birth preparedness measure did significantly change during the analysis period among women in the youngest and the oldest age groups, among women with secondary or higher education, among women from the medium and least poor wealth terciles, and among women who lived within 30 minutes to an hour's distance from the nearest health facility.

The concentration of the indicator at baseline survey was among women with higher education, and women from the least poor wealth terciles, which remained the same during the midterm survey. Although there was no disparity in birth preparedness due to women's age during the baseline survey, it was present during the midterm survey—the concentration of the indicator was among women who were comparatively old. However, there was no disparity in taking any birth preparedness measure according to the distance of women's households from the nearest health facility at any of the survey periods.

Safe and clean delivery

Table 6 shows that, between the baseline and midterm surveys, the percentage of institutional deliveries increased by more than two-fold in L10K areas, from five to 11 percent; and the percentage of deliveries assisted by a health professional increased from 10 to 16 percent. The improvement in

institutional deliveries between the two surveys was not observed among women who lived within 30 minutes to an hour's distance from the nearest health facility; while improvement in skilled deliveries were not observed among women from the youngest and the oldest age groups.

The concentration indices in Table 6 indicate that there were no disparities by women's age for any of the two safe and clean delivery indicators. However, both the indicators of safe and clean delivery had disparities by women's education and wealth during the midterm survey. The concentration of the safe and clean delivery indicators were among women with higher education during both the survey periods and among women who were less poor during the midterm survey. Distance from the nearest health facility was a disparity factor for skilled deliveries during both the survey periods. Women who had skilled birth attendant during their last pregnancy were concentrated among those who lived relatively closer to a health facility.

Postnatal care

The percentage of women with children zero to 11 months whose last birth took place at home and who visited a health facility or were visited by a HEW at home for check-up any time during the postnatal period (PNC coverage) increased by four-fold from four to 16 percent between the survey periods (Table 6). The improvement in PNC coverage was observed across women's age, education, wealth, and distance from the nearest health facility categories.

There were no disparities in PNC coverage according to the distance from the nearest health facility. However, PNC coverage concentrated among older women during the midterm survey, women with higher education during both the survey periods, and among women from less poor households during the midterm survey.

Newborn care

The newborn care indicators at baseline and during midterm surveys are given in Tables 6 and 7. Taking thermal care of the newborn, taking clean (umbilical) cord care of the newborn and giving the baby first milk (i.e., colostrums) increased during the analysis period. Taking thermal care increased two-fold from 12 to 24 percent; taking clean cord care increased from 31 to 40 percent; while giving colostrums to the baby increased from 45 to 53 percent. However, improvement in thermal care was not observed among women from the poorest wealth terciles; improvements in

Table 6: Percentage of women with children zero to 11 months who during last pregnancy had institutional delivery, skilled delivery, received any PNC, and took thermal care of the newborn by women's age, education, distance to a health facility, and wealth; and the age, education, distance from a health facility, and wealth disparity concentration indices, baseline (Dec. 2008) and midterm (Dec. 2010) surveys, L10K area. (sample size in Table A1.3 of Appendix 1)

	Institutional deliveries						Deliveries assisted by skilled health professionals					
	Percentage			Concentration index with 95% confidence interval			Percentage			Concentration index with 95% confidence interval		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group				-0.14	0.04	0.17				-0.08	0.00	0.83
15-19	8.4	16.3	7.9**	(-0.38, 0.11)	(-0.06, 0.13)	(-0.09, 0.44)	12.3	19.1	6.7	(-0.19, 0.03)	(-0.06, 0.06)	(-0.05, 0.21)
20-34	4.8	10.5	5.7**				9.3	15.6	6.3**			
35-49	5.6	11.1	5.5**				9.1	14.4	5.3			
Education				0.14	0.28	0.14				0.11	0.20	0.09
None	4.4	7.1	2.7**	(0.01, 0.27)	(0.17, 0.38)	(-0.03, 0.31)	8.1	11.1	3.0**	(0.03, 0.19)	(0.13, 0.27)	(-0.1, 0.20)
Primary	5.1	17.0	11.9**				10.3	23.3	13.1**			
Second/higher	15.8	34.6	18.7**				25.9	41.4	15.5**			
Wealth				0.11	0.23	0.12				0.04	0.11	0.07
Poorest	3.4	8.4	4.9**	(-0.02, 0.24)	(0.00, 0.26)	(-0.14, 0.38)	7.5	12.3	4.8**	(-0.03, 0.12)	(0.03, 0.20)	(-0.04, 0.18)
Medium	5.2	8.7	3.5**				9.2	13.2	4.1**			
Least poor	7.7	17.5	9.8**				12.6	23.2	10.5**			
Distance to HF				0.13	0.17	0.05				0.15	0.13	-0.02
<30 min.	6.0	12.4	6.3**	(-0.08, 0.34)	(-0.13, 0.48)	(-0.32, 0.42)	12.0	17.7	5.8**	(0.01, 0.28)	(0.02, 0.23)	(0.19, 0.15)
30 min – <1 hour	6.0	9.0	3.0				7.9	12.4	4.4**			
1+ hour	2.7	8.2	5.5**				5.2	11.2	6.0**			
All women	5.2	11.1	5.8**				9.5	15.7	6.2**			
No. of women	1,548	3,959					1,548	3,959				
				Received any PNC						Took thermal care of the baby		
Age group				-0.05	0.06	0.11				-0.06	0.01	0.07
15-19	4.3	12.0	7.6**	(-0.19, 0.10)	(0.00, 0.11)	(-0.05, 0.26)	13.1	21.8	8.7**	(-0.13, 0.01)	(-0.5, 0.06)	(-0.02, 0.15)
20-34	4.6	16.4	11.8**				12.1	24.4	12.3**			
35-49	2.4	18.8	16.4**				8.0	22.5	14.5**			
Education				0.13	0.15	0.03				0.01	0.12	0.11
None	3.4	14.7	11.3**	(0.01, 0.25)	(0.02, 0.29)	(-0.15, 0.20)	11.9	21.7	9.8**	(-0.08, 0.10)	(0.04, 0.19)	(-0.1, 0.22)
Primary	9.1	21.9	12.7**				9.3	26.3	17.0**			
Second/higher	4.8	21.9	17.2**				12.9	38.8	25.8**			
Wealth				0.01	0.17	0.16				-0.06	0.11	0.18
Poorest	3.8	12.4	8.6**	(-0.11, 0.12)	(0.01, 0.33)	(-0.03, 0.36)	15.1	18.2	3.1	(-0.13, 0.01)	(0.05, 0.18)	(0.08, 0.27)
Medium	4.1	17.3	13.2**				10.0	24.4	14.5**			
Least poor	5.0	20.3	15.3**				9.0	30.5	21.5**			
Distance to HF				0.03	0.32	0.29				0.02	0.01	-0.01
<30 min.	4.4	18.9	14.5**	(-0.08, 0.14)	(-0.08, 0.72)	(-0.13, 0.70)	12.2	24.7	12.5**	(-0.05, 0.09)	(0.05, 0.07)	(-0.11, 0.08)
30 min – <1 hour	2.6	12.2	9.7**				10.7	22.9	12.2**			
1+ hour	5.5	11.8	6.3**				11.2	21.4	10.2**			
All women	4.2	16.4	12.2**				11.6	23.9	12.3**			
No. of women	1,548	3,959					1,548	3,959				

**p<0.05 for significant changes. Shaded cells for the concentration indices are statistically significant (p<0.05)

clean cord care was not observed among women from the youngest and the oldest age groups, among women with secondary or higher education, and among women from the least poor wealth terciles; while improvements in giving baby colostrums were not observed among women in the oldest and the youngest age groups, and among women who lived within 30 minutes from a health facility.

Taking thermal care of the newborn was concentrated among women with higher education and among women from less poor households during the midterm survey. Taking clean cord care was concentrated among older women during the midterm survey; among women from less poor households during both the survey periods; and among women who lived relatively further from the nearest health facility during the midterm survey. Giving baby colostrums was concentrated among older women during both the survey periods; among women with higher education during the midterm survey; among women from relatively less poor households during both the survey periods; and among younger women during the midterm survey.

It was of concern to note that wealth disparity for thermal care and education disparity for giving the baby colostrums increased between the analysis periods.

Child health

Table 8 describes the child health indicators at baseline and during the midterm surveys and the disparity indices in child health indicators according to women's age, education, wealth, and distance from the nearest health facility.

Household visits by health workers to provide child health and nutrition advice

The percentage of women with children zero to 23 months who were visited by a health worker (i.e., HEW or CHP) to discuss the health and nutrition of their child increased by two and a half times, from 11 to 26 percent between the survey periods. The improvements in the household visits for child health and nutrition by frontline health workers were observed across women's age, education, wealth and

Table 7: Percentage of women with children zero to 11 months who during last pregnancy took clean care of the umbilical cord and gave baby colostrums (first milk), by women's age, education, distance to a health facility, and wealth; and the age, education, distance from a health facility, and wealth disparity concentration indices, baseline (Dec. 2008) and midterm (Dec. 2010) surveys, L10K area. (sample size in Table A1.3 of Appendix 1)

	Took clean care of the umbilical cord						Gave baby colostrums (first milk)					
	Percentage			Concentration index with 95% confidence interval			Percentage			Concentration index with 95% confidence interval		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group				0.02	0.05	0.03				0.06	0.03	-0.03
15-19	30.8	30.9	0.1	(-0.03, 0.08)	(0.02, 0.08)	(-0.03, 0.90)	46.9	48.6	1.7	(0.02, 0.10)	(0.01, 0.05)	(-0.08, 0.01)
20-34	30.9	40.8	10.0 **				42.7	52.7	10.0 **			
35-49	32.9	41.2	8.3				53.7	56.6	2.9			
Education				0.05	-0.04	-0.09				-0.07	0.06	0.14
None	30.1	40.3	10.2 **	(-0.03, 0.13)	(-0.10, 0.02)	(-0.20, 0.01)	44.3	51.0	6.7 **	(-0.18, 0.05)	(0.03, 0.10)	(0.01, 0.26)
Primary	31.3	41.0	9.7 **				44.7	54.7	10.0 **			
Second/higher	43.3	36.9	-6.4				49.2	67.0	17.8 **			
Wealth				0.10	0.07	-0.03				0.07	0.04	-0.03
Poorest	27.7	35.8	8.2 **	(0.01, 0.19)	(0.02, 0.12)	(-0.13, 0.08)	42.2	49.6	7.4 **	(0.00, 0.14)	(0.00, 0.08)	(-0.11, 0.05)
Medium	28.3	40.3	12.0 **				44.4	51.4	7.0 **			
Least poor	39.6	45.5	5.9				48.3	59.4	11.1 **			
Distance to HF				-0.02	0.08	0.094				-0.03	-0.04	-0.02
<30 min.	31.2	43.0	11.8 **	(-0.10, 0.06)	(0.02, 0.13)	(-0.01, 0.20)	45.2	50.8	5.7	(-0.10, 0.05)	(-0.08, -0.01)	(-0.10, 0.07)
30 min - <1 hour	29.0	35.5	6.5				44.9	56.8	11.9 **			
1+ hour	33.1	34.3	1.2				43.2	56.7	13.5 **			
All women	31.1	40.1	9.0 **				44.6	53.0	8.3 **			
No. of women	1,548	3,959					1,548	3,959				

**p<0.05 for significant changes. Shaded cells for the concentration indices are statistically significant (p<0.05)

Table 8: Percentage of women with children zero to 23 months who were ever visited by a health worker (i.e., a HEW or a CHP) to discuss about child nutrition; whose child had acute respiratory infection (ARI) in the last two weeks and taken to any health provider; whose child had diarrhea during the last two weeks and given oral rehydration therapy (ORT); and the percentage of women with children 12 to 23 months whose child received all vaccines, according to women's age, education, distance to a health facility, and wealth; and the age, education, distance from a health facility, and wealth disparity concentration indices, baseline (Dec. 2008) and midterm (Dec. 2010) surveys, L10K area. (Sample size in Table A1.4 of Appendix 1)

	Visited by health worker to discuss child nutrition						Child with ARI taken to any health provider					
	Percentage			Concentration index with 95% confidence interval			Percentage			Concentration index with 95% confidence interval		
	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change	Baseline	Midterm	Change
Age group				0.12	0.03	-0.09				-0.07	-0.01	0.06
15-19	7.4	16.6	9.2 **	(0.05, 0.19)	(0.00, 0.06)	(-0.17, -0.01)	48.4	37.3	-11.2	(-0.21, 0.07)	(-0.10, 0.07)	(-0.11, 0.22)
20-34	11.3	25.7	14.4 **				30.7	35.6	4.9			
35-49	11.6	28.3	16.8 **				29.0	34.3	5.3			
Education				0.22	0.07	-0.15				0.02	0.09	0.071
None	10.5	24.6	14.1 **	(-0.23, 0.67)	(0.01, 0.13)	(-0.60, 0.30)	29.6	33.1	3.5	(-0.11, 0.13)	(-0.02, 0.19)	(-0.08, 0.23)
Primary	11.4	26.5	15.1 **				46.0	45.9	-0.1			
Second/higher	17.8	32.7	14.9 **				24.0	42.4	18.5			
Wealth				-0.07	0.08	0.15				0.03	0.07	0.04
Poorest	10.8	22.0	11.2 **	(-0.71, 0.57)	(0.02, 0.13)	(-0.48, 0.78)	28.2	25.8	-2.4	(-0.06, 0.12)	(0.00, 0.14)	(-0.07, 0.15)
Medium	10.6	27.6	17.0 **				31.9	41.4	9.5			
Least poor	11.9	27.6	15.7 **				33.9	39.4	5.5			
Distance to HF				0.37	0.11	-0.27				0.01	0.08	0.073
<30 min.	11.5	27.6	16.1 **	(-1.00, 1.00)	(0.03, 0.18)	(-1.00, 1.00)	30.9	40.2	9.3	(-0.08, 0.09)	(-0.01, 0.17)	(-0.05, 0.19)
30 min - <1 hour	11.3	22.0	10.8 **				28.9	32.1	3.2			
1+ hour	9.8	21.9	12.1 **				33.6	16.7	-16.9			
All women	11.0	25.6	14.5 **				31.3	35.5	4.1			
No. of women	2,838	7,907					301	597				
				Children with diarrhea given ORT			Received all vaccines (children 11 to 23 months)					
Age group				0.05	0.00	-0.05				0.02	0.05	0.03
15-19	42.0	45.6	3.5	(-0.03, 0.13)	(-0.05, 0.05)	(-0.14, 0.04)	36.7	39.7	3.1	(-0.02, 0.06)	(0.02, 0.07)	(-0.02, 0.07)
20-34	43.9	48.2	4.4				44.7	51.3	6.6 **			
35-49	44.2	48.8	4.6				45.0	59.4	14.4 **			
Education				0.14	0.01	-0.13				0.06	0.10	0.05
None	41.4	47.6	6.2	(-0.02, 0.31)	(-0.05, 0.08)	(-0.30, 0.04)	42.5	50.4	7.9 **	(-0.01, 0.12)	(0.05, 0.16)	(-0.04, 0.14)
Primary	54.1	50.7	-3.4				50.5	56.3	5.7			
Second/higher	51.9	48.9	-3.0				59.0	65.5	6.5			
Wealth				0.01	0.02	0.01				-0.02	0.03	0.05
Poorest	42.7	46.6	4.0	(-0.09, 0.11)	(-0.2, 0.07)	(-0.09, 0.12)	45.5	50.9	5.4	(-0.08, 0.04)	(-0.02, 0.08)	(-0.03, 0.13)
Medium	46.9	49.0	2.0				41.6	50.4	8.8 **			
Least poor	40.9	49.0	8.1				46.7	56.7	10.1 **			
Distance to HF				-0.05	0.03	0.09				-0.02	-0.01	0.01
<30 min.	41.7	50.4	8.7 **	(-0.17, 0.07)	(-0.01, 0.08)	(-0.05, 0.22)	44.3	51.7	7.5 **	(-0.06, 0.03)	(-0.06, 0.03)	(-0.06, 0.07)
30 min - <1 hour	44.7	43.6	-1.0				48.2	52.5	4.3			
1+ hour	47.6	45.9	-1.7				40.4	55.8	15.4 **			
All women	43.8	48.1	4.4				44.3	52.3	8.0 **			
No. of women	669	1,248					1,290	3,948				

**p<0.05 for significant changes. Shaded cells for the concentration indices are statistically significant (p<0.05)

distance from the nearest health facility categories. Although the age disparity of the indicator improved between the two survey periods, it still remained during the midterm survey. The indicator was concentrated among women who were older.

Household visits by frontline health workers for child health and nutrition during the midterm survey also concentrated among women with higher education, women from less poor households, and women who lived closer to a health facility.

Care-seeking for childhood illness

For children aged zero to 23 months with any ARI symptoms during the two weeks preceding the survey, there was no change in the percentage taken to a health provider between the two survey periods. Similarly, the percentage of children (zero to 23 months) with an episode of diarrhea during the two weeks preceding the survey who were given ORT (i.e., any extra fluid) did not change significantly ($p>0.05$) between the survey periods.

There was no disparity in the child health care-seeking indicators during the baseline survey; however, during the midterm survey there were disparities in care-seeking behavior for children with ARI according to wealth; the care-seeking behavior for ARI concentrated among mothers who were from less poor households.

Childhood immunization

The percentage of children aged 12 to 23 months who had received all childhood vaccines increased from 44 to 52 percent between the surveys. However the improvements were not observed among children whose mothers were in the youngest age group, among mothers with primary or higher education, among mothers who were from the poorest households, and among mothers who lived within 30 minutes to an hour's distance from the nearest health facility.

Disparities in full vaccination existed during the midterm survey according to women's age and education. Fully vaccinated children were concentrated among older mothers, and among mothers with higher education.

Newborn and child health care practices by the sex of the child

The analysis of the newborn and child health care outcomes according to the sex of the child did not reveal any differentials ($p>0.05$) during any of the survey periods; as such, it is not reported.

CONCLUSIONS AND RECOMMENDATIONS

This study examines the equitability of the MNCH care practices and its changes between December 2008 and December 2010 in the L10K areas. Four factors were considered to assess the equity of the MNCH care practices. These were women's age, education, household wealth, and household's distance from the nearest health facility. The equity factors were standardized for each other. For example, the disparity of an outcome of interest due to women's wealth controlled for the disparities due to women's age, education, and household's distance from the nearest health facility. Similarly, the disparity of an outcome of interest due to women's education was standardized for women's age, wealth and her household's distance from the nearest health facility, and so on.

Of the 76 disparity indicators analyzed, only five changes were observed between the baseline and midterm surveys—two disparity indicators improved while three of them deteriorated. Encouragingly, the wealth disparity of household visits by a HEW decreased over the analysis period; as such, the wealth disparity of the indicator that was observed during the baseline survey was not observed during the midterm survey. The age disparity of household visits by frontline workers for child health purpose decreased; however, the disparity still remained, although to a lesser extent.

It was of concern to note that the age disparity in contraceptive use; wealth disparity in taking thermal care of the newborn, and education disparity of giving the newborn colostrums increased during the analysis period. Nevertheless, age disparity in contraceptive use was not statistically significant during the midterm survey.

During the midterm survey, the disparities of the MNCH indicators according to women's education were the most prominent of the four equity factors considered, and are thus of major concern for MNCH programs in Ethiopia. Of the 19 MNCH indicators analyzed, education disparity was observed for 16 of them. Age disparity was the next prominent factor during the midterm, which was observed for 13 of the 19 indicators analyzed. Wealth was the next prominent factor—wealth inequity was observed for 10 of the 19 indicators. Interestingly, giving baby colostrums was more common among the poorer women during the midterm survey.

Last but not least, the distance of the women's household from the nearest health facility was a disparity factor for six of the 19 indicators during the midterm. The disparity in household visits by HEWs according to distance from the nearest health facility is of concern. However, it was assuring to note that household visits by CHPs, model family households, and the possession of family health card was not associated with the distance of the women's household from the nearest health facility—suggesting the CHPs and model families are reaching to population in areas where HEW visits are infrequent. Maternal and newborn health care messages can reach areas where HEW visits are infrequent, as there were no disparities according to distance for 10 of the 15 maternal and newborn health disparity indicators analyzed from the midterm survey. This is reinforced by the lack of a disparity in the possession of family cards by distance from a health facility.

Although there has been no positive shift in disparities in the indicators of interest according to the distance from a health facility, it is encouraging to note that the proportion of the rural population who live more than one hours distance from a health facility has been declining; from 22 percent in December 2008 to just nine percent in December 2010. Thus while those furthest from a health facility still deprived of some of the MNCH care, they represent a smaller fraction of the population over time.

Disparities in MNCH indicators according to women's age existed for all four indicators of exposure to the HEP frontline workers. The L10K project supports the HEP as it provides MNCH services. The expected pathway of the impact of L10K on MNCH behavior and practices is through the interactions of the HEP frontline workers with households. This equity analysis suggests that to the extent in which the impact of L10K occurs through HEW outreach activity, that impact would likely be inequitable by women's age, education and distance from a health facility, though not by a woman's wealth. To the extent that L10K impacts MNCH behavior and practices through household visits by CHPs, then those impacts would likely be inequitable according to women's age and education, but not by women's wealth or distance from a health facility.

The differentials in under-five mortality rate according to the sex of the child observed in EDHS 2011 are not likely

due to differentials in newborn and child health care practices. Male disadvantage in neonatal, infant and child mortality rates is also observed in many populations (Naeye et al. 1970; Sawyer 2012) which is most likely attributable to natural causes (Wells 2000). Further investigations will be required to assess the matter for Ethiopia.

It is clear that the existing strategies and policies of the HEP and L10K are less than optimum for minimizing disparities in MNCH services, whether according to women's age, education, distance from a health facility, or wealth. The promotion of equitable MNCH services is essential if Ethiopia is to reach its MDG related maternal and child health targets. Women aged 15 to 19 years and women who live more than an hour away from a health facility represent a small fraction of the target population for MNCH services (i.e., about seven and nine percent during the midterm survey, respectively; see Table 1). At the same time, the average distance from a health facility has been declining over time. Therefore, achieving equity of MNCH services by age and distance from a health facility would have small (but important) short-term impacts on the overall target of the GOE. For example, achieving equity in contraceptive use according to women's age in L10K areas would mean an increase in contraceptive use from 40 percent (observed during the midterm survey) to 42 percent.

By contrast, the fraction of the women in rural L10K areas who have no education was substantial (78 percent) during the midterm survey; likewise, the fraction of the population in the poorest wealth terciles is also substantial (see Table 1). As such, addressing MNCH inequities according to women's education or wealth will have greater impact and will significantly contribute towards achieving the GOE's maternal and child health-related MDG targets. For example, achieving equity in MNCH indicators according to women's education would mean an increase in the contraceptive prevalence rate from 40 percent (during the midterm survey) to 54 percent. Similarly, institutional deliveries would increase from 11 to 35 percent, and deliveries assisted by health professionals would increase from 16 to 41 percent, among others.

To promote equity in MNCH services in rural Ethiopia, the first step must be raising awareness of the problem among HEP program managers and policymakers, including an emphasis on how addressing the problem would contribute towards achieving the maternal and child health related MDG targets. Second, policymakers must commit to ad-

ressing equity. Third, health workers must be made aware of the problem and the importance of addressing it to improve program performance. The fourth step would be to regularly monitor the equity of MNCH services by including equity indicators in the national Health Management Information System (HMIS); this would be the cornerstone for the success of a strategy to address equity.

The disparities in MNCH indicators according to education were most likely a combination of program uptake issues and differential targeting by the HEP. Women who are more educated may be proactively seeking out and accepting MNCH services provided by the HEP; as such less educated women are lagging behind. As such, efforts to address inequity in the health sector should be complemented by the broader social sector, where the introduction of strategies to reduce illiteracy and improve the population's education will eventually eliminate education as a major source of inequality.

Using geographic information, strategic planning to establish more health posts, or provide outreach services to those who live far from any health facilities could eventually eliminate distance from health facilities as a source of inequality.

Assessing MNCH service equity according to religion and ethnicity was beyond the scope of this study. Nevertheless, there may be other health inequalities according to these and other factors. Measuring such inequities is important for monitoring the effectiveness of existing policies for equitable social services in Ethiopia. Accordingly, the equity of MNCH services by religion, ethnicity, region, and place of residence should also be monitored using the EDHS.

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APPENDIX 1

Table A1.1: The sample sizes (i.e., denominators) of the cell estimates in Tables 2 & 3.

	Baseline	Midterm
Age group		
15-19	278	667
20-34	2,804	7,157
35-49	850	2,143
Education		
None	3,123	7,389
Primary	511	1,477
Higher	298	1,101
Wealth		
Poorest	1,427	3,235
Medium	1,411	3,431
Least poor	1,094	3,301
Distance to HF		
<30 min.	2,077	6,392
30 min. – <1 hour	966	2,592
1+ hour	889	983
Total	3,932	9,967

(x) Restricted to the midterm survey sampling frame

Table A1.2: Sample sizes of the cell estimates of the family planning indicators in Table 4.

	Baseline	Midterm
Age group		
15-19	137	246
20-34	1,260	1,485
35-49	500	670
Education		
None	1,533	1,789
Primary	240	336
Higher	124	276
Wealth terciles		
Poorest	717	773
Medium	686	843
Least poor	494	785
Distance to HF		
<30 min.	969	1,617
30 min. – <1 hour	462	546
1+ hour	466	238
Total (L10K all)	1,897	2,401

The restricted sample during the baseline is the baseline sample restricted to the midterm survey sampling frame.

Table A1.3: Sample sizes for maternal and newborn health indicators in Tables 5, 6 & 7

	Women with children zero to 11 months		Women with children zero to 5 months	
	Baseline	Midterm	Baseline	Midterm
Age group				
15-19	129	289	61	175
20-34	1,186	3,015	553	1,502
35-49	233	655	104	312
Education				
None	1,198	2,885	561	1,423
Primary	227	612	101	320
Higher	123	462	56	246
Wealth				
Poorest	558	1,244	251	588
Medium	547	1,395	259	724
Least poor	443	1,320	208	677
Distance to HF				
<30 min.	816	2,458	370	1,224
30 min. – <1 hour	362	1,088	169	577
1+ hour	370	413	179	188
Total (L10K all)	1,548	3,959	718	1,989

Table A1.4: Sample sizes of the cell estimates of the child health indicators in Table 8.

	Women with children zero to 23 months						Women with children 12 to 23 months	
	All women		Children with ARI		Children with diarrhea		Baseline	Midterm
	Baseline	Midterm	Baseline	Midterm	Baseline	Midterm		
Age group								
15-19	198	467	17	32	46	68	69	178
20-34	2,143	6,012	231	464	512	955	857	2,997
35-49	497	1,428	53	101	111	225	264	773
Education								
None	2,234	5,880	228	451	525	944	1,036	2,995
Primary	378	1,185	44	95	103	189	151	573
Higher	226	842	29	51	41	115	103	380
Wealth								
Poorest	1,025	2,544	98	180	215	380	467	1,300
Medium	1,008	2,757	107	211	250	426	461	1,362
Least poor	805	2,606	96	206	204	442	362	1,286
Distance to HF								
<30 min.	1,493	4,941	149	377	342	785	677	2,483
30 min. – <1 hr	670	2,159	61	159	160	330	308	1,071
1+ hour	675	807	91	61	167	133	305	394
Total (L10K all)	2,838	7,907	301	597	669	1,248	1,290	3,948

The restricted sample during the baseline is the sample restricted to the midterm survey sampling frame.



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