



## Health & Demographic Surveillance System Profile

# Health & Demographic Surveillance System Profile: The Dikgale Health and Demographic Surveillance System

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### Why was the HDSS set up?

As Alberts and colleagues explained in 1999,<sup>1</sup> during the 1990s concerns arose in the newly democratic South Africa that exposures to various non-communicable disease (NCD) risk factors were increasing rapidly as lifestyles changed. The Dikgale Health and Demographic Surveillance System (DHDSS) was conceived along the same lines as the nearby Agincourt HDSS,<sup>2</sup> but on a much smaller scale. It was primarily intended as a sampling framework for monitoring NCDs and their risk factors on a population basis. The DHDSS was one of the founder members of the INDEPTH Network.<sup>3</sup>

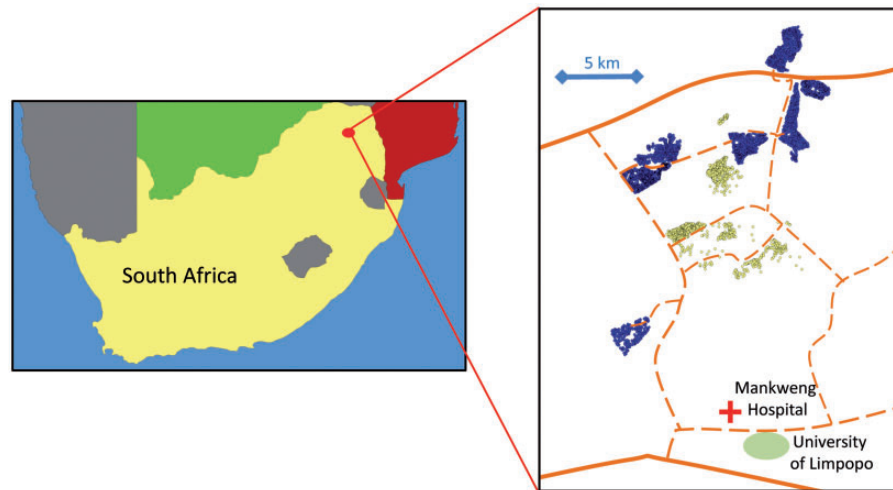
### What does it cover now?

In its original manifestation, DHDSS covered a considerably smaller population (approximately 8000) than most comparable HDSS sites. For some purposes, such as detailed biochemical profiling, this population size provided an adequate sampling frame. However for mortality surveillance, particularly for cause-specific considerations, the

numbers were inadequate. A decision to substantially enlarge the DHDSS into contiguous surrounding communities was taken in 2009, with initial enumeration undertaken in 2010. This added a population of around 28 000, taking the total to around 36 000.

### Where is the HDSS area?

The DHDSS is situated approximately 40 km north-east of Polokwane, the headquarters of Limpopo Province, and slightly closer to the University of Limpopo Turfloop campus. The site is located between 29.65° and 29.85°E, and 23.65° and 23.90°S. Maps showing the location of the site, including households in the original and new areas, are shown in [Figure 1](#). The DHDSS is located on a high plateau area (approximately 1250 m above sea level) where communities typically consist of households clustered in villages, with access to local land for small-scale food production. A typical household is shown in [Picture 1](#). Mains electricity and mobile phone networks are ubiquitous; piped water supplies are more problematic. Primary health care is provided at local clinics, as shown in [Picture 2](#), and



**Figure 1.** Map showing the Dikgale Health and Demographic Surveillance System area and its location within South Africa. Paler dots represent households in the original surveillance area, and darker dots households in the extended surveillance area.

district hospital services are available at Mankweng, at a distance of 10–30 km from the villages.

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

The initial enumeration at the end of 1995 covered 8071 people.<sup>1</sup> Everyone whose permanent home is in the site is included in the surveillance although, in common with many rural areas in South Africa, there is a substantial proportion of the adult population living away from home for much of the time as temporary migrants, for reasons of employment. An annual census update round has been conducted since 1996, to capture life events, migrations and (periodically) household socioeconomic status. Occasional sample surveys have been undertaken to gather additional information such as health care utilization. In the original surveillance area, verbal autopsies to determine cause of death were not carried out because the overall population was too small to make this a meaningful exercise, but this has been included for all deaths since the HDSS was enlarged. Global positioning system (GPS) coordinates for each household have also been collected.

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

In the early stages of the DHDSS, measurements were limited to life events, background factors and various small-scale sampled studies relating to specific biomedical outcomes. Since the expansion of the DHDSS, there are new possibilities for fully fledged HDSS operations. This includes the attribution of cause of death, by carrying out verbal autopsies using WHO standards<sup>4</sup> and interpreted

using the InterVA model,<sup>5</sup> as well as increased scope for comparative studies involving the Agincourt<sup>6</sup> and Africa Centre<sup>7</sup> HDSS sites in South Africa.

The original DHDSS database was managed using Microsoft<sup>®</sup> Access but, with the expansion of the site, the increased volume of data required that the system was transferred to a Microsoft<sup>®</sup> SQL server database environment, based at the nearby University of Limpopo. This is an essentially similar system to that used at the nearby Agincourt HDSS.<sup>2</sup> Table 1 shows the variables routinely collected in each annual update round for all individuals, modified from the format previously described for Agincourt.

Although the DHDSS has been used as a sampling frame for small-scale studies as detailed below, many of these are essentially cross-sectional surveys which do not form part of the ongoing longitudinal population database.

### Key findings and publications

Figure 2 shows the following population pyramids: from the baseline of the original site (1996); 10 years later (2006); separately for the original and new areas following the site's enlargement (2011); and the most recent situation for the original and new areas (2013). The strong similarity between the pyramids for the old and new areas suggest that there was no major effect on the population of the old area as a consequence of having been observed regularly for 15 years.

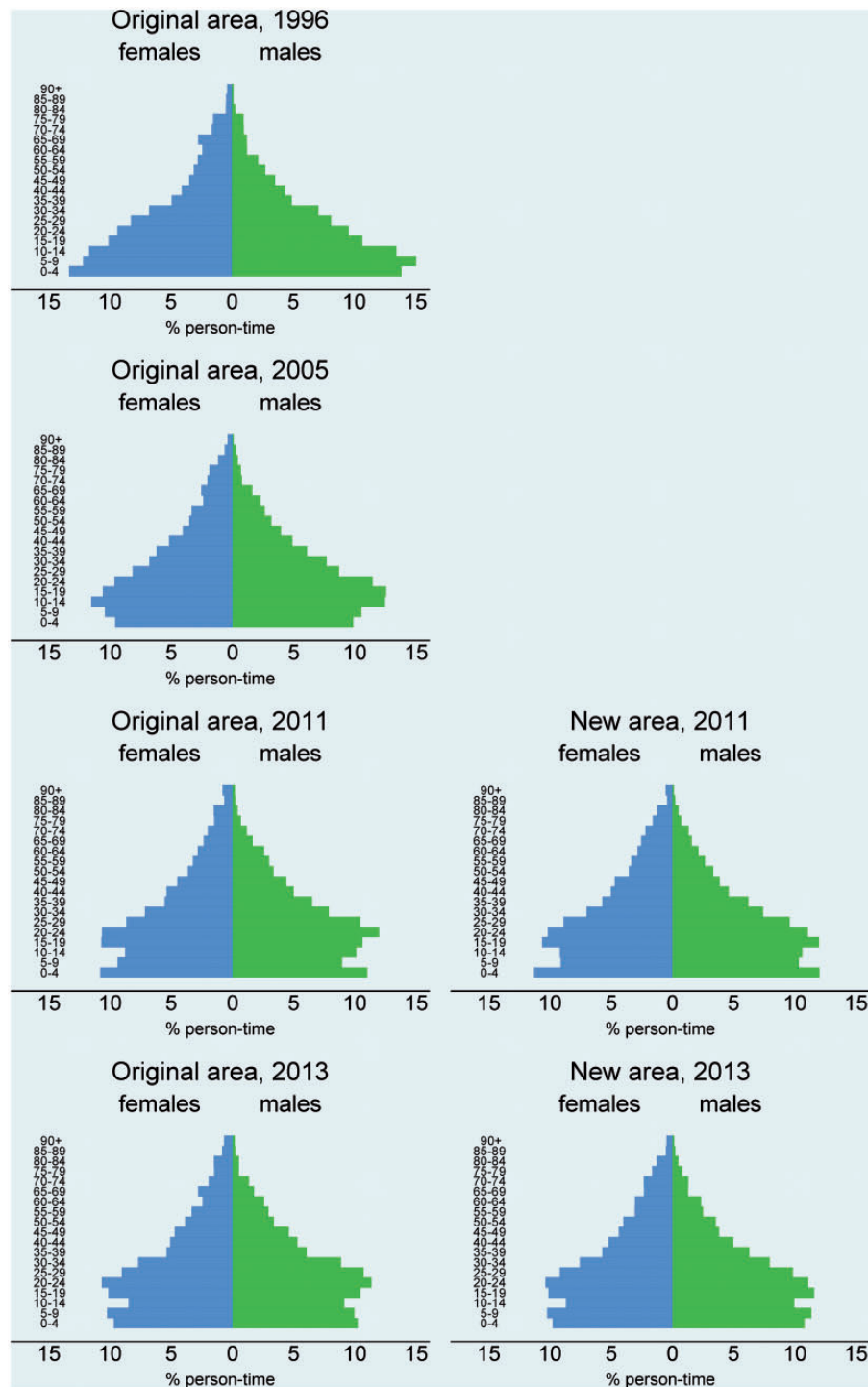
In common with much of South Africa, the major epidemiological event in the Dikgale population over the past two decades has been a massive epidemic of HIV/AIDS, which happens to have taken place during South Africa's first two decades of democracy. The early effects of the HIV/AIDS epidemic were evident in DHDSS's first analysis of mortality patterns for the period 1996 to 2003.<sup>8</sup> Some

**Table 1.** Variables collected during annual resident status and vital events update, Dikgale HDSS (modified from description of Agincourt variables<sup>2</sup>)

Variables	Main data item	Specific information	
Household roster	Village number; dwelling number	Including GPS coordinates on initial visit	
	Name, surname and gender	Recorded for each individual	
	Date of birth	Noted if estimate	
	Mother's identification and location	Vital status and where she lives	
	Father's identification and location	Vital status and where he lives	
	Relationship of individual to household head		
	Months resident in past year	Number of months resided in rural household	
	Residence status		Migrant (< 6 months in area over past year)
			Permanent (> 6 months in area over past year)
			Visitor (not member of household)
	Education status	Highest level completed	
	Pregnancy status	Currently pregnant or not; expected delivery month	
	National ID number		
Pregnancy outcome	Antenatal clinic attendance	Number of visits	
	Contraceptive use before/after pregnancy		
	Delivery	Date, location, name of hospital, birth attendant and complications	
	Outcome	Live birth, stillbirth, abortion and multiple births	
	Duration of pregnancy		
Death	Infant	Gender, birthweight, breastfeeding and birth registration	
Death	Date of death	Noted if estimate	
	Location of death	Home, clinic, health centre, hospital (with name) or accident site	
	Maternal death	Death during pregnancy or delivery or within 42 days	
	Death registration		
Migration	Details of in- or out-migrants	Name, national ID	
	Move date	Noted if estimate	
	Place migrated from and to		
	Main reason for migration		
Maternity history	Full childbirth history of all women	Information on each child not listed in household roster	
Socioeconomic status (not every year)	Physical details of household	Construction, condition	
	Energy and sanitation sources	Electricity, other fuels, toilet	
	Food supply	Staple and luxury foods	
	Assets	Land, livestock, transport, consumer goods	

inter-village heterogeneity in adult mortality was observed in a spatio-temporal analysis of all-cause deaths as overall mortality increased.<sup>9</sup> Although the DHDSS did not determine cause of death until after the site was expanded, the overall pattern of mortality showed an approximate doubling of rates during the period 2003 to 2007, compared with earlier and later levels (Figure 3). This was similar to the pattern observed at the Agincourt HDSS,<sup>6</sup> where cause of death data also showed that the increase in overall mortality was largely due to HIV/AIDS-related deaths. In the DHDSS, it appears that the peak in mortality among males preceded that among females, and a period of increased

fertility followed the mortality peak. This is consistent with analyses of fertility, migration and mortality among adult women undertaken during the period when mortality was rising.<sup>10</sup> These changes in birth rate are reflected in the changes seen in the lower age groups of the population pyramids shown in Figure 2. The details of these dynamics are a matter for further analysis. It is only now that all-cause mortality rates are approaching similar levels to those preceding the HIV/AIDS epidemic. Because the HIV/AIDS epidemic started around the time of South Africa's democratic transition, it is difficult to separate the effects of these two major forces on population health.

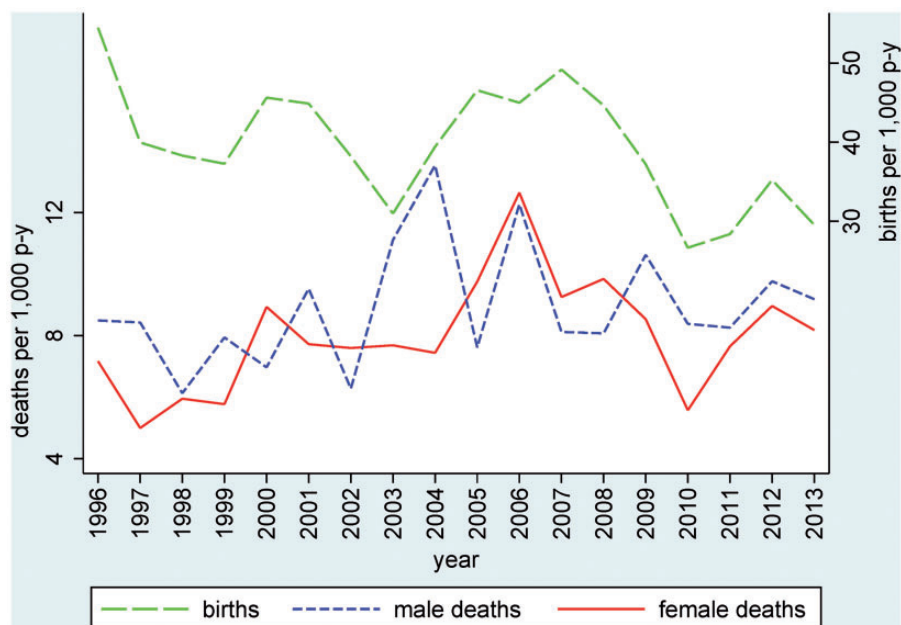


**Figure 2.** Population pyramids showing the Dikgale Health and Demographic Surveillance System original and new surveillance areas, over time.

Given concerns about exposure to non-communicable disease risks in rural South Africa, there may be further increases in overall mortality in the future, particularly as life expectancy increases and the inevitability of non-communicable disease mortality in older age groups plays its part.<sup>11</sup> A high prevalence of chronic disease risk factors

has been reported from sub-groups in the DHDSS population, suggesting that cardiovascular risks in this rural South African population are comparable to those in urban areas.<sup>12</sup>

Dietary considerations in the DHDSS population have been explored in terms of seasonal variation within the



**Figure 3.** Rates of births and deaths per 1000 person-years (p-y) from 1996 to 2013 in the Dikgale Health and Demographic Surveillance System.



**Picture 1.** A typical household in the Dikgale HDSS area (picture credit: Peter Byass).

partly subsistence-based community,<sup>13</sup> as well as demonstrating improved folate status among women of childbearing age following fortification of cereal-based foods.<sup>14</sup>

A number of Masters and PhD theses have been produced, which have made use of DHDSS data and/or used the site as a sampling frame. Several publications have reported population-based patterns of biochemical parameters in the site.<sup>15,16</sup>

A series of DHDSS studies have used objective measures of physical activity in this rural population. Independent of

physical activity, motor vehicle ownership was associated with increased adiposity but body mass index was weakly associated with ambulatory activity.<sup>17</sup> Ambulatory levels were found to be high in the DHDSS population, mainly because of high-volume, low-to-moderate intensity subsistence demands.<sup>18–20</sup>

### Future analysis plans

Future analyses will look into the effects of the HIV/AIDS epidemic in the Dikgale area, with the benefit of hindsight





**Picture 2.** Dikgale HDSS works closely with the government-run Seobi-Dikgale Clinic, sited in the surveillance area and seen here during a visit by INDEPTH Network Executive Director Osman Sankoh (picture credit: Peter Byass).

now that the pandemic in South Africa has moved on from acute mortality to longer-term management of HIV-positive individuals with anti-retroviral therapy. Recent results from the INDEPTH Network<sup>21</sup> suggested that there were higher rates of (possibly misclassified) non-communicable mortality during high HIV/AIDS-related epidemics. This was seen at the nearby Agincourt HDSS,<sup>16</sup> and it also appeared there that non-communicable disease mortality did not decline to previous levels after the AIDS epidemic peak. This could be due to increased non-communicable disease mortality among people on anti-retroviral therapy, or mortality trends beginning to reflect exposure to other non-communicable disease risk factors. At DHDSS, with its strong track record in assessing non-communicable disease patterns, and now undertaking verbal autopsies in the extended surveillance site, there are likely to be good opportunities to track trends in non-communicable disease mortality in the post-AIDS era. The larger area now under surveillance also offers increased potential for non-communicable disease intervention research.

### Strengths and weaknesses

The relatively small scale at which the DHDSS was started was clearly a weakness in relation to many aspects of HDSS operations, particularly in respect of monitoring

relatively rare events such as age-specific and cause-specific mortality, even though it permitted the original site to operate with relatively limited resources. This has now been remedied by the expansion of the DHDSS into the neighbouring villages, with additional resources from Belgium. Comparisons between the original and extended areas show close similarities (Figure 2), suggesting that it will be increasingly irrelevant going forward to consider the areas separately. The expanded DHDSS offers strong possibilities for comparison with other HDSS sites in South Africa, and future comparative analyses across all sites should enable greater understanding of micro-level differences between various populations. The DHDSS is currently engaging with the planning stage of a possible national network of HDSS sites in South Africa.

### Data sharing and collaboration

The DHDSS summary findings are shared online via the INDEPTH Network INDEPTHStats portal [<http://www.indepth-ishare.org/indepthstats/>] and DHDSS plans to make individual-level data available via the INDEPTH Network data repository in the near future.<sup>22</sup> Any requests for collaborative access beyond the scope of the public domain material should be made to Prof. Marianne Alberts [[marianne.alberts@ul.ac.za](mailto:marianne.alberts@ul.ac.za)].

### Dikgale HDSS in a Nutshell

- Dikgale HDSS has covered a rural population in north-eastern South Africa since 1996, situated around 29.75°E and 23.75°S. It was initially established as a field site for population-based studies on chronic disease parameters at the nearby University of Limpopo.
- Since an initial census of 8071 people in 1995, annual household update rounds have been undertaken. An additional contiguous area covering around 28 000 people was surveyed in 2010, and included in the Dikgale HDSS thereafter, bringing the total population to around 36 000 in 7000 households.
- Basic data collection and update have proceeded on an annual cycle, including the basic household roster together with data on pregnancy outcomes, deaths and migrations.
- Special studies have principally used the HDSS population as a sampling frame for much smaller projects, including population-based analyses of biochemical markers.
- Dikgale HDSS was a founding member of the INDEPTH Network and continues to make core data available via the INDEPTH Data Repository. Enquiries about specific potential collaborations can be made directly to the Site Leader.

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