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## Health & Demographic Surveillance System Profile

# HDSS Profile: The Kersa Health and Demographic Surveillance System

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### Abstract

Kersa HDSS was established in 12 sub-districts of Kersa district, Eastern Hararge, Oromia Region, Ethiopia. The site is principally rural with two small towns (Kersa and Weter). The baseline census was conducted in 2007 and since then has been updated every 6 months, with registration of demographic and health events. Data are entered into the HRS-2 relational database. At baseline a total of 10 085 houses, 10 522 households and 50 830 people were registered. The sex ratio and number of persons per household were 1.0 and 5.1, respectively. At the end of 2013, the population was 60 694. Up to the end of 2013, 12 571 births and 3143 deaths were registered, respectively. Over 85% of births and deaths occurred at home. The annual net population growth ranges from 0.06 to 1.6. The majority of the population in Kersa are not working age group; hence the dependency ratio in most of the years is below 1. The total fertility rate ranges from 4.0 to 5.3. A reduction in neonatal, infant and under-five mortalities was observed. For all deaths, verbal autopsies were done. Tuberculosis is the leading cause of death among adults and malnutrition is the leading cause of death among children aged under 5 years. Kersa HDSS is ready to collaborate with interested researchers on health and demographic issues. For further details please visit: [<http://www.haramaya.edu.et/research/projects/kds-hrc/>].

**Key words:** Kersa HDSS, health and demographic surveillance, birth, mortality, INDEPTH

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### Key Messages

- Kersa HDSS is located in rural Eastern Ethiopia and is a member of INDEPTH.
- Currently the population under surveillance is 63 000.
- The site has been a fertile ground for several MSc and PhD studies. It is actively engaged in research of national priority.
- Completed and ongoing studies include studies of pregnancy outcomes, child nutrition, water safety and diarrhoeal disease, child nutrition and school performance, childhood disability and uptake of vaccines.

## Why was the HDSS set up?

Demographic and health surveillance can provide important community-based health information to planners and policy makers and may inform evidence-based interventions in resource-limited settings.<sup>1,2</sup> In these settings, the majority of the population has poor access to health care, yet much of the available data are based on clinical reports from health facilities and some small-scale surveys.<sup>3</sup> In Ethiopia, universities have a mandate to provide evidence to guide decision making. However, due to scarce resources and poor research governance, the information generated is fragmented and does not always address the major health problems of the country.<sup>4</sup> It was therefore a high priority for Haramaya University in Eastern Ethiopia to establish, in 2007, the Kersa Health and Demographic Surveillance System (HDSS) and thus to create a framework for research at the community level.

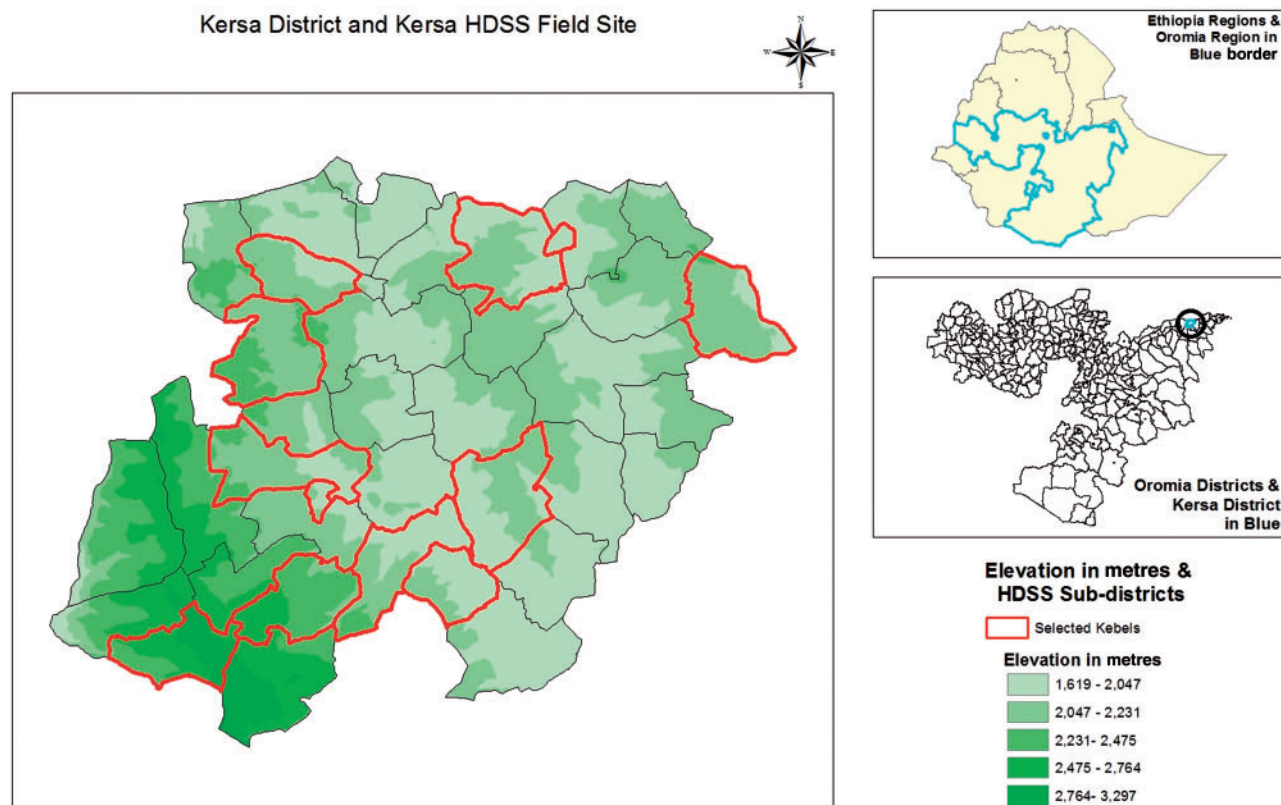
## What does it cover now?

The vision of Kersa HDSS is ‘to become a centre of excellence in health science research in Ethiopia’. The core objectives are: (i) to generate up-to-date community-based data including vital events such as births, deaths and migration; (ii) to conduct studies addressing national and local health issues and assess trends in demographic, health

and environmental conditions; (iii) to evaluate health interventions; (iv) to enhance the research culture at the College of Health and Medical Sciences of the University; (v) to provide support on research methods and data analysis to students and staff; and (vi) to advocate utilization of research findings to improve the health of the community. The three main activities of Kersa HDSS are the regular HDSS activities, support for other researchers, and studies of national and regional priority.

## Where is the HDSS area?

Kersa HDSS is located in the eastern part of Ethiopia (Figure 1). The region is home to roughly 10 million people. Kersa HDSS is located in Kersa district between 41°40'0" and 41°57'30" (longitude) and 09°15'15" and 09°29'15" (latitude). Kersa district is bordered on the south by Bedeno district, on the west by Meta district, on the north by Dire Dawa administrative council, on the northeast by Haramaya district and on the southeast by Kurfa Chele district. The district capital is Kersa.<sup>5</sup> The elevation ranges from 1400 to 3200 m above sea level, the monthly minimum average temperature is 12.0°C, the maximum average temperature is 24.2°C and the monthly average rainfall is 65 mm (range 0–301 mm).<sup>6</sup> The district has 28.5% arable land, 2.3% pasture and 6.2% forest, and the remaining



**Figure 1.** Location of Kersa HDSS and the 12 sub-districts (kebles, local name for sub-district) of the study site with elevation.

56.3% is built up, degraded or otherwise unusable. Chat (*Chat Edulis*), fruits and vegetables are important cash crops. Coffee is also an important cash crop, covering 5000 hectares.<sup>7,8</sup> There are 35 rural sub-districts (called Kebeles) and three small towns. According to the 2007 national census, the district has a total population of 172 626 of whom 6.9% are urban dwellers, and a population density of 372 people per square kilometre.<sup>9</sup> All the sub-districts have either land or mobile telephone connections. The towns, but not the rural areas, have a 24-h electricity supply. The main sources of water are springs and wells, but there is tapwater in the towns and nearby sub-districts.

The Kersa HDSS covers 12 of the 38 sub-districts, with four health centres and 10 health posts. There are 18 elementary, two secondary, one preparatory and two religious schools in the HDSS area, as well as 134 mosques, eight churches and six farmers' training stations. Most inhabitants are farmers, with a minority working in small trade, government posts or casual labourers. Wheat, barley and vegetables are the dominant crops produced in the highlands whereas sorghum, maize and potatoes are common in the midland and lowland areas. Khat is the dominant cash crop in most of the sub-districts (Figure 2). Farming is generally seasonal, during the rainy season (mid June to mid September), with the exception Handhura Kossum sub-district where irrigation is common.

### Who is covered by the HDSS and how often have they been followed up?

Kersa HDSS is an open cohort of all individuals permanently living in the area. Temporary visitors or those individuals living for less than 6 months in the study site are not considered residents. At the start of the HDSS in September 2007, we mapped the study area, assessed the number of residential houses and did a census of the population. A total of 10 085 houses, 10 522 households (families), and 50 830 people were registered. The sex ratio and the number of persons per household were 1.0 and 5.1, respectively (Table 1). A year later, in 2008, the census was repeated and since then the database was updated at 3-monthly intervals (up to 2012) and at 6-monthly intervals (since 2013). The population has so far fully cooperated with the surveillance process. The population pyramid is typical for a developing country (Figure 3). In 2010, global positioning system (GPS) coordinates have been taken for each household in the HDSS.

### What has been measured and how have the HDSS databases been constructed?

The data collectors update the list of individuals living in the house during the 6-monthly field visits, by recording

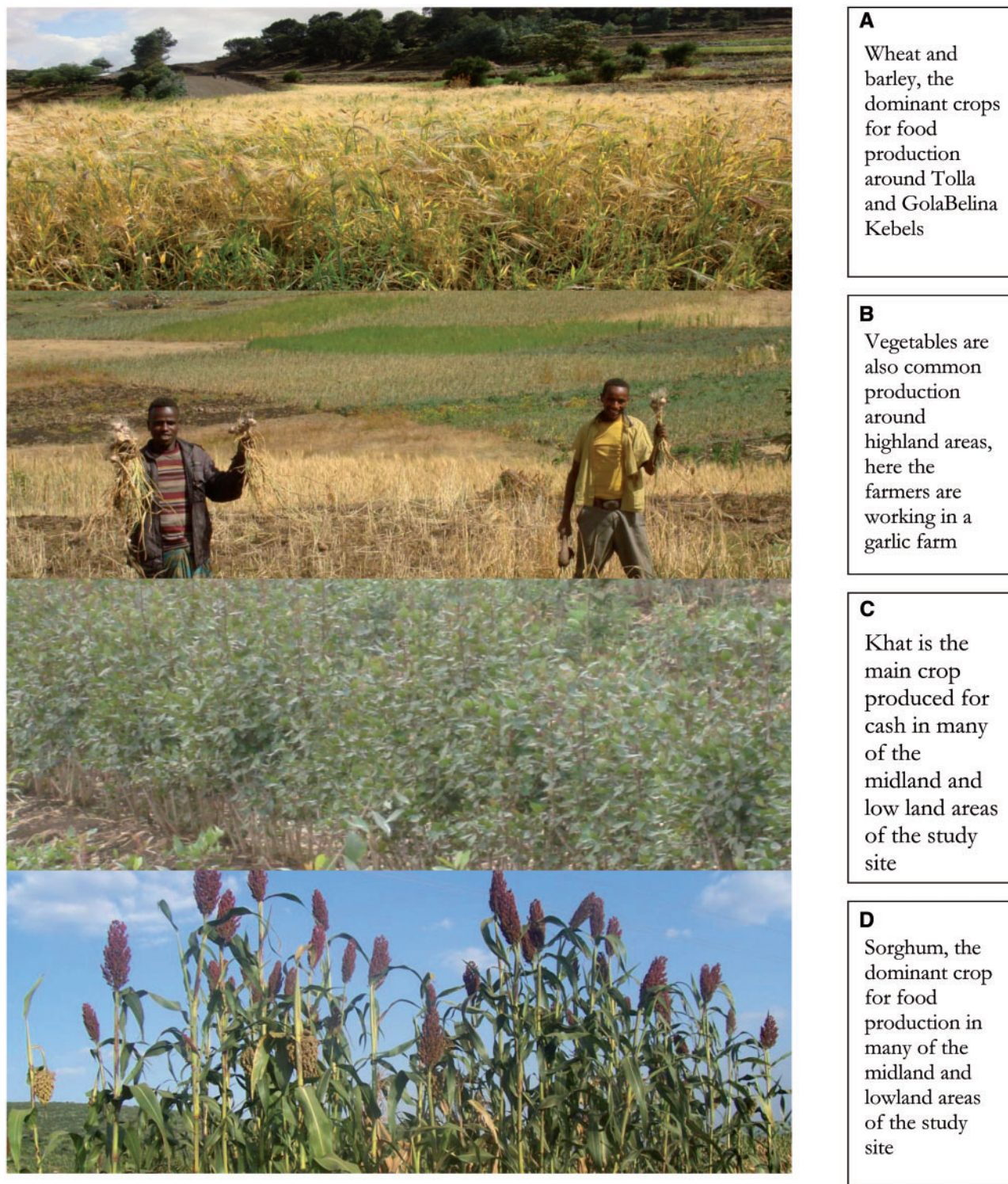
births, deaths and in- or out-migration. Changes in marital status through marriage, divorce, death of husband or wife or other separation are also recorded. Marriages usually result in the in-migration of the wife or husband, and the formation of a new household whose economic status is assessed. Women are asked whether they were pregnant and about the pregnancy outcome. Children younger than 5 years and adults older than 15 years are asked about morbidities during the past 15 days. Immunizations in children aged 1–23 months and the level of education of household members aged above 7 years are updated once a year. The economic status of individuals is updated every 2 years and assessed in detail every 5 years. In addition to death registration for the deceased, verbal autopsies are taken from close relatives typically after the mourning period of 45 days. The verbal autopsy questionnaire is based on the World Health Organization (WHO) verbal autopsy forms for neonates (less than 28 days of age), children (4 weeks to 15 years of age) and adults (15+ years of age). The verbal autopsies are done by data collectors separately from the regular surveillance data collection. Other areas of interest of the HDSS are environmental health, reproductive health, nutrition, HIV/AIDS and health-care seeking and use (Table 2). The relevant data collection instruments can be accessed at: [<http://www.haramaya.edu.et/research/projects/kds-hrc>].

Kersa HDSS uses HRS-2 software to store data. The verbal autopsy data are entered into a Statistical Package for Social Sciences (SPSS) database. Eight clerks are responsible for data entry and two computer programmers are responsible for data management and error checking. Data entry into computer is facilitated by one server and eight computers connected in a network.

Data quality assurance is completed at every step of the surveillance process, from data collection to entry to computer. If inconsistent or missing data are detected at any step, the questionnaire is returned to the data collectors for checks and corrections. In addition, the field supervisors select 5% of questionnaires and visit the houses where the data were collected to check whether the information is accurate. The field coordinator checks 1% of the questionnaires in a similar manner. Once the data have passed these steps and are entered into the database, the hard copies are archived (Figure 4).

### Key findings

The demographic indices of the Kersa HDSS 2008–13 are summarized in Table 1. The figures are more or less consistent with the Ethiopian Demographic and Health Survey (DHS) report and other relevant reports.<sup>10–12</sup> Of note, neonatal, infant and under-five mortality rates have declined over recent years.



**Figure 2.** Pictures A–D depict farm production in Kersa HDSS site.

### Woman and child health

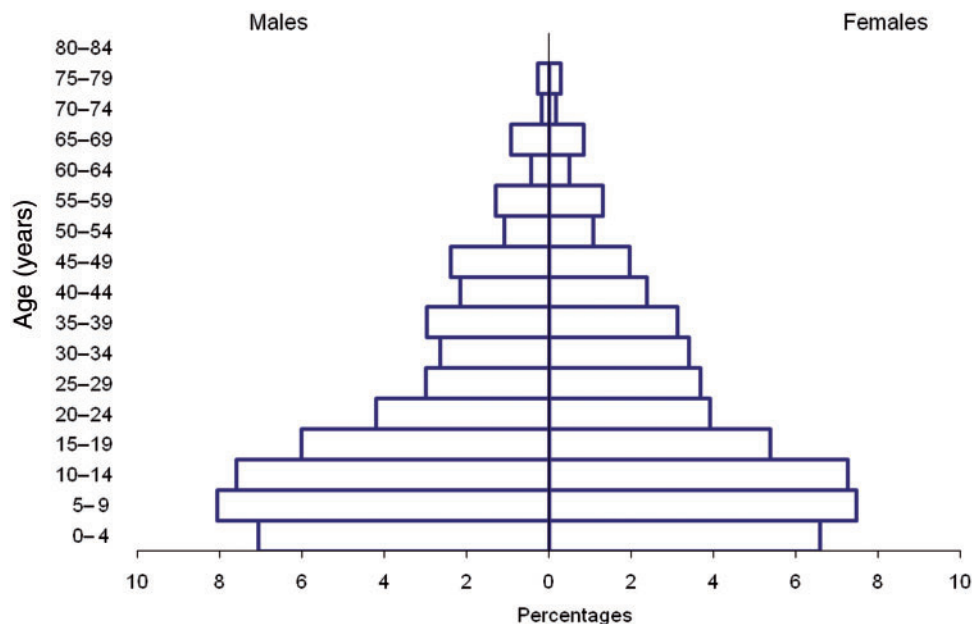
A cross-sectional study on female genital mutilation (FGM) based on house-to-house interviews was conducted during 2008 among women of reproductive age (15–49 years) to identify the prevalence, perceptions, perpetrators and

reasons for conducting FGM.<sup>13</sup> The study found that FGM was common in the community: 88% of respondents reported FGM in their daughters, mainly performed by local healers. Although some of the women knew about the negative reproductive health effects, only a few had tried to stop

**Table 1.** Demographic characteristics of the Kersa HDSS

| Characteristics                                   | 2008  | 2009  | 2010  | 2011  | 2012  | 2013   |
|---|-------|-------|-------|-------|-------|--------|
| Mid-year population                               | 51398 | 52969 | 54378 | 58633 | 59459 | 60694  |
| Total houses                                      | 10863 | 11046 | 11984 | 12496 | 12783 | 13,544 |
| Persons per household                             | 4.7   | 4.8   | 4.5   | 4.7   | 4.7   | 4.5    |
| Sex ratio (male to female)                        | 1.02  | 1.02  | 1.02  | 1.02  | 1.02  | 1.02   |
| Sex ratio at birth (male to female)               | 1.08  | 1.07  | 1.04  | 1.00  | 1.20  | 1.12   |
| Life expectancy at birth for males                | 66.0  | 60.7  | 59.9  | 59.8  | 67.1  | 62.7   |
| Life expectancy at birth for females              | 74.9  | 58.9  | 66.4  | 57.0  | 73.2  | 66.1   |
| Dependency ratio                                  | 1.00  | 0.98  | 0.97  | 0.91  | 0.91  | 0.89   |
| Young dependency ratio                            | 0.96  | 0.95  | 0.94  | 0.88  | 0.88  | 0.83   |
| Old dependency ratio                              | 0.04  | 0.04  | 0.03  | 0.03  | 0.03  | 0.06   |
| Women of reproductive age (15–49 years)%          | 21.2  | 20.9  | 22.1  | 21.3  | 21.5  | 22.3   |
| Total number of live births                       | 1616  | 1756  | 1983  | 1549  | 1770  | 2260   |
| Crude birth rate per 1000                         | 31.4  | 33.2  | 36.5  | 26.4  | 29.8  | 37.2   |
| Crude death rate per 1000                         | 9.7   | 8.4   | 9.4   | 10.1  | 8.8   | 7.8    |
| Crude in-migration rate per 1000                  | 3.6   | 3.0   | 4.5   | 4.3   | 5.0   | 7.4    |
| Crude out-migration rate per 1000                 | 15.0  | 11.7  | 19.3  | 21.9  | 20.6  | 20.5   |
| Crude population growth rate per 100              | 2.17  | 2.48  | 2.71  | 1.63  | 2.10  | 2.94   |
| Net population growth rate per 100                | 1.0   | 1.6   | 1.2   | −0.1  | 0.5   | 1.6    |
| Total fertility rate (TFR)                        | 4.5   | 4.6   | 5.1   | 4.0   | 4.2   | 5.3    |
| General fertility rate (GFR)                      | 148.7 | 158.9 | 165.4 | 123.9 | 138.4 | 166.8  |
| Neonatal mortality per 1000 live births           | 22.3  | 29.6  | 31.8  | 23.9  | 25.4  | 27.0   |
| Post-neonatal mortality rate per 1000 live births | 39.0  | 24.5  | 27.2  | 45.8  | 28.2  | 19.9   |
| Infant mortality rate per 1000 live births        | 61.3  | 54.1  | 59.0  | 69.7  | 53.7  | 46.9   |
| Child mortality rate per 1000 population          | 37.7  | 37.6  | 40.8  | 38.1  | 35.6  | 32.7   |
| Under-five mortality per 1000 live births         | 131.8 | 90.5  | 106.9 | 160.7 | 109.6 | 77.4   |

- Young dependency ratio = those under age 15 years divided by the total working age group (age 15–64).
- Old dependency ratio. = the total number of old population (65+ years) divided by the total working age group (age 15–64).
- Dependency ratio = the total number of population age under 15 years plus old population (65+ years) divided by the total working age group (age 15–64).

**Figure 3.** Population distribution Kersa HDSS, February 2013.

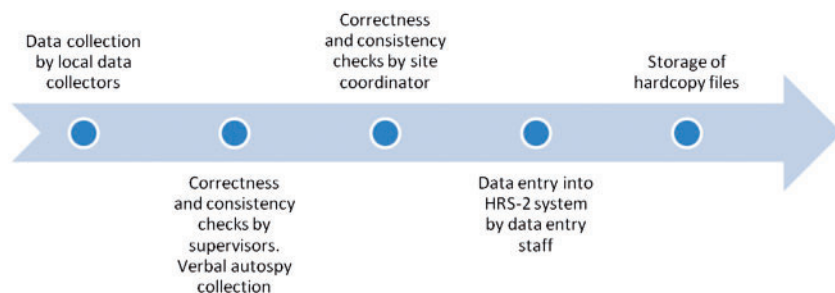
**Table 2.** The core HDSS activities, schedules of update and key information collected in Kersa HDSS

| Registration of           | Time started                     | Time of registration  | Main information gathered   |
|---------------------------|----------------------------------|---|---|
| House                     | September 2007                   | At census or 6-monthly at re-numeration round                           | Characteristics of the house, location and measurements, number of rooms and main purpose of the house  |
| Individual                | September 2007                   | At census or 6-monthly at re-numeration round                           | Name and sex of the individual, data of birth, education, ethnicity marital status and main occupation  |
| Birth                     | January 2008                     | Six-monthly at re-numeration round                                      | Place of birth, physical normality and functionality, number of births, parity, gravidity, duration of pregnancy  |
| Death                     | January 2008                     | Six-monthly at re-numeration round                                      | Place of death, perceived cause of death, health care for fatal conditions  |
| Living conditions         | September 2007                   | At census, at re-numeration round for new families                      | Main means of living, monthly income, monthly expenses for different items  |
| In-migration              | January 2008                     | Six-monthly at re-numeration round                                      | Number of persons coming into the system, causes of in-migration, individual characteristics using individual registration form and origin                                |
| Out-migration             | January 2008                     | Six-monthly at re-numeration round                                      | Number of person who left the system, cause of out-migration, destination   |
| Internal move             | January 2008                     | Six-monthly at re-numeration round                                      | Place of move out, place of move in, cause and individual characteristics   |
| Marital status change     | January 2008                     | Six-monthly at re-numeration round                                      | Partners ID if they are from within the system, or in-migrant individual characteristics, kind of marital status change,(if divorce) the reasons for divorce              |
| Child vaccination         | September 2010                   | Yearly for babies aged 12–23 months                                     | Date and type of antigen the baby has taken, source of information (card/oral), reason for failure to complete immunization   |
| Child morbidity           | September 2010                   | Yearly until 2012; every second year from 2013                          | Perceived sickness (focuses are fever, diarrhoea and cough), sign and symptoms and whether the child was taken to health institutions                                     |
| Adult morbidity           | September 2010                   | Yearly until 2012; every second year from 2013                          | Perceived sickness, duration of illness, kind of treatment, outcome of treatment  |
| Pregnancy                 | September 2010                   | Quarterly   | Antenatal care, tetanus vaccination, pregnancy intention and future pregnancy plan  |
| Family planning           | September 2010                   | Quarterly in women who were pregnant from 2010                          | Ever used family planning, type of family planning  |
|                           | September 2014                   | Every second year in all married women from 2014                        | Knowledge, ever use, future intention to use family planning  |
| Education                 | September 2014                   | At first enumeration; yearly since 2014                                 | Type of school attended, the maximum grade completed  |
| Economic status of family | September 2013                   | In September 2013, since then every 5 years for newly formed households | The major contents of wealth index questionnaire are included   |
| Verbal autopsy            | September 2007<br>September 2014 | Every 6 months  | The WHO verbal autopsy questionnaires with three age categories are used: neonate, child and adult questionnaires. Details of illness and signs and symptoms are included |

the practice.<sup>13</sup> The same study collected data on intimate partner violence and found that 20% of women ever experienced such violence; 70% of perpetrators were husbands.<sup>14</sup>

In 2009/10 a study was set up to examine pregnancy outcomes. The rate of pregnancy was 227 per 1000 women in reproductive age, and about a quarter of the pregnancies did not

result in a live birth. The prevalence of unintended pregnancy was 28%, with greater risk among women of lower socioeconomic status and higher parity and women who lived far from the nearest health facility. Pregnancy loss was experienced by 10% of women, with an increased risk among women with shorter pregnancy intervals or unintended pregnancies,



**Figure 4.** Process of data collection, consistency checks, data entry and archiving at Kersa HDSS.

women with a history of symptoms of sexually transmitted infections and women who never received antenatal care.<sup>15,16</sup> The prevalence of low birthweight (LBW) was 28%. LBW was associated with lower socioeconomic status, lack of antenatal care, physical violence during pregnancy and living far from the health facility. The same study reported a neonatal mortality rate (NMR) of 41.4 per 1000 live births.<sup>17</sup>

Malnutrition is one of the major causes of death among children in the study area. A prospective study was set up in 2010 to examine the prevalence of undernutrition in children aged 6–36 months (defined as children with weight-for-height Z-scores below -2 standard deviations) during the wet and dry seasons. The study found that 7.4% experienced undernutrition in the wet and 11.2% in the dry season.<sup>18</sup> The prevalence of non-exclusive breastfeeding among babies under 6 months of age was 28.3%.<sup>19</sup>

### Environmental health

A study of waste management in households found poor waste disposal and hygiene practices. The majority of households (66%) disposed of solid waste in open dumps, and only 36% of households had latrines.<sup>20</sup> Diarrhoea is a major killer among children under 5 years of age. The 2-week period prevalence of diarrhoea in this age group was 23%,<sup>21</sup> with inconsistent use of oral rehydration therapy (ORT). A community-based case-control study revealed that caregivers' previous knowledge and experience with ORT and their health-seeking behaviour were predictors of ORT use.<sup>22</sup>

Malaria is endemic in study area. Insecticide-treated bed nets (ITN) are promoted to prevent malaria. In 2010, a cross-sectional survey of malaria-related knowledge and perceptions among women, and the use of malaria vector control interventions, found that close to 60% of women knew that malaria was transmitted by mosquito bites. Only 34% of women used an ITN during the survey.<sup>23,24</sup>

### Future analysis plans

Future analyses will focus on time trends 2008–13 in neonatal, infant, under-five and adult mortality and causes of

death, stratified by urban and rural residence. Analyses of patterns of fertility and the effect of antenatal care on institutional delivery, and analyses of adult and child morbidity and family health-seeking behaviours are also planned.

### Strengths and weaknesses

Kersa HDSS has stable support from Haramaya University, resulting in the uninterrupted running of the HDSS. It is also supported by the Centers for Disease Control and Prevention (CDC) and the Ethiopian Public Health Association (EPHA). The site has a good working relationship with the communities. The questionnaires were tested in other HDSS in Ethiopia. The use of HRS-2 database software for data storage is also a strength. Houses are visited every 6 months only, and some events may therefore be missed. For example, data on abortions are extremely difficult to collect. It is expected that 10–20% of pregnancies ended in abortion<sup>25</sup> but our record of abortion is nearly 0%. Stillbirths and neonatal mortality may also be under-ascertained.<sup>26</sup>

### Data sharing and collaboration

Kersa HDSS is ready to collaborate with researchers nationally and internationally. The data sharing policy of Kersa HDSS can be accessed at: [<http://www.haramaya.edu.et/research/projects/kds-hrc/kds-hrc-project-data/>]. Ethical approval has been obtained for routine data collection and analyses of these data do not require additional ethical clearance. A formal request for data is needed. The application will be reviewed by the Kersa HDSS team. If the application is granted open access, the applicant can analyse the original data. In the case of restricted access, sensitive information like names, identification numbers, house numbers and the like will be removed before providing the data set to the applicant. In this case, new identification numbers will be generated to allow linking the data back to the original files. Closed access means that the data can be accessed locally at the Kersa HDSS, and tables with results, but no raw data, can be taken away. Studies that

aim to collect additional data must seek ethical clearance from the Institutional Ethical Board (IRB) of the College of Health and Medical Sciences, Haramaya University.

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**Conflict of interest:** None declared.

## References

1. Desta S. Epidemiology of public health research and action in developing society. *Ethiopian Journal of Health Development* 1994;8:1–35.
2. Misganaw F, et al. Dabat Rural Health Project, North West Ethiopia, Report of the Baseline Survey. *Ethiopian Journal of Health Development* 2001;15
3. Thacker S. The principles and practice of surveillance in public health; the use of data in public health. *Santé Publique* 1992;43–44.
4. Goodman R, Remington P, Howard R. *Communicating Information for Action. Principles and Practice of Public Health Surveillance*. New York: Oxford University Press, 1994.
5. EMA. *Cartographer Map of Kersa Harar*. 2013.
6. EMet A. *Monthly Climatic Record of Temperature and Rain Fall for Kersa District*. Addis Ababa: Ethiopian Meteorological Authority, 2011.
7. Coffee Cooperatives. *Coffee Production*. Addis Ababa: Oromia Coffee Production Cooperatives, 2006.
8. Oromia Government. *Socio-economic Profile of the East Hararghe Zone*. Addis Ababa: Regional Government of Oromia, 2006.
9. Population Census Commission. *Summary and Statistical Report of 2007 Population and Housing Census*. Addis Ababa: Population Census Commission, 2008.
10. Central Statistics Authority. *Ethiopia Mini Demographic and Health Survey 2014*. Addis Ababa: Central Statistics Authority, 2014.
11. Central Statistics Authority. *Ethiopia Demographic and Health Survey 2011*. Addis Ababa: Central Statistics Authority, 2012.
12. United Nations Children's Fund. *Levels and Trends in Child Mortality*. New York, NY: United Nations Children's Fund, 2013.
13. Shanko W, Assefa N, Wolday M, Arja R. Female genital mutilation: prevalence, perceptions and effect on women's health in Kersa district of Ethiopia. *Int J Womens Health* 2012;4:45–54.
14. Shanko W, Wolday M, Assefa N, Aro A. Domestic violence against women in Kersa, Oromia region, Eastern Ethiopia. *East Mediterr Health J* 2013;19.
15. Assefa N, Berhane Y, Worku A. Pregnancy rates and pregnancy loss in Eastern Ethiopia. *Acta Obstet Gynecol Scand* 2013;92:642–47.
16. Kassa N, Berhane Y, Worku A. Predictors of unintended pregnancy in Kersa, Eastern Ethiopia, 2010. *Reprod Health* 2012;9:1.
17. Assefa N, Berhane Y, Worku A. Chest circumference at birth significantly predicts neonatal survival in rural settings: Kersa, Eastern Ethiopia. Pregnancy rate and outcomes in the rural Eastern Ethiopia: Fetal and neonatal survival. Harar: Haramaya University, 2011.
18. Egata G, Yemane B, Worku A. Seasonal variation in the prevalence of acute undernutrition among children under five years of age in east rural Ethiopia: a longitudinal study. *BMC Public Health* 2013;13:864.
19. Egata G, Yemane B, Worku A. Predictors of non-exclusive breastfeeding at 6 months among rural mothers in east Ethiopia: a community-based analytical cross-sectional study. *Int Breastfeeding J* 2013;8:8.
20. Mengistie B, Baraki N. Community based assessment on household management of waste and hygiene practices in Kersa Woreda, Eastern Ethiopia. *Ethiopian Journal of Health Development* 2010;24:103–09.
21. Mengistie B, Berhane Y, Worku A. Prevalence of diarrhea and associated risk factors among children under-five years of age in Eastern Ethiopia: A cross-sectional study. *J Prev Med* 2013;3:446–53.
22. Mengistie B, Yemane B, Worku A. Predictors of Oral Rehydration Therapy use among under-five children with diarrhea in Eastern Ethiopia: a community based case control study. *BMC Public Health* 2012;12:1029.
23. Gobena T, Berhane Y, Worku A. Low long-lasting insecticide nets (LLINs) use among household members for protection against mosquito bite in kersa, Eastern Ethiopia. *BMC Public Health* 2012;12:914.
24. Gobena T, Berhane Y, Worku A. Women's knowledge and perceptions of malaria and use of malaria vector control interventions in Kersa, eastern Ethiopia. *Global Health Action* 2013;6:20461.
25. Sedgh G, Henshaw S, Singh S, Ahman E, Shah I. Induced abortion: estimated rates and trends world wide. *Lancet* 2007;370:1338–45.
26. Feresu S, Harlow S, Welch K, Gillespie B. Incidence of and socio-demographic risk factors for stillbirth, preterm birth and low birth weight among Zimbabwean women. *Paediatr Perinat Epidemiol* 2004;18:154–63.