

# Setting up a Demographic Surveillance System in

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## Abstract

*As in many regions of the developing world, the lack of accurate and up to date demographic information in Angola is a handicap to demographic and health research. To overcome this gap, a Health and Demographic Surveillance System (HDSS) was designed to support the research activities of CISA Project, a health research centre created in 2007 and located within Dande municipality in northern Angola. Here we report the methodology for setting up the HDSS-Dande as well as the adjustments made to improve the data collection process since the conclusion of the baseline census in April 2010. The HDSS data is instrumental for the support of epidemiological and other health studies.*

## Resumé

*Comme dans de nombreuses régions du monde en développement, en Angola le manque d'informations démographiques exactes et à jour est un handicap pour la recherche démographique et de santé. Pour surmonter cette lacune un système de surveillance démographique et de santé (SSDS) a été conçu pour soutenir les activités de recherche de CISA Project, qui est un centre de recherche médicale, créé en 2007 et situé dans la municipalité du Dande, dans le nord de l'Angola. Nous rapportons ici la méthodologie choisie pour la mise en place de la SSDS-Dande ainsi que les ajustements effectués pour améliorer le processus de collecte des données depuis le recensement de base conclu en avril 2010. Les données du SSDS sont instrumentales pour le soutien des études épidémiologiques et d'autres études de santé.*

**Keywords:** Angola, health and demographic surveillance system, HDSS, longitudinal data, health research

## Introduction

With the overall goal of contributing to the improvement of health conditions in Angola through training and research,

a partnership between Angola and Portugal was established in 2007, to create a health research centre, "Projecto CISA" (Centro de Investigação em Saúde em Angola).<sup>1</sup> The CISA Project is

located within the Bengo General Hospital, in Caxito, a city 60 km northeast of Luanda, in the Municipality of Dande, Province of Bengo.<sup>2</sup>

CISA Project's research interests include observational, intervention and clinical studies in malaria, tropical neglected diseases (schistosomiasis, soil transmitted helminthiasis, tripanosomiasis), and other diseases with public health relevance in the area. In 2008 a Health and Demographic Surveillance System (HDSS) was designed and implemented to support these research activities. The main objective of the HDSS is to collect accurate longitudinal data on population structure, dynamics and location, providing reliable up-to-date denominators for the calculation of vital rates and analyses requiring 'at risk' populations, as well as to provide a sampling frame for epidemiological or other health related studies.

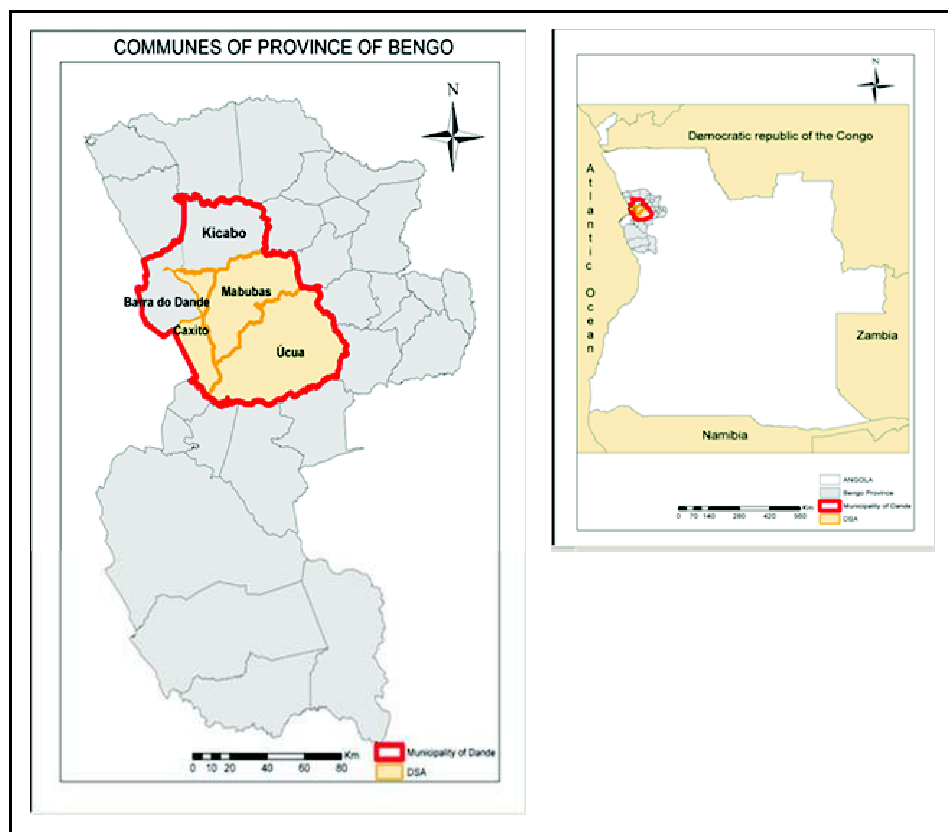
This paper describes the methodology used for setting up the HDSS-Dande, the design and implementation of the field and data management procedures, the difficulties and limitations of collecting, storing and producing information, and the efforts to overcome these difficulties and limitations. It also includes a basic demographic description of the people living in the surveillance area, as well of their housing conditions.

The DSA (Figure 1) covers the communes of Caxito, Mabubas and Úcuá, a contiguous area with a total area of 4.763,6 km<sup>2</sup>. The climate is tropical dry with an average temperature of 25°C. The annual precipitation is low on average (600 mm), although rainfall can be strong and destructive and drought is a problem both for agriculture and water supply (Tavares and Arsénio 2007). Three rivers cross the DSA and nine lakes are located within the area. Man-made irrigation channels exist within Caxito and Mabubas. Two main interprovincial paved roads cross the DSA, all others being dirt roads, making it difficult to reach some of the rural communities during the rainy season. Health problems have been mainly associated with infectious diseases, especially malaria (WHO 2011, AMD 2006), which is commonly referred to as a major cause of death. Other infectious diseases present in the area include sleeping sickness and schistosomiasis.

Of the 69 hamlets which comprise the DSA, 26 are in urban areas (25 hamlets in Caxito, the capital of Bengo's Province, and one in Mabubas).<sup>3</sup>

1. CISA Project is the first Health Research Centre in Angola. It is the result of a partnership between the Portuguese Institute for Development Assistance (IPAD), Calouste Gulbenkian Foundation (FCG), the Angolan Ministry of Health (MINSA) and the Bengo Provincial Government and is being developed under the scope of the Cooperation Program between Angola and Portugal.
2. The major administrative areas in Angola are the Provinces ("provincias"), which are divided into municipalities ("municípios"), which in turn are divided in communes ("comunas"). Within the communes, the population lives in hamlets ("bairros"). Hamlets designate the group of houses that comprise villages in rural areas and neighborhoods in urban areas.

## The Demographic Surveillance Area (DSA)



**Figure 1** Health and Demographic Surveillance Area in the Dande Municipality, Bengo Province, Angola

### Literature review and theoretical framework

A HDSS is the process of defining risk and corresponding dynamics in demographic rates of birth, death and migration over time (Phillips 1998). It is an important tool to address health and epidemiological studies and to inform

health policies (Ngom 2001, Sié *et al.* 2010). The majority of the established HDSS are organised in the International Network for the continuous Demographic Evaluation of Populations and their Health (INDEPTH). This network has 42 members in 19 countries, and most of them are located in Africa (29) and in Asia (12) (INDEPTH 2011).

3. Urban areas are defined as the capitals of provinces and municipal headquarters, having agglomerations of 2 000 or more inhabitants and basic infrastructures (schools, health centres, pavement main roads, etc.) (National Statistics Institute of Angola, 2011). Rural areas are mainly dispersed settlements.

None of the African centres is located in Angola nor in Central Africa, reinforcing the importance of the implementation of the HDSS in Dande within the international health research panorama.

The general methodology of a HDSS consists in performing an initial census, *i.e.* enumerating and registering the entire population of a given geographic area, followed by updates on demographic and health related events, for every resident in the DSA, according to a specified and regular periodicity, therefore keeping a longitudinal cohort of life events (Sankoh 2002; Clark 2004). Although the INDEPTH provides the basis for the standardization of methodology (INDEPTH 2011b), each HDSS adopts its own, according to the local context and its purpose.

Although some papers discuss the methodology for longitudinal monitoring systems, the published literature on HDSS is mainly on demographic and health outcomes resulting from long-term sequential data collection (e.g. Kamugisha *et al.* 2001, Adazu *et al.* 2005, Kahn *et al.* 2007, Jahn *et al.* 2007). The current manuscript aims to fill that gap.

## Data and methods

The HDSS-Dande initial census was conducted between September 2009 and April 2010 and since then each household is visited every four months to update information on pregnancies, births, deaths and migrations.

### Variables and concepts under surveillance

During the initial census data were col-

lected at the individual (sex, date of birth, relationship to the head of household, literacy level, parents' and husband's identifications) and household levels (composition of the household walls and roofing materials, number of rooms, source of drinking water, existence of kitchen and latrines).

A resident in the HDSS-Dande is defined as any person who lives, has been living or intends to stay in a household for a period of at least three months. People who live in more than one household are registered where they spend more than half their time. A person's follow-up ends within the HDSS when he/she migrates to an area outside of the DSA (Hosegood 2007 and Nhacolo *et al.* 2006).

A household is defined as any group of people living together and sharing the same economy. Members of the same family living in the same house but having separate domestic expenses and identifying different household heads count as two or more households. The household head is the person recognized as such by the members of the household. Some persons are heads of more than one household but are registered as residents of only one. Polygamous men are registered in the house of the first wife.

A unique identifier system is used to follow individuals longitudinally. Each household is given a code in which the first three characters indicate the hamlet and the last four the house number. This code is then used to create the individual permanent ID, based on the location where each person is living the first time he/she is identified by the system. When a person changes his/her place of residence within the DSA, a

location ID is registered, allowing the database to keep record of all movements, to track migrations and to avoid double enumeration of members in the database (Kahn *et al.* 2007).

### Design and implementation of procedures

The initial census work plan was presented to all levels of local administration (municipality, communes and hamlets). The scouting operations in the field took place from May to December 2008. Hamlet coordinators and traditional authorities ('*sobas*') collaborated with the HDSS team in the process of recognising territory, helping to define the borders of each hamlet and mediating the contacts between the field team and the local population, namely through the arrangement of community meetings. These meetings were organized in each hamlet before the beginning of fieldwork with the purpose of informing the population about the HDSS's objectives and mobilizing them to cooperate.

A pilot survey was done to test and adjust the questionnaire. A manual with all the definitions, procedures and staff functions was produced and distributed to the entire team, along with the set of forms used for data collection and quality control.

Team dimensioning was based on the productivity results of the pilot survey<sup>4</sup> with the aim of setting up a HDSS covering approximately 60,000 people, that according to the available data by the Municipal Administration of Dande (AMD) would include the entire municipality and correspond to 14,000 house-

holds.<sup>5</sup> Twenty one field workers (sixteen interviewers and five supervisors) and six data clerks were considered necessary for the implementation of the baseline census. All workers underwent an initial two-week training session and weekly meetings between the entire field team and the HDSS manager allowed for knowledge consolidation and problem solving.

### Counting, enumerating, and georeferencing of households

During the process of counting the households of the area, done to preview the dimension of the census and to estimate logistic needs (such as the household identification plates), it became evident that the real number of households would fairly exceed the estimates of the total population based on the data of AMD. Therefore only three of the five communes of the Dande municipality were included (Caxito, Mabubas and Úcua), to maintain the initial intention of about 60,000 people under surveillance. The three communes included in the DSA are contiguous and comprise urban and rural settings, with a variety of landscapes and environmental conditions.

After counting, the households of the DSA were enumerated, i.e. the household ID code was painted on wooden plates and fixed at the main entrance of each household, facilitating its visibility by the household members and field workers. Given the importance of the geographical location of events for understanding health outcomes (Montana and Spencer 2001), the households were simultaneously

4. Each fieldworker interviewed an average of fifteen households per day.

5. Considering the average number of 5 inhabitants per household given by the Malaria Indicators Survey (MIS) 2006-2007 (COSEP, 2007).

georeferenced, using a hand-held geographical positioning system (GPS) Garmin 60 Cx. Household georeferentiation was complemented with the collection of coordinates of relevant locations such as roads, paths, rivers, lakes, irrigation channels and public buildings (health facilities, schools, administration, churches, etc.). All the coordinates were integrated in a geodatabase and will be used to produce maps.

#### Initial census and update rounds

The census which established the baseline population has been followed by update rounds in order to update the information on demographic events for every resident in the DSA and to keep a longitudinal data collection. Given the high mobility of the population in the DSA update, rounds are carried out every four months to minimize the loss of events such as deaths, births, abortions or stillbirths and in and out migrations. With the support of a update round book, which summarizes all the collected individual data in each household, the field team visits each DSA household, checks the composition of the household and registers demographic events (who died, who was born, who entered or left the DSA and when). In each household there is an attempt to recruit an adult member capable of giving information on all the residents and on the characteristics of the household. In the absence of such a suitable informant the field worker schedules a new visit, with a maximum of four visits per update round,<sup>6</sup> and at

the end of each round a period of revisits is planned as a final attempt to interview a resident in all households. Whenever an adult member is not available after all the revisits, a neighbour may serve as a proxy informant to collect basic information. The information that the respondent is a non member of the household is registered in the questionnaire.

Data on housing conditions is updated only once a year and was actualized at the end of 2011 during the 5th round.

#### Data management and quality control

The field team reviews every questionnaire to check for missing answers and major inconsistencies. Supervisors are responsible for additional procedures to guarantee the quality of data collection, including: random spot checks (duplication of 5% of the interviews to assure the veracity and quality of field work) and supervised visits with each fieldworker (to monitor their performance).

At the Data Unit questionnaires are recorded and issued a unique ID serial number. Quality is assured by validation checks, double entries verified by automatic comparison and regular computer checks to look for inconsistencies (e.g. duplicated ID and members, wrong ID on deaths and out-migration). Inconsistent or illogical data returns to the field for correction.

Daily copies of the database are made, one of which is kept outside the computer room for safety.

6. The four revisits are done only in the hamlets with good accessibility. In some of the rural areas that are difficult to reach, the round plans only two visits (a regular visit and a second one at the final period of the round).

## Ethical issues

The HDSS forms were registered in the National Institute of Statistics of Angola (INEA). Participation of households, both in census and update rounds, is voluntary and verbal consent is required. After the initial census researchers provided feedback information to all levels of the administration and promoted meetings with local leaders to discuss research findings, where fact sheets with the main demographic findings of each hamlet and commune were distributed. All individual data was treated in confidentiality and no information on names was disseminated.

To assure confidentiality of stored data, password access and different levels of access, depending on the user, is guaranteed.

Health and social problems mentioned by residents during their visits were communicated to the Provincial Health Directorate and Social Services respectively.

## Challenges and constraints in the follow-up of individuals in the HDSS

Specific procedures are in place to overcome the many difficulties arising from following up all residents and event in the DSA, listed below.

1. To ensure a high coverage of the population: some geographically isolated populations, mostly coal burners and farmers, can be very difficult to reach, as roads leading to these locations may become inaccessible during the rainy season. Additionally, these workers are not available during the day, as they leave their houses very early in the morning and return at night. For successful visits previous con-

tacts are needed, by radio announcements or through supervisor visits, in order to schedule interviews according to the availability of the population. Hamlet coordinators are important liaisons with the population.

2. To obtain accurate data on the characteristics of the members of the DSA: the difficulty of obtaining accurate data in some African censuses and surveys, with contexts identical to those found in our DSA (high rates of illiteracy and lack of identification documents) is well documented (United Nations 1955, Andoh 1980; IDRC 2002; Jahn *et al.* 2007; Adazu 2009). Sometimes respondents find it difficult to answer questions related to other residents of the household and occasionally about themselves, mainly on names and ages. People often use different names at different moments (one name at home and another at school, for example) and nicknames are common (people are frequently known as “the eldest one”, “the youngest one”, “mummy”, “daddy”), making it difficult to register official names and to guarantee that residents will be identified in the next visit. In order to minimize these problems the field team should ask for documents to obtain dates of birth and names as accurately as possible or, in the absence of such documents or reliable information, to use approximate dates when the respondent doesn't know the exact year, month or day of his own or someone else's date of birth.<sup>7</sup> In the last case, field workers register that a date of birth



has been estimated and make a note to confirm the exact date in the next visit. During the initial census, 3% of the individual birth dates registered was estimated by the field workers.

3. To track migrants: people often move from one household to another within the DSA. These movements correspond to internal migrations. In order to prevent duplicate registries, complete internal migration file reconciliation has been introduced, i.e. every in-migration register form of someone who moves within the DSA has to match with its counterpart out-migration register form. Reconciliation of in and out-migration forms is performed at the data management unit, where computed operations facilitate the detection of double registers.
4. To reduce missing demographic events. The number of births expected in the DSA for one year, based on the age specific fertility rate given by the MIS (COSEP 2007), is of 2.640 whereas the DSA captured 2.371 (90% of the expected) in a similar period. According to the World Health Organization estimates for mortality in Angola in 2009, the expected number of deaths in the DSA in one year would be 1,115 whereas only 581 deaths were registered (52%). Some deaths may have occurred

after the visit of the fieldworker and would be reported in the following round. Others might have been omitted due to cultural issues. To overcome these questions, field workers receive constant training, namely during the weekly meetings with several role play exercises, on techniques regarding how to approach interviewees in order to obtain reliable and complete information. Furthermore there has been an effort to strengthen the network of community informants, especially through systematic contacts with hamlet coordinators, who are asked to register deaths and births in the hamlet. Another attempt to reduce the number of "missing deaths" is consulting hospital records. These records are then compared with the HDSS database to find correspondences between the names of people who died in the hospital and the residents in the DSA. In order to avoid losing perinatal deaths (due to an undercount of stillbirths and early infant deaths that can occur between the rounds), each known pregnancy and expected date of birth is registered. The database produces lists of expected births, helping to control its data collection.

## Results

### Demographic data and housing

7. Field workers have a calendar of local events to help respondents locate dates of birth and a table of conversion of calendar years in years of age and vice versa. Furthermore, there are defined rules to approximate dates when the day or month of birth is unknown: the interviewer tries to determine whether the person was born in the beginning, middle or at the end of the month (then indicating date of birth on days 5, 15 or 25). When the respondent does not know the day or the month of the birth date, the interviewer indicates the date as 30<sup>th</sup> of June (middle of the year).



conditions

The HDSS-Dande initial census registered 15,643 households and 60,075 people. The population density in the DSA is 12.6 inhabitants per km<sup>2</sup>. Urban areas concentrate a great part of the population (70% of the households, corresponding to 77% of residents). The average number of inhabitants per household is 3.8 (4.2 in urban centres and 3 in rural areas), which is influenced by the large number of households composed of singular persons (19% of total, 10% residing in urban and 9% in

rural areas). The median of the distribution is 3 and the mode is 1 (in urban centres, median and mode are both 4, and in rural areas more people live alone, being the median and the mode of 2 and 1, respectively).

The population age pyramid of HDSS-Dande (Fig. 2) illustrates the predominance of young and the reduced number of aged people (half the populations is under 20 years old, 46% have ages between 20 and 64 years old and only 4% are 65 or over).

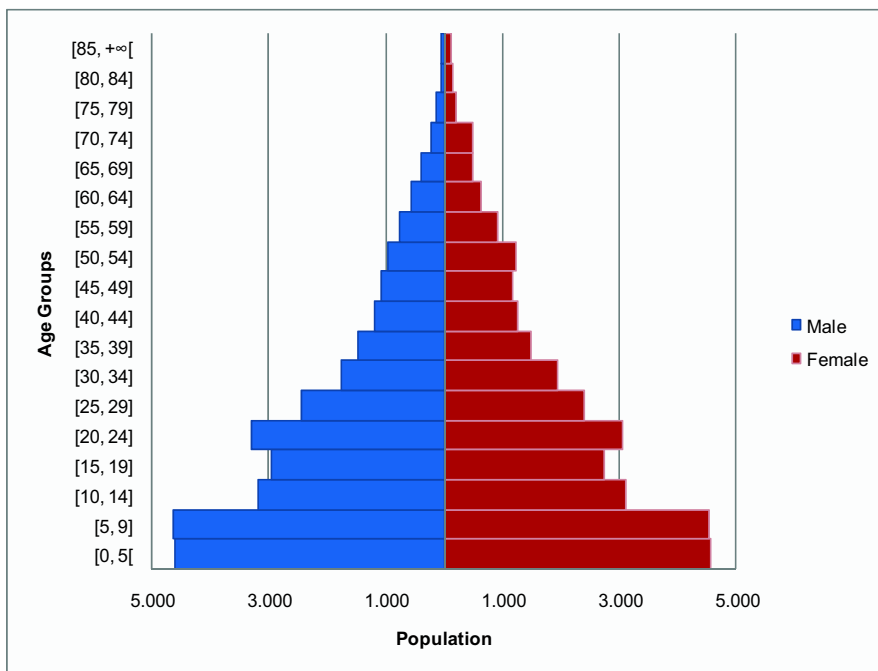


Figure 2 Population pyramid of HDSS-Dande, 2010

The median age within the HDSS-Dande is 19 years old, 18 in urban and 29 in rural populations. Those values, as well the different age ratios (Table 1), show that the age structure differs con-

siderably according to the place of residence, being the urban population younger than the rural (54% and 40% under 20, respectively). People aged 65 or above represent 3% of the total

population in urban areas and 7% in rural areas.

The indicators of fertility also show different patterns according to the place of residence. Women of child-bearing age represent 48% of the female population in urban centres and 40% in rural areas. The ratio that

measures the relation between the two halves of the female population in reproductive age shows that the potential for fertility, defined as the number of women aged 20-34 per 100 women aged 35-49, is much higher in urban (237) than in rural areas (89).

**Table I** Demographic ratios calculated for DSA, according to rural-urban residence

Ratios	DSA	Urban	Rural
Youth ratio (under 15/over 64)*100	11,4	16,7	5,0
Ratio of children (aged 0-4)/(aged 5-9)*100	100	100	100
Age dependency ratio (under 15 + over 64)/(aged 15-64)*100	80	85	65
Youth dependency ratio (under 15)/(aged 15-64)*100	74	80	54
Elderly dependency ratio (over 64)/(aged 15-64)*100	6	5	10
Child-women ratio (0-4)/(women aged 15-49)*1000	650	656	627
Ratio of (women 20-34)/(women 35-49)*100	189	237	89
Sex ratio (man)/(women)*100	98	96	102

The most common referred wall material in the DSA was adobe, whereas iron sheets were the predominant roof material. The majority of households (70%) do not have a kitchen and almost half the households (45%) do not have latrines. Of those that have latrines 43% share them with neighbours. More than half households in the HDSS (62%) obtain drinking water from an unimproved source: 48% of the households from a river, 10% from an unprotected dug well and 3% from lakes and irrigation channels. Only around 8% of the households, located mainly in urban areas, have access to private taps of treated water.

#### The accuracy of data

The accuracy of data collected was evaluated by standard statistical and demographic methods: the Whipple's

Index (WI), the Myers' blended Index (MI) and the United Nations Age-Sex Accuracy Index (ASAI). According to the WI and MI, the census results are reliable data (WI = 95, MI = 4.2), and according to the ASAI are fairly reliable data (ASAI = 38.7).

#### Discussion

Regarding methodology and the procedures followed in the HDSS-Dande, there are some aspects that need to be improved, namely the communication and the involvement of the community of the DSA. Occasionally field workers have difficulty attempting to interview people not used to door to door questionnaires and maybe because of the long war period in Angola they are not very "open" to expose their identity, especially those working in security or

police forces (a considerable number of adult men). To overcome this problem it was necessary to organize meetings at the police headquarters to explain the objectives of the HDSS. There is also the constant need to deal with the expectations of the population, who expect drug distribution or provision of health care services, since field workers are associated with a health research centre. Another aspect to highlight is the local understanding of the ID plates which enumerate the households. They had a very good acceptance by the inhabitants of the DSA and are being used for other purposes such as in residential addresses and by the electricity company during the door-to-door installation of public provision of electricity. Some people remove the plate and take it with them when moving from one house to another (within or without the DSA), causing some disturbance in the field work. These aspects show the need for strengthening the communication strategy with the community. In addition to the frequent contact with the local leaders, one should consider other strategies such as theatre plays for the community, as well as jingles on the radio with short and accessible messages about the role of the CISA Project and the HDSS.

The implementation and the maintenance of a HDSS is usually a time and cost consuming challenge. A drawback of these sites is the inability to extrapolate data from a HDSS to extensive areas since the data is typically collected on small or isolated areas and is not representative of larger populations. Another issue relates to the demographic characteristics of the study areas, often marked by migration

movements, making it difficult to compare with the composition of greater populations (e.g. Clark, 2004; Adazu *et al.*, 2005). Despite these limitations, in the absence of vital records or of demographic and health knowledge of specific populations, the DSA is an important tool to support health research and interventions. In the particular case of CISA Project, the population registered in the DSA (60,000) is more than double the estimates given by the local Administration of population for the three communes under surveillance (29,000 persons) (AMD 2006). This lack of knowledge on the demographic characteristics of populations as well as on the housing and health conditions reveals the importance of the implementation of the HDSS to support health research in Angola, and in this particular area.

At CISA Project, the HDSS is being developed in parallel with a Paediatric Clinical Surveillance System and supports a Verbal Autopsy System. Additionally, the HDSS can be used as a sampling frame, as it happened in previous studies, namely a malaria, shistosomiasis, geohelminths, anemia and malnutrition prevalence study (Figueiredo *et al.* 2011), and a hypertension prevalence study. The HDSS is also valuable in allowing for follow-ups of residents during and after an intervention and cohort studies. Furthermore it aims to gather information beyond demography, as specific sets of questions are added on subjects like health care access and utilization and economic welfare and the wellbeing of the households. During the 5<sup>th</sup> update round, data on housing conditions collected in the initial census was updated and indi-

cators assessing living standards were collected to allow for the calculation of a wealth index of the DSA population. The framework of analysis that integrates those indicators seeks comparability with other HDSS and Demographic Health Surveys.

As shown by baseline census data, the population of the DSA has a typical age structure for Angola and other sub-Saharan African countries (COSEP 2007 and Nhacolo *et al.* 2006). There is a general similarity of several demographic indicators in HDSS-Dande and in the national population according to the Population Wellbeing Survey (PWS) (INEA 2008). Both register a young population, as the age ratios confirm, particularly in urban areas. That characteristic is more pronounced in the DSA where the young urban represent more than three times the weight of young rural (16.7 vs. 5) (Table 1), while in PWS they represent the double (27.4 vs. 13.7).

There is a particularity in the shape of the DSA pyramid: a reduced number aged 10-19 (compared to the previous age group 5-9), followed by a protuberance in the age group 20-24. The latter happens only in urban population, and may be due to a potential attraction exercised by the higher education institutions located in Caxito that would bring young people from Luanda to study in Caxito. In the national population the number of people in those age groups declines gradually.

The ratio of children aged 0-4 and 5-9 years shows similar numbers of children in both groups in the DSA (100) that is not present in the national population (where that ratio is 120). Further research will allow understand-

ing if it is the result of a sub-representation of the former group or indicative of a decline in fertility.

The weight of women in reproductive ages is very similar in the DSA and in the national population (46% and 45%, respectively) as well the number of young women of childbearing age (189 women aged 20-34 per 100 women aged 35-49 in the DSA vs 184 in the national territory).

The sex ratio shows that women exceed men both in the DSA (98) and in national population (93). The exception occurs in rural areas of the DSA, where the number of men exceeds women in a sex ratio of 102. This might be the result of migrations of young single men, coming usually from the southern provinces (like Benguela and Huambo) for farming labour in the DSA, or of the labour migration of coal burners coming mostly without family mainly from within the DSA and Luanda province. These migrants are probably more vulnerable to health threats, as they appear to be living in poorer conditions, without a social net to which turn to, in case of need. Further studies are warranted in order to characterize this population.

## Conclusions

This paper aimed to describe the methodology of setting up the DSS-Dande and give the first glimpse on the population in surveillance. The HDSS is a platform which provides the population basis for health surveys and will develop its full purpose as new research projects are conducted. The HDSS-Dande is the first HDSS implemented in the region of Central Africa. Further characterization of the population in the

DSA-Dande is needed and vital information on mortality and fertility will be obtained with long time series of data and continuous updating.

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